Volume V • No. 1
January –March • 2012

ISSN 1898-6498

MILITARY PHARMACY AND MEDICINE

QUARTERLY INTERDISCIPLINARY JOURNAL

- PHARMACY
- MEDICINE
- MEDICAL TECHNIQUE
- ENVIRONMENT AND HEALTH
- EDUCATION

The Staff of the Military Center of Pharmacy and Medical Technology
in Celestynow – Poland

MILITARY PHARMACY AND MEDICINE • Volume V • No. 1 • 2012

Druga strona okładki

Volume 5, No 1 January - March, 2012

MILITARY PHARMACY AND MEDICINE

Quarterly Interdisciplinary Journal
of Military Centre of Pharmacy and Medical Technique in Celestynów
on scientific socio-professional
and training issues of Military Pharmacy and Medicine

ISSN 1898-6498

MILITARY PHARMACY AND MEDICINE

SCIENTIFIC BOARD

MILITARY PHARMACY AND MEDICINE

MILITARY PHARMACY AND MEDICINE

PUBLISHER

Military Centre of Pharmacy and Medical Technique in Celestynów
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e-mail: wofitm@wp.mil.pl

PUBLISHED BY

International Scientific Literature, Inc
361 Forest Lane,
Smithtown, New York 11787, USA
phone +1 516 874 4341
e-mail: office@isl-science.com

Interdisciplinary journal of Military Centre of Pharmacy and Medical Technique in Celestynów, Poland
http://military.isl-journals.com/

ISSN 1898-6498 | quarterly | Indexed in: MNiSW, Index Copernicus | 140 copies

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Biochemistry

Synthesis and studies on properties of dibutyltin-(*S*) – (camphorsulfonyl) hydride – a new reagent for stereoselective reduction of ketones and α-bromoesters of carboxylic acids

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Received: 2011.12.16 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Synthesis and studies on physicochemical properties of dibutyltin-(*S*)-(camphorsulfonyl) hydride, a new reagent for stereoselective reduction of ketones were carried out.

Key words: mixed organotin hydrides, stereoselective reduction.

The goal of the study was to develop a novel method of stereoselective reduction of ketones and α-bromoesters of carboxylic acids. The reagent used in the reactions was di-*n*-butyl-(S)-(camphorsulfonyl)tin hydride and derivatives thereof.
Organotin hydrides were first obtained by reduction of corresponding organotin chlorides with lithium aluminum hydride. Currently, this method is widely used in laboratory practice.

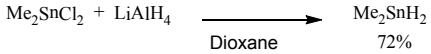

Figure 1.

Due to its properties (lower volatility and toxicity compared to other homologs) and price, the readily available tri-*n*-butyltin hydride found wide use in organic synthesis. In laboratory conditions, tri-*n*-butyltin hydride may be obtained by distillation of tri-*n*-butyltin oxide and poly(methylhydroxysiloxane) (PHMS) under reduced pressure (80 °C and 0.4 mmHg) [1].

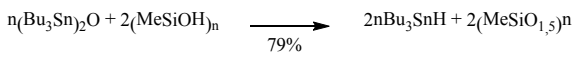

Figure 2.

Organotin dihydrides, R_2SnH_2, following their combination with dialkyltin(IV) compounds, R_2SnX_2 (where X = halide, carboxylate, sulfonate etc), undergo disproportionation to form as part of chemical equilibrium new hydrides of formula R_2SnXH, with properties different from starting dihydrides or the better known trialkyltin hydrides R_3SnH [2, 4]. These new hydrides are decomposed in the presence of amines with decomposition rate depending on the nature of substituent X. Electronegative substituents at the tin atom increase the reactivity of free stannyl radicals. The more electronegative the substituent, the higher its electron density due to the transfer of electrons from the tin atom. Decomposition of mixed organotin hydrides occurs via a free radical-based chain mechanism [5], leading to formation of molecular hydrogen and appropriate tetrakis(organo)ditin XR_2SnSnR_2X [4, 6].

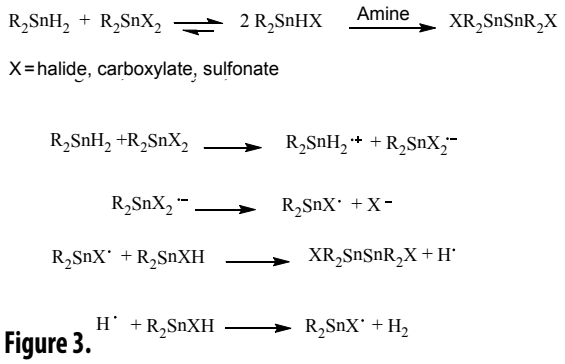

Figure 3.

Since decomposition of compounds of general formula R_2SnHX occurs at temperatures as low as room temperature, they are an attractive alternative to other tin hydrides, which react at higher temperatures or upon UV lamp irradiation. Thus, mixed hydrides may be used e.g. in the presence of substances sensitive to high temperatures [5].

M. Murakata, H. Tsutsui and O. Hoshino were the first to publish examples of efficient free-radical reduction proceeding in an enantioselective manner in the presence of a Lewis acid. Their research focused on α-methoxy-α-iodolactone reduced by tri-n-butyltin hydride conjugated with a chiral amine and magnesium iodide [7].

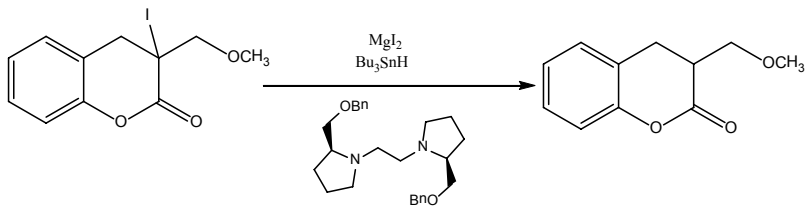

Figure 4. The first stage of our study was the synthesis of starting organotin hydrides.

Dibutyldihydrydotin was obtained by the van der Kerk's method, i.e. by reducing dibutyltin chloride with lithium aluminum hydride $LiAlH_4$. Etherate solution of the hydride was placed in a two-necked flask equipped with a dropping funnel and reflux condenser with calcium chloride tube on top.

Dibutyldichlorotin solution was added slowly from the dropping funnel as the flask content was stirred. After addition of the entire amount of Bu_2SnCl_2, stirring was continued for 1.5 hours. After that time, a small amount of hydroquinone was added to bind the aluminates formed in the reaction, followed by water to quench the reaction.

A 20% aqueous solution of potassium sodium tartrate was used for extraction. Subsequent extractions using Et_2O followed by distillation allowed to obtain Bu_2SnH_2 with a nearly 100% yield.

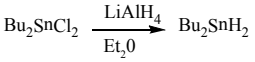

Figure 5.

The ^1H NMR spectrum of di-*n*-butyltin dihydride is characterized by the following chemical shift values:

$\delta_H(C_6D_6)$: 4.58 (2H, m, $^1J^{117}_{Sn} = 1542.8$ Hz; $^1J^{119}_{Sn} = 1614.7$ Hz; SnH_2);

The ^{13}C NMR spectrum of di-*n*-butyltin dihydride is characterized by the following chemical shift values:

δ_C 7.11 ($^1J^{117}_{Sn} = 357.9$ Hz; $^1J^{119}_{Sn} = 374.5$ Hz; C-α); 13.90 (C-δ);
27.16 ($^3J^{117/19}_{Sn} = 64.7$ Hz;C-γ); 30.61($^2J^{117/119}_{Sn} = 23.7$ Hz;C-β);

Di-*n*-butylchlorotin hydride was obtained in the reaction of disproportionation between di-*n*-butyltin hydride and di-*n*-butyltin chloride. Equilibrium was reached as early as 90 minutes after mixing equimolar amounts of both reagents in ethanol, benzene or toluene.

The ^1H-NMR spectrum of the equilibrium mixture showed that under these conditions, the mixture contained 97% of di-*n*-butylchlorotin hydride and 3% of starting di-*n*-butyltin chloride.

The ^1H NMR spectrum of di-*n*-butylchlorotin hydride is characterized by the following chemical shift values:

$\delta_H(C_6D_6)$: 7.42 (1H,s,$^1J^{117}_{Sn} = 1875.8$ Hz,$^1J^{119}_{Sn} = 1963.0$; SnHCl);

The ^{13}C NMR spectrum of di-*n*-butylchlorotin hydride is characterized by the following chemical shift values:

δ_C 13.65 (C-γ); 17.00 ($^1J^{117}_{Sn} = 379.7$ Hz,$^1J^{119}_{Sn} = 397.4$ Hz;C = α);

27,65 ($^3J^{117/119}_{Sn} = 63.37$Hz; C-γ); 28.20($^2J^{117/119}_{Sn} = 40.24$ Hz; C = β);

Acetoxydi-*n*-butyltin hydride was obtained in the reaction of disproportionation between di-*n*-butyltin hydride and di-*n*-butyltin diacetate. In this kind of solution, equilibrium is shifted towards the starting reagents.

The ^{1}H NMR spectrum of acetoxydi-*n*-butyltin hydride is characterized by the following chemical shift values:

$\delta_H(C_6D_6)$: 7.6 (1H, s, SnH);

The ^{13}C NMR spectrum of acetoxydi-*n*-butyltin hydride is characterized by the following chemical shift values:

δ_C 13.71 (C-β); 18.75 ($^{1}J^{117}_{Sn}$ = 415.9 Hz, $^{1}J^{119}_{Sn}$ = 435.2 Hz; C-α); 26.82 ($^{3}J^{117/119}_{Sn}$ = 78.9 Hz; C-γ); 27.85 ($^{2}J^{117/119}_{Sn}$ = 24.8 Hz; C-β)

Dibutyldi(camphorsulfonyl)tin was obtained from dibutyltin oxide and camphorsulfonyl acid by means of aseotropic dehydration conducted in a distillation system equipped with a Dean-Stark apparatus. The initial product of this reaction is dibutyldi(camphorsulfonyl)tin dihydrate, which sheds two molecules of water upon drying, forming dibutyldi(camphorsulfonyl)tin. Dibutyldi(camphorsulfonyl)tin undergoes disproportionation with Bu_2SnH_2 in the solution, forming dibutyl(camphorsulfonyl)tin hydride.

The ^{119}Sn NMR spectrim of freshly prepared dibutyldi(camphorsulfonyl)tin dihydrate is characterized by the following chemical shit values:

δ_{Sn}(DMSO): -378.5 ppm

The next stage of the study was the preparation of equipment for kinetic measurements and preparation of solutions, on which the kinetic studies of decomposition of organotin hydrides in the presence of amines were to be carried out. The equipment consisted of:

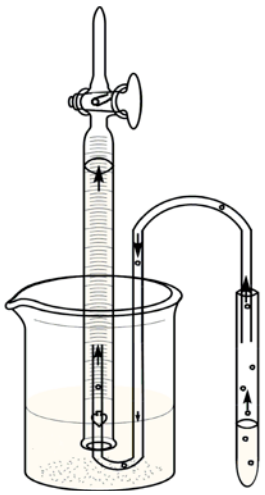

Figure 6.

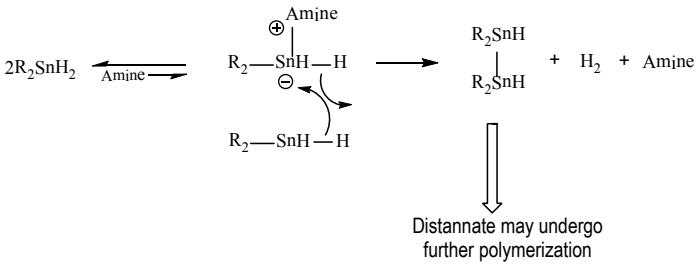

Figure 7.

- A glass tube, in which the reaction mixture was placed.
- A rubber tubing at the end of the glass tube to deliver hydrogen generated in the reaction to an inverted, callibrated burette immersed in a beaker containing water. The gas accumulated in the burette pushed water outside the burette, allowing to measure the volume of hydrogen generated during the reaction.

Observation of the ongoing reactions and the reaction equations showed that all reactions followed the first-order kinetics. For ln[A], the relationship is linear in time t [s], where [A] is the concentration of the organotin hydride in the reaction mixture.

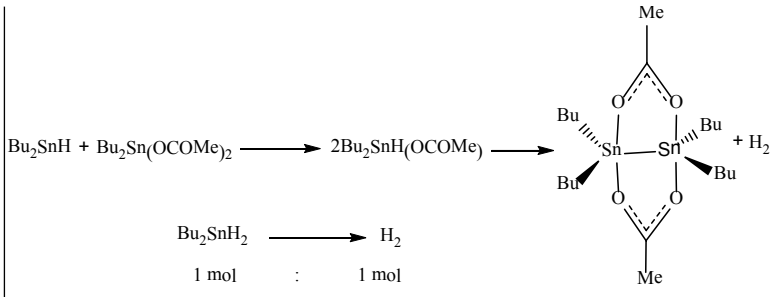

Figure 8.

Spontaneous, amine-free process

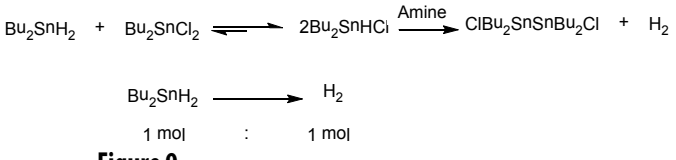

Figure 9.

The values of the reaction rate constant k and the half time $t_{0.5}$ for the 1° reaction were determined in a graphical method using the MS EXCEL spreadsheet {the least squares method – function "*reglinp*" y = -bx-a,where tgα = $-k_i$, to this end, a graph of the function ln[A] = f(t) was plotted

out} and by substituting the value to the formula for calculating k_i, $t_{0.5}$:

Graphical method:

where tgα $y=-bx-a$

$y=\ln a$

$x=t_{[s]}$

Haf time $t_{0.5}$: $t_{0,5}=\frac{\ln 2}{k_{i(graf)}}$

Table 1: Rate constants for the reaction of decomposition of organotin hydrides in the presence of amines. Values in the table are mean values determined by the graphical method. $Bu_2Sn(OSO_2camphor)H$ stands for di-n-butyl(camphorsulfonyl)tin hydride.

Tin Hydride	Amine	Solvent	mean k_{graf} [s^{-1}]
Bu_2SnHCl	pyridine	$CHCl_3$	1.34E-03
$Bu_2Sn(OCOCH_3)H$	morpholine	$CHCl_3$	1.07E-03
Bu_2SnH_2	Et_3N	$CHCl_3$	8.05E-03
Bu_2SnHCl	Et_3N	$CHCl_3$	1.77E-02
$Bu_2Sn(OCOCH_3)H$	Et_3N	$CHCl_3$	4.22E-02
Bu2SnHCl	pyridine	TOLUENE	2.35E-04
$Bu_2Sn(OCOCH_3)H$	pyridine	TOLUENE	2.52E-04
$Bu_2Sn(OCOCH_3)H$	morpholine	TOLUENE	4.77E-04
Bu2SnHCl	Et_3N	TOLUENE	2.81E-04
$Bu_2Sn(OCOCH_3)H$	Et_3N	TOLUENE	5.84E-03
$Bu_2Sn(OSO_2camphor)H$	pyridine	METHANOL	2.38E-04

Table 2: Percentage yield of acetophenone hydrostannylation using selected organotin hydrides. Omes represents methylsulfonate.

Time [h]	Bu_3SnH [%]	Bu_2SnHX [%]				
		X=H	X=Cl	X=OCOMe	X=Omes	X=camph-sulph
1	0	0		46	69	81 (41 after 15 min)
2	0	0	51	68	81	
3	0	0	84			

We have also attempted the assessment of reactivity of a series of studied organotin hydrides in acetophenone reduction process. We observed no reaction between Bu_3SnH or Bu_2SnH_2 and acetophenone at room temperature. Meanwhile, hydrides of the type Bu_2SnHX react within several hours, yielding a dibutyltin derivative of 1-phenylethanol, and the sequence of reactivity is correlated with the rate of homolytic decomposition of these hydrides at room temperature. This shows that the rate of reaction is determined by the initiation stage not involving acetophenone.

By means of theoretical calculations, isotropic absolute nuclear shielding constants $\sigma_{iso}(^{119}Sn)$ and chemical shifts $\delta(^{119}Sn)$ and $\delta(^{1}H)$ were calculated for hydrides of formula Bu_2SnHX with optimized geometry. Calculations were performed by methods based on the B3PW91 hybrid functional, and IGLO-II/III functional databases [107]. IGLO-III database was used for H, C, O, F and Cl atoms, while IGLO-II was used for Br, Sn and I.

Chemical shifts $\delta(^{1}H)$ of the proton directly bound to the tin atom were also studied for molecules of formula n-Bu_2SnHX.

We have conducted studies [8] on the following molecules: Me_4Sn, n-Bu_2SnH_2, n-Bu_2SnCl_2, n-Bu_2SnHCl,n-$Bu_2SnH(O_2CMe)$, n-$Bu_2SnH(OSO_2Me)$ and n-Bu_3SnH.

The *n*-$Bu_2SnH(OSO_2Me)$ molecule was studied instead of di-*n*-butyl(camphorsulfonyl)tin hydride, which proved too complex for quantum calculations. Only basic geometry optimization was performed for each molecule. Conformational analysis was not performed.

Table 3: Calculated energy of tin-hydrogen bond dissociation BDE(0K), entalpy $\Delta_rH°(298K)$, entropy $\Delta_rS°(298K)$ and free Gibbs energy $\Delta_rG°(298K)$ for the reaction of hydrogen dissociation for molecules of n-Bu_2SnH_2, n-Bu_2SnHCl, n-$Bu_2SnH(OSO_2Me)$ and n-Bu_3SnH.

Molecule	BDE(0K)[1,2] [kcal/mol]	$\Delta_rH°(298K)$[3] [kcal/mol]	$\Delta_rS°(298K)$ [cal/(mol·K)]	$\Delta_rG°(298K)$ [kcal/mol]
n-Bu_2SnH_2	77.30	78.56	25.00	71.11
n-Bu_2SnHCl	75.01	76.34	28.73	67.77
n-$Bu_2SnH(OSO_2Me)$	75.13	76.56	31.99	67.02
n-Bu_3SnH	77.67	77.99	24.27	70.64

(1) values are corrected for zero-point energy (ZPE).
(2) the energy of the hydrogen atom was assumed to be the exact value of $E_0 = -0.5$ au.
(3) corrected for temperature.

Based on the obtained values of standard enthalpy of formation, the energy effect of hydrogen dissociation was determined for the following molecules: *n*-Bu_2SnH2, *n*-Bu_2SnHCl, *n*-$Bu_2SnH(OSO_2Me)$ and *n*-Bu_3SnH. Observation of changes in the Sn–H bond dissociation energy at 0K, BDE (0K), shows that the energy of the Sn–H bond decreases in the following series:

n-Bu_3SnH > n-Bu_2SnH_2 > n-$Bu_2SnH(OSO2Me)$ ≅ Bu_2SnHCl

Table 4: Reduction products of (1*R*)-camphor, optically inactive camphor, (2*S*,5*R*)-(-)-menthone, 3-iodo-3-methyl-3,4-dihydrocoumarin and 2-bromo-2-(6-methoxy-2-naphthyl)propionate using di-*n*-butyl-(S)- (1) and di-n-butyl-(*R*)-(camphorsulfonyl)tin hydride (2).

No.	Reduced ketone	Reducing reagent	Product	Yield [%]	Enantiomeric excess [%]
1	(1*R*)-camphor	(1)	(1*R*,2*R*)-isoborneol	100	100
2	(1*R*)-camphor	(2)	(1*R*,2*R*)-isoborneol	100	100
3	camphor	(1)	(1*S*,2*S*)-isoborneol	100	100
4	camphor	(2)	(1*S*,2*S*)- and (1R,2R)-isoborneol (1*S*,2*R*)- and (1R,2S)-isoborneol	45:30:15:15	
5	(2*S*,5*R*)-(-)-menthone	(1)	(1*R*,2*S*,5*R*)-(–)-menthol (1*S*,2*S*,5*R*)-(+)-neomenthol	40:60	100
6	(2*S*,5*R*)-(-)-menthone	(2)	(1*R*,2*S*,5*R*)-(–)-menthol (1*S*,2*S*,5*R*)-(+)-neomenthol	73:27	100
7	3-iodo-3-methyl-3,4-dihydrocoumarin	(1)	3-methyl-3,4-dihydrocoumarin	100	7
8	methyl 2-bromo-2-(6-methoxy-2-naphthyl) propionate	(1)	methyl 2-(6-methoxy-2-naphthyl) propionate	100	30

Reduction of camphor by di-*n*-butyl-(*S*)-(camphorsulphonyl)tin hydride or its (*S*) enantiomer confirmed a strong impact of sterical effects on the course of the reaction. Steric requirements of camphor determine the preference for the hydride approaching from *endo* side, leading, as a consequence, to formation of exo product in case of (*R*)-camphor. The reaction product was (1*R*,2*R*)-isoborneol. The product of analogous reaction of (*S*)-camphor was (1*S*,2*S*)-isoborneol. In case of reduction of optically inactive camphor using di-*n*-butyl-(*R*)-(camphorsulfonyl)tin hydride, a mixture of following products was formed: (1*R*,2*R*)-isoborneol, (1*S*,2*S*)-isoborneol, (1*R*,2*S*)-borneol and(1*S*,2*R*)-borneol in quantitative ration of 3:2:1.

Reduction of (2*S*,5*R*)-(−)-menthone with either (*S*)- or di-*n*-butyl-(*R*)-(camphorsulfonyl) tin hydride led to formation of a mixture of two products: (1*R*,2*S*,5*R*)-(−)-menthol and (1*S*,2*S*,5*R*)-(+)-neomenthol. The quantitative composition of both mixtures was different. The (*S*) hydride led to preferential formation of neomenthol, formed in 3:2 ratio relative to menthol. The (*R*) hydride led to preferential formation of menthol, which was generated in 73% yield.

Reduction of methyl 2-bromo-2-(6-methoxy-2-naphthyl)propionate led to methyl (*S*)-(+)-2-(6-methoxy-2-naphthyl)propionate. Enantiomeric excess value for this reaction was 30%. The product is a methyl ester of naproxene. Comparing the obtained result with analogous reduction of acetophenone, for which enentiomeric excess on the order of 6% was obtained without the use of a catalyst, one may expect that the ee might reach values close to 100% in the presence of $ZnCl_2$, Bu_2SnCl_2 or $MnCl_2 \cdot 4H_2O$. Confirmation of this hypothesis would require further studies.

The procedure of reduction methyl 2-bromo-2-(6-methoxy-2-naphthyl)propionate consisted

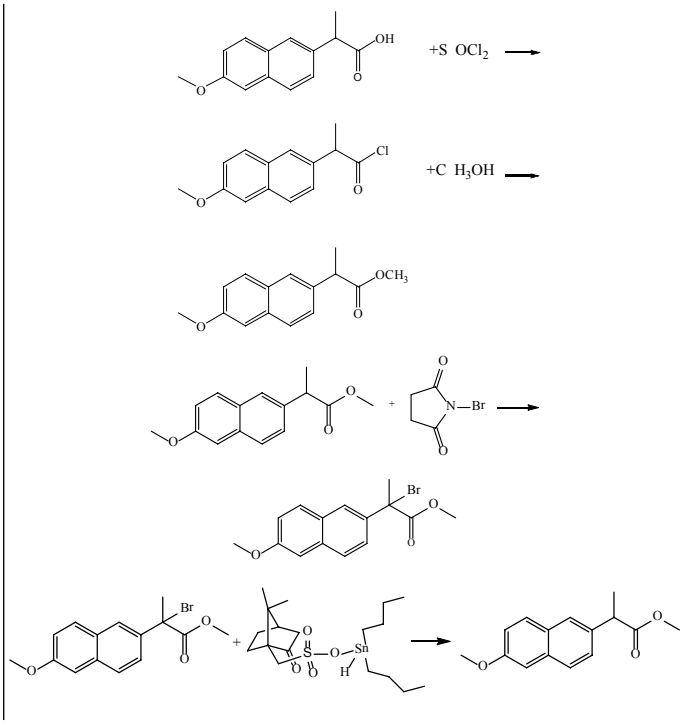

Figure 10.

of three stages. In the first stage, racemic 2-bromo-2-(6-methoxy-2-naphthyl)propionic acid was converted into its methyl esther. Next stages involved bromination followed by reduction consisting in dissolution of 0.001 mol of di-*n*-butyldi-(*S*)-(camphortsulfonyl)tin in 5 mL of benzene. A value of 0.001 mol of di-*n*-butyltin hydride was added to the obtained solution, followed by 0.001 mol of methyl 2-bromo-2-(6-methoxy-2-naphthyl)propionate. The mixture was then stored for 48 hours at room temperature. The reaction product was purified by column chromatography on silica gel using 30% solution of petroleum ether in ethyl acetate as the eluting phase.

Methyl esther of (*S*)-(+)-2-(6-methoxy-2-naphthyl)propionate, which is a derivative of naproxene, was obtained as the product of this reduction reaction with quantitative yield and 30% ee.

The distinctness of each of the studied hydrides compared to other reagents was also manifested in reduction of cyclopropyl(4-methoxyphenyl)methanone. Reduction of this compound with lithium aluminum hydride led to formation of corresponding alcohol. The compound obtained from the mixed organotin products was 1-(cyclopropylmethyl)-4-methoxybenzene. The mechanism of this reaction has not been fully established. In case of reduction with Bu_3SnH, the reaction followed yet another course, as shown in the scheme.

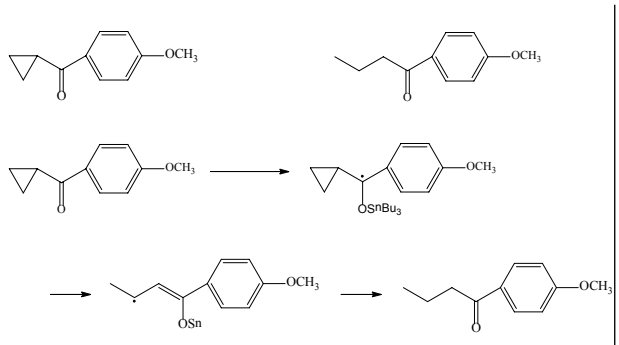

Figure 11.

In our opinion, the difference in the behavior of Bu_3SnH compared to other studied tin hydrides is largely due to different mechanisms of the initiation processes. In case of Bu_3SnH, free radicals that initiate the process are generated by electron transfer. In case of other studied tin hydrides (Bu_2SnHX), undergoing spontaneous free radical-based decomposition at room temperature, the initiation process proceeds largely according to the following mechanism:

We found that reduction of acetophenone with di-*n*-butyl-(1*S*)-(camphorsulfonyl)tin hydride

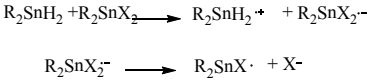

Figure 12.

Table 5: Reduction of acetophenone by di-n-butyl-(S)-(camphorsulphinyl)tin hydride (1) and di-n-butyl-(R)-(camphorsulphinyl)tin hydride (2) or diphenyl-(S)-(camphorsulphinyl)tin hydride (3) in the presence of catalysts. The product of acetophenone reduction was 1-phenylethanol, obtained in quantitative yields.

Reducing agent	Catalyst	ee (enantiomeric excess) [%]
(1)	–	6
(2)	–	8
(1)	ZnCl2	37
(1)	MnCl2 · 4H2O (20 molar equivalents)	31
(2)	MnCl2 · 4H2O (10 molar equivalents)	13.5
(1)	SnCl4	10.8
(2)	SnCl4	5.2
(1)	BF3	6
(3)	–	11

(21) leads to formation of 1-phenylethanol with 6% ee. Better selectivity was obtained when using diphenyl-(S)-(camphorsulfonyl)tin hydride (23) (11% ee) , with (–)-1-fenyloetanolu being the excess enantiomer. On the other hand, reduction using di-*n*-butyl-(1*R*)-(camphorsulfonyl)tin hydride (22) led to formation of (+)-1-phenylethanol with enantiomeric excess of 8%. Addition of ca. 20 equivalents of $ZnCl_2$ to the reaction mixture including di-*n*-butyl-(*S*)-(camphorsulfonyl)tin hydride led to significant increase in enantioselectivity. The (–)-1-phenylethanol was obtained with 37% ee. Analogous effect in case of $MnCl_2 \cdot 4H_2O$ was 31%. These results confirm a strong impact of Lewis acids on the enantioselectivity of studied reduction reactions.

Conclusions

1) Dibutyldi(camphorsulfonyl)tin was obtained from dibutyltin oxide and camphorsulfonyl acid by means of aseotropic dehydration conducted

in a distillation system equipped with a Dean-Stark apparatus.

2) An initial product of this reaction is dibutyldi(camphorsulfonyl)tin dihydtate, which sheds two molecules of water upon drying, forming dibutyldi(camphorsulfonyl)tin.

3) Dibutyldi(camphorsulfonyl)tin undergoes disproportionation with Bu_2SnH_2 in the solution, forming dibutyl(camphorsulfonyl)tin hydride.

4) As shown by theoretical calculations, kinetic measurements of decomposition of a wide range of organotin hydrides catalyzed by different amines, and studies comparing the rates of acetophenone reduction using these hydrides, dibutyl(camphorsulfonyl)tin hydride is the most reactive of these compounds.

5) The difference in the behavior of dibutylcamphorsulfonyltin hydride compared to the commercially available Bu_3SnH was also observed in case of cyclopropyl 4-methoxyphenyl ketone reduction.

6) We suspect that the particular properties of dibutylcamphorsulfonyltin hydride are determined by the ease of its initiation at room temperature.

7) Optically active dibutyl-(*S*)-camphorsulfonyltin hydride and its derivatives, dibutyl-(*R*)-camphorsulfonyltin hydride, diphenyl-(*S*)-camphorsulfonyltin hydride were successfully used in stereoselective reduction of acetophenone and methyl 2-bromo-2-(6-methoxy-2-naphthyl)-propionate.

Acknowledgements:

The above paper is a translated reprint from the 5-th Polish Conference- Progress in Medical andPharmaceutical Studies, Medical University in Lodz, Department of Pharmacy, November 21-23, 2010.

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Pharmacology & Pharmacy

β- blockers and diabetes mellitus

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Received: 2012.02.11 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

During the 50 years since the discovery of propranolol, β-blockers established their position on the grounds of numerous clinical trials on treatment of coronary artery disease, hypertension and heart failure. Absolute contraindications greatly limit effective treatment and unfavorable metabolic profile is often the cause of discontinuation of treatment. Epidemiological data indicate a significant rise in a population of patients suffering from diabetes and cardiovascular diseases. A particular conflict occurs between those disorders, namely – β-blockers, leading to a reduced β-blocker administration in diabetic patients. In this article, we present the role of β-blockers in selected cardiovascular disorders with coexistent diabetes as well as positive features of this group of drugs despite some of their disadvantages.

Key words: β-blockers, cardiovascular diseases, diabetes mellitus.

Introduction

Diabetes mellitus is a chronic metabolic disease characterized by elevated blood glucose concentration (hyperglycemia) as a result of dysfunction of pancreatic Langerhans' islet beta cells and/or peripheral cellular insulin resistance (organism is not able to utilize insulin effectively). Persistent hyperglycemia as well as disorders of fat and protein metabolism lead to development of acute complications (coma) or chronic organ and systemic damage. Vascular complications of diabetes lead to increased risk of arterial hypertension, cardiac ischemic disease and heart failure. Diabetes significantly elevates the risk of acute cardiovascular events (myocardial infarction, stroke) [1,2]. Multidirectional actions for primary and secondary prevention of acute cardiovascular events, based on clinical and laboratory research, involve the use of β_1-blockers. However, most of them promote weight gain and exert an adverse influence on lipid metabolism. Interference of agents blocking β-adrenergic receptors with sympathetic nervous system activity may be the reason for the alleviation of symptoms of hypoglycemia. This is a consequence of inadequate administration of medicines in relation to the nutritional supply and intensity of physical exercise. Symptoms of hypoglycemia include: excessive sweating, palpitations, and tremor.

They are caused by autonomic nervous system stimulation. Patients may also experience nausea and headaches. With significant hypoglycemia (usually < 55mg%), the following symptoms occur: confusion, somnolence, impaired motor coordination, blurred vision and, at last, coma. Episode of severe hypoglycemia always requires immediate medical intervention [3]. One of the cohort studies revealed significant differences

between groups of patients treated with selective vs. non-selective β-blockers. It was confirmed that patients treated with insulin are exposed to greater risk of hypoglycemia in case of simultaneous use of non-selective β-blockers. However, that did not apply to patients treated with β_1-blockers [4]. High prevalence of diabetes and co-existence of cardiovascular complications are common causes of β-blocker administration. However, numerous contraindications often lead to a conviction that there are major or even absolute contraindications for their use in patients with diabetes. In this article, authors attempt to present current information on the significance of β_1-blocker use in patients with coexistent cardiovascular disease and diabetes.

β-blockers

Discovery and development of β-adrenergic receptor antagonists (β_1-blockers) may be considered one of the most important advances and breakthroughs in the history of cardiovascular pharmacology. The first β-blocker – propranolol – was discovered in 1964 by Sir James W. Black (Scottish doctor and a pharmacologist living in the years 1924-2010), who received the Nobel Prize in the field of physiology and medicine for it in 1988. During those times, the majority of research studies focused on seeking medicines increasing supply of oxygen to the heart. However, Sir James asked himself an opposite question: "Could the myocardial need for oxygen be reduced?"

It turned out to be possible thanks to introduction of β-blockers. A 4-fold reduction in mortality in comparison to a group not receiving this drug was observed after only the first three years following introduction of propranolol onto the market [5].

Beta-adrenolytics inhibit two types of β-adrenergic receptors: β_1 and β_2 to various extent. This group is characterized by great pharmacokinetic and pharmacodynamic heterogeneity. Differences in pharmacodynamics are related to β_1/β_2-selectivity, intrinsic sympathomimetic activity and vasodilatatory capacity (Table 1). Cardioselective β-blockers (they only inhibit β_1) are superior to non-selective ones due to the reduction of adverse events associated with β_2 blockade. Intrinsic sympathomimetic activity is characterized by weak β_1 stimulation with simultaneous basic antagonism of those receptors and is exhibited by acebutolol and, above all, pindolol [6,7].

Table 1: The division of β-blockers using in cardio-vascular diseases

I generation Non-selective β-blockers	II generation β1-selective blockers	III generation	
		Non-selective β-blockers with additional actions	β1-selective blockers with additional actions
Propranolol Pindolol	Acebutolol Atenolol Bisoprolol Metoprolol	Carvedilol Labetolol	Celiprolol Nebivolol

New, so-called III-generation β –blockers were introduced in the past few years. They differ from older preparations by additional characteristics such as ability to block α1-adrenergic receptors (carvedilol, labetalol), stimulate NO release (nebivolol), β_2-receptor antagonism (celiprolol), inhibition of calcium ion influx (carvedilol, betaxolol), and antioxidative properties (carvedilol) [6, 8, 9].

Pharmacokinetic differences between β-blockers concern their lipophilicity. Propranolol exhibits greatest affinity to lipids, while metoprolol, carvedilol and betaxolol – moderate. Strong lipophilic properties result in a good blood-brain barrier penetration, which may cause sympathetic nervous system suppression [6,7].

Basic contraindications for β-blockers include: poorly-controlled asthma, II and III degree atrioventricular block, sick sinus syndrome and sinus bradycardia < 50 beats/minute during arousal – especially if it is symptomatic (Morgagni-Adams-Strokes syndrome, MAS). The data available in the literature indicate that β-adrenolytic agents promote weight gain [10], exert an unfavorable influence on lipid metabolism and increase (in comparison to other drugs) the incidence of diabetes [11,12]. They may also "mask" the symptoms of hypoglycemia.

Treatment with β-blockers in ischemic heart disease

The first studies conducted by Sir James were already directed at treating angina pectoris through blocking the influx of endogenous catecholamines (epinephrine and norepinephrine)

to the heart, decreasing heart rate and contractility and therefore, reducing oxygen consumption. Therapy with β-blockers lowers the demand of cardiac muscle for oxygen at rest and, above all, during stress, physical exercise and in situations associated with stimulation of sympathetic nervous system [13]. The remaining mechanisms of β-blockers playing a positive role in ischemic heart diseases are presented in Table 2.

Table 2: The properties of β-blockers predisposing them to use in angina pectoris

Angina pectoris
› Reduction heart rate and contractility › Decrease oxygen demand › Decrease peripheral vascular resistance in long-term administration › Lowering blood pressure › Reduction afterload

Acute coronary syndromes such as unstable angina and myocardial infarction occur in diabetics very often [14-16]. Clinical studies, including metaanalyses, proved significant benefits associated with β_1-blocker use in patients after myocardial infarction [17]. These benefits include reduction in overall mortality by about 23% [18], risk of recurrent MI and death due to cardiac causes. Diabetic patients gain particular benefits from the use of β_1-blockers, as demonstrated through a reduction of mortality in patients following myocardial infarction and decrease in the number of patients with newly diagnosed myocardial infarction [19-24]. Therefore, β-blockers are particularly indicated in all diabetic patients with acute coronary syndromes [19,20,25].

It is important to individually select a proper drug from this group taking into consideration co-morbidities and type of treatment for diabetes. Selective β_1-blockers should be preferred in patients receiving insulin while administration of α-1 and β-adrenergic receptor blockers such as carvedilol may bring additional benefits in patients with co-existent peripheral artery disease or substantial insulin resistance [26].

However, as current data show, diabetics suffering from ischemic heart disease are often deprived of this life-saving treatment [27-29], which may result from established beliefs regarding detrimental influence of β-blockers in this group of patients.

Treatment with β-blockers in arterial hypertension

In the year (1965) following introduction of propranolol to the market, Prichard and Gillam demonstrated effectiveness of this drug in the treatment of hypertension [30]. Properties of β-blockers that determine their use in hypertension are presented in Table 3.

Table 3: Mechanism of hypotension action of β-blockers

Hypotension effects of β-blockers – mechanism of action
› Decrease cardiac output › Inhibition of RAA system via inhibition renin release › Blockade presynaptic β-adrenoceptors and inhibition of Norepinephrine release › Decrease central actions › Decrease peripheral vascular resistance in long-term administration
Additional hypotension effects of III generation of β-blockers – mechanism of action
› Production of nitric oxide –nebivolol › Blockade of α_1-adrenoreceptors – carvedilol › Activation of β_2-adrenoceptors – celiprolol › Blockade of Ca^+ entry – carvedilol, betaxolol

Among the most important characteristics of this group of drugs we should mention: reduction in cardiac output, inhibition of renin release by juxtaglomerular cells and therefore, inhibition of RAA system (rennin-angiotensin-aldosterone), as well as blocking presynaptic β-adrenergic receptors, thus inhibiting norepinephrine release. Reduction in peripheral vascular resistance occurs in effect of long-term β-blocker administration. On the other hand, III generation β-blockers possess additional hypotensive properties such as nitrous oxide production, blockage of α1-adrenergic receptors, activation of β2-adrenergic receptors and inhibition of calcium ion influx [6,9]. This allows for broadening the indications for their use.

Beta-blockers, next to diuretics, calcium channel blockers, ACE inhibitors and angiotensin receptor blockers constitute one of five classes

of hypotensive drugs that, according to ACCF/AHA 2011 (American College of Cardiology Foundation/American Heart Association), significantly reduce the risk of cardiovascular events and are indicated during initiation as well as continuation of hypotensive treatment both in monotherapy and in combination. Particular attention should be paid to careful administration of β-blockers, or even their avoidance, in therapy of patients with metabolic syndrome or at risk of diabetes, especially when they are used in combination with thiazide diuretics. Nevertheless, experts' views on the choice of hypotensive therapy consider preferential use of β-blockers in patients after myocardial infarction, with angina pectoris, for rate control in permanent atrial fibrillation, in heart failure and during pregnancy.

Two recent large clinical studies [31,32] and one metaanalysis [33] demonstrated that β-blockers, especially atenolol [9], are less effective in stroke prevention, although they reduce the risk of coronary incidents and mortality equally well to other drugs. There were benefits associated with use of β –blockers in patients with angina pectoris, heart failure and after recent MI [18,34,35]. Therefore, β-blockers may be considered during both initiation as well as continuation of hypotensive treatment. In this group of patients, special attention should be paid to β-blockers exerting vasodilatatory effects. These include carvedilol and nebivolol, which cause less pronounced metabolic disturbances or are completely devoid of this effect [36].

Therapy with β-blockers in heart failure

Heart failure of various etiologies significantly worsens the quality of life and is a cause of frequent hospitalizations. Research studies confirming the benefits associated with administration of beta-adrenergic receptor blocking drugs, despite their negative inotropic effects, were taken into account in the recommendations. Current guidelines of the European Society of Cardiology recommend using blockers of β-adrenergic receptors in all patients with symptomatic heart failure and left ventricular ejection fraction (LVEF) of ≤ 40%. Benefits associated with their use in heart failure patients include, among other things, reduction in the number of hospitalizations due to exacerbation of heart failure and, most importantly, improvement in survival and quality of life [37,38].

As a consequence of numerous trials, including CIBIS II (with bisoprolol), MERIT-HF (with metoprolol), SENIORS (with nebivolol) and COPERNICUS (with carvedilol), several β-blockers - carvedilol, bisoprolol, metoprolol and nebivolol - were approved for treatment of chronic, stable heart failure (NYHA II-IV) [7,8].

Following introduction of propranolol by Sir James, heart failure was a contraindication to its use together with several other drugs from this group. Frankly, their administration seemed counterintuitive. However, cardiac function impairment due to chronic sympathetic nervous system activation pointed to a new direction in treatment – β-blockers. They counteract the structural changes in the heart and vessels, myocyte damage and, as follows, decrease in contractility, reduction in concentration of β_1-adrenergic receptors, increased cytokine levels, apoptosis, ischemia and other factors (Table 4) resulting from sympathetic nervous system overactivity.

Properties of β-blockers and clinical trials provided the grounds for current guidelines developed by American Heart Association and American College of Cardiology (AHA/ACC) stating that this group of drugs should be used in all patients with symptomatic LV systolic dysfunction. Heterogeneity of β-blockers is also apparent in their administration in heart failure. Metoprolol and bisoprolol are β_1-selective, as is nebivolol, which additionally possesses vasodilatory properties, while carvedilol is a β_1-, β_2- and α_1-adrenoreceptor antagonist exhibiting anti-oxidant, anti-apoptotic and anti-endothelin effects. Despite those differences, all drugs reduced mortality by about 34% in above mentioned clinical trials [7,8].

Conclusions

Progress in pharmacotherapy of cardiovascular diseases is the reason for increase in the number of indications for treatment with β-adrenergic receptor blockers. Despite disadvantages and contraindications for β-blockers, clinical trials

Table 4: Mechanism of hypotension action of β-blockers*

The international name	The trade name and doses	Indications
Acebutololum	Sectral 200 and 400 mg	A, H, IHD
Atenololum	Atenolol Sanofi 25 and 50 mg	A, H, IHD, MI
Bisoprololum	Bisoratio 5 and 10 mg	HF, H, IHD
	Coronal 5 and 10 mg	H, IHD
Carwedilolum	Atram 6,25; 12,5; 25 mg	HF, H, IHD
	Avedol 3,125; 6,25; 12,5; 25 mg	HF, H, IHD
	Carvetrend 3,125; 6,25; 12,5; 25 mg	HF, H, IHD
	Carvedigamma 6,25; 12,5; 25 mg	HF, H, IHD
	Carvedilol Teva 6,25; 12,5; 25 mg	HF, H, IHD
	Carvedilol-ratiopharm 6,25; 12,5; 25 mg	HF, H, IHD
	Coryol 3,125; 6,25; 12,5; 25 mg	HF, H, IHD
	Dilatrend 6,25; 25 mg	HF, H, IHD, LVEF
	Hypoten 6,25; 12,5; 25 mg	HF, H, IHD
	Symtrend 3,125; 6,25; 12,5; 25 mg	HF, H, IHD
	Vivacor 6,25; 12,5; 25 mg	HF, H, IHD
Metoprololum	Metocard 50 and 100 mg	A, H, IHD, T
Propranololum	Propranolol WZF 10 and 40 mg	A, Ax, CH, ET, H, IHD, M, P, PH, T

*
The Table was based on Summaries of Product Characteristics published on the website of the Ministry of Health (leki.urpl.gov.pl/index.php) included in a Declaration of the Minister of Health, of 27 February 2012 on the list of reimbursed medicinal products and foods for special medical purposes valid as of 1March 2012 (Official Journal of Minister of Health of 27 February 2012, item 4).

Ax – anxiety,
A-arrhythmias,
CH –cardiomyopathy hyperthrophic,
ET – essential tremor, HF – heart failure,
H – hypertension,
IHD – ischaemic heart disease,
LVEF –left ventricular ejection fraction ≤ 40% after MI,
M – migraine,
MI –myocardial infarction,
P – phaeochromocytoma,
PH – portal hypertension,
T - thyrotoxicosis

and broadly-defined benefits such as reduced hospitalization rates and mortality argue for their application in ischemic heart disease, arterial hypertension and heart failure. Co-existence of diabetes, which leads many doctors to avoid β-blockers, should not be the grounds for not using these drugs in those patients. It should be noted that clinical benefits ensuing from application of β_1-blockers in diabetic patients with heart failure and/or after myocardial infarction are undisputable and these patients should not be deprived of treatment with those drugs.

This group of drugs should not be the first choice for patients with arterial hypertension. However, diabetes and pre-diabetic state are not absolute contraindications to such treatment. Moreover, the variety of characteristics, especially among III generation β-blockers, allows for selection of an appropriate medication for patients with diabetes. Table 5 presents all drugs that were registered and refunded in Poland (not all of III generation drugs appeared

in this table because of that) with their indications based on the summaries of product characteristics. Indications, as shown in the table, may differ between products with the same international name.

Acknowledgments:

Article funded by Medical University of Lodz within the statutory activity (503/1-023-01/503-01 and 503/3-011-02/503-01).

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Emergency Medicine

Current health threats connected with the use of biological weapons

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Received: 2011.12.14 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Taking into account the possible scale of threat to health connected with the use of biological weapons, it is necessary to provide physicians, nurses and medical rescue workers, including students, with the corresponding theoretical and practical knowledge in the area of bioterrorism. It is crucial to introduce issues concerning biological weapons to the curricula at each level of education.

Key words: threats to health, biological weapons, bioterrorism.

Proper education and training of health professionals should help all people in the world to achieve optimal state of health. This is accomplished by the promotion of the health of people throughout their lives and reduction of the number of cases and the level of suffering caused most often by illnesses and injuries. For this reason, this chapter presents the main aspects of the types and the applicability of biological weapons. It also presents the principles of dealing with health threats associated with bioterrorist attacks.

This knowledge is essential for the organization of health care, where the nurse plays a key role. In particular, district nurses and nurses cooperating with GPs may have frequent contact with people who need medical assistance, and thus they can observe changes and abnormal responses of the body related to the effects of various biological pathogens.

The assumptions of a joint health policy program "*Health for all*" for the citizens of the European Region "*Health – 21*" were adopted by the WHO European Regional Committee in September 1998. Twenty-one tasks (goals) to be achieved in this century were defined. One of the objectives of this program concerns the development of human resources for health care, and reads as follows: *by 2010, all Member States should enable health care professionals and professionals in other sectors to acquire knowledge, skills and attitudes appropriate for the protection and promotion of health* [1].

Particular attention is paid to the qualifications of doctors and nurses working in primary care, as they should be a "*center of the entire network of services*", necessary to perform the tasks resulting from the adopted program. The key tasks of GPs and nurses are listed in the program documents of

the WHO. It is stressed there that these professionals must have necessary knowledge and skills.

Proper education and training of health professionals is included in the *Health – 21* policy and its "permanent objective" that is "to achieve optimal health for all people" through implementation of two tasks, namely promotion of the health of people throughout their lives and reduction of the number of cases and the level of suffering caused most often by illnesses and injuries" [1].

Currently, the greatest potential health threat to society, related to the possible use of biological agents, may be biological terrorism. In the era of advanced research and development of the media, citizens of developed economies seemed to be free from fear and confident that nothing could surprise them. However, the events of September 11, 2001, and those which followed them, proved that a new, radical form of terrorism was born, the promoters of which are willing to use unpredictable and nearly unknown weapons – biological weapons.

At the moment, there are no other weapons that would be so easy to hide, inexpensive to manufacture and yet able to cause such great losses in people. Detection of the fact of their use is extremely difficult, and since there is little public awareness of the consequences of its use and methods of dealing with risk, the mere mention of the possibility of a bioterrorist attack causes panic disorganizing the work of all emergency staffs and medical services.

Signing and ratification by a majority of countries of international agreements on the prohibition of improvement, production, storage and use of biological and chemical weapons limited only the probability of their use, without giving a guarantee of the weapons not being used, because there still exists a group of countries, among others Iraq, Iran, Libya, North Korea, where such weapons are produced and improved. Weapons of mass destruction are also present in the arsenals of many other states and they can be used in a possible conflict.

It is very difficult to predict an act of biological terrorism or a threat of biological crime. Even in the case of a threat of biological attack, the type of biological agent and its application may not be known, which reduces the effectiveness of protection measures. It would be possible to use security and protective measures, significantly reducing the number of potential victims of the expected attack, only if the time and place of the use of the biological agent as well as its nature were known.

When considering issues related to biological weapons, it should be noted that with the development of chemistry and biochemistry, the differences between chemical and biological weapons are becoming increasingly blurred. More and more germs are being replaced with toxic products of their metabolism, derived synthetically. Therefore, weapons are no longer divided into chemical and biological ones, and a general term is used to describe them – CB weapons.

Biological and chemical weapons consist of three basic elements:
1) active agent;
2) container with this agent;
3) medium.

Chemical warfare (chemical weapons) are toxic compounds, which due to their physical and chemical properties are suitable for military use. They are characterized by lethal or harmful effects on humans, animals or crops and are usually liquids and solids, less frequently gases, and they occur in the form of vapors and aerosols [2].

All chemicals used as weapons of mass destruction, must have the following characteristics:
1) toxicity;
2) fast or latent (chronic) effects;
3) no organoleptic characteristics;
4) easy permeability through different materials (textiles, rubber);
5) resistance to weather conditions and chemical disinfectants;
6) difficult detectability;
7) resistance to detonation, temperature, long-term storage

In terms of the mechanism of action, chemical weapons are divided into the following groups:
1) irritants;
2) psychotoxic;
3) vesicant (causing necrosis);

4) generally poisoning;
5) causing paralysis and convulsions.

Biological weapons are a means of mass infection of humans, animals and plants. Their active agents are biological substances, which include pathogens (bacteria, viruses, rickettsiae, fungi) and venoms produced by bacteria (toxins). The Annex to the "Convention of 1999 on the Prohibition of the Development (…) of Biological and Toxin Weapons (…)" lists the following factors as pathogenic for humans: 9 species of bacteria, 3 species of rickettsiae, 2 species of protozoa, 16 types of viruses, 19 different toxins and 14 viral pathogens of animals and 16 plant pathogens.

However, article I of the Convention allows for research regarding prevention and protection against these factors under the control of international organizations. Yet, we know that increasing the production of dangerous biological agents to a mass scale is not currently a major technical or financial problem (5). Biological agents of mass destruction can be used to achieve the following objectives:
- military – biological war,
- bioterrorism,
- biocrime.

An effective biological weapon is characterized by:
1) easy, fast and cheap reproduction of pathogens;
2) high virulence of biological agents;
3) resistance to adverse environmental factors;
4) potential for scattering in the form of aerosols;
5) causing disease with a short period of incubation, high infectivity and mortality;
6) difficult detectability, in particular with traditional methods;
7) potential for causing panic in the civilian population.

In the recent period, dangerous biological agents were divided into three categories: A, B, C. The biological agents of so-called category A (suitable for use in biological war) are one of the following pathogens: smallpox virus, anthrax bacillus, yersinia pestis, tularemia bacillus, botulin and filoviruses (Ebola, Marburg) (4). These factors were given the highest priority because they:
- are easy to spread or easily spread from person to person,
- cause high mortality and can have a big impact on the health of the population,
- can cause panic among people,
- require no special preparation on the part of public services (particularly health care services).

The concept of a biological agent was defined to describe the needs of potential bioterrorist activities. Thus, biological factors are – "*Living organisms or materials derived from them, causing illness or injury to humans, animals or plants, or causing any damage or deterioration of material properties. Biological agents*

Table 1: The main diseases caused by biological agents.

Type of gent Name of disease	Mortality incidence without treatment	Mortality incidence with treatment	Time of elimination of a man from the battle field	VACCINE TREATMENT	The risk of infection	The use in biological warfare
BRUCELLOSIS	2-5%	Below 2%	Months or years	available not very effective treatment (antibiotics)	WEAK	aerosol, contaminated water and food
CHOLERA	10-80%	5-30%	Up to 30 Days	available antibiotics sulfonamides	STRONG	aerosol, contaminated water, food and objects
YERSINIA PESTIS	100%	10%	1-2 weeks	available antibiotics sulfonamides	STRONG	aerosol, contaminated water and food
YELLOW FEVER	5-90%	5-90%	10-14 days	mass-produced difficult	NOT AVAILABLE	aerosol, infected mosquitoes
SMALLPOX	25-40%	6-10%	12-14 days	mass-produced difficult	STRONG	aerosol, contaminated water, household items
TYPHUS	40%	5%	Up to 3 months	mass produced antibiotics	STRONG	aerosol, infected lice
BOTULISM	60-70%	60-70%	2-6 months	in the form of antitoxin very difficult	NOT AVAILABLE	aerosol, contaminated water or food

Table 2: Threat category A.

Microorganism	Disease caused	Incubation period	Mortality
Bacillus anthracis	ANTHRAX	1-3	pulmonary and intestinal form about 100%
Clostridium botulinum	BOTULISM	0.5-2	100%
Francisella tularensis	TULAREMIA	1-21, usually 2-7	small
Yersinia pestis	PLAGUE	1-10	pulmonary form up to 100%

Table 3: Threat category B.

Microorganism	Disease caused	Incubation period (days)	Mortality
Burkholderia mallei	GLANDERS	2-5	60-90%
Burkholderia pseudomallei	MELIOIDOSIS	2-6	Over 90%
Rickettsia provazeki	EPIDEMIC TYPHUS	8-15	Up to 30
Coccidioides imitis	COCCIDIOIDOMYCOSIS	7-28	dangerous if the immunity is weakened

Table 4:

Virus or viral family	Disease caused	Incubation period	Mortality (%)
Arenaviridae	Lassa fever	7-21	30-50
Arenaviridae Junin, Sabial, Machupo	South American hemorrhagic fevers	7-14	About 30 Uncertain data
Arboviridae	Rift Valley fever	4-6	30 (blindness)
Filoviridae	Ebola hemorrhagic fever	3-7	50-90
Filoviridae	Marburg hemorrhagic fever	5-8	30
Ortopoxviridae Poxvirus	Smallpox	4-7	20-40
Equine Morbillivirus	Hemorrhagic fever with acute encephalitis	About 3 (uncertain data)	100

may take the form of liquid droplets, aerosols or dry powders. They can be adapted and used as a terrorist weapon causing diseases such as anthrax, tularemia, cholera, encephalitis, plague and botulism. There are three different types of biological agents: bacteria, viruses, and toxins." [3]

Currently, the known biological agents can be transferred to humans in two ways: through the digestive tract or by inhalation.
Other methods, such as spreading of infected insects or objects, now only have historical significance because of the limited effectiveness of such actions.

Currently, one can expect the use of biological agents by spraying an aerosol or contamination of food or drinking water.

The term aerosol includes "airborne solid or liquid material, classified as dusts, fumes, mists and vapors, depending on their physical nature, particle size and method of manufacture. Particle size can vary from 0.01 to 100 / μn in diameter." [3]

Biological agents can be spread anywhere through the air without attracting attention, because they have no taste or smell. The means of transmission may be an airplane, helicopter, or a single man. Objects may be attacked either in the open space, as well as in closed and crowded places – subway, shops, offices.

The following will dominate in the structure of sanitary losses in terms of the factor of destruction and type of injuries, for biological weapons: poisoning 50-70% of losses and illnesses

30-50%; for chemical weapons: poisoning 90-95% and burns 5-10%.
There are biological factors that are considered as a potential threat, weapons of mass destruction including bacteria, viruses, fungi and toxins – Table 3.

Pathogenic viruses classified as destruction "A" could pose a threat to health, considered as a potential biological weapon – Table 4.

Additionally, a potential health threat can be bacterial, plant and animal toxins. They have been summarized in the following table – Table 5.

Symptoms occurring in the body after the use of biological agents:

Pulmonary form of anthrax: fever, cough, chest pain, dyspnea, cyanosis, shock. Death after 24-36 h following worsening of symptoms. Hemorrhagic meningitis in 50% of cases. Physical examination reveals nonspecific symptoms.

Pulmonary form of yersinia pestis: high fever, headaches, symptoms of toxemia, rapidly progressing dyspnea, cyanosis. Death accompanied by the symptoms of shortness of breath, shock, bleeding. Physical examination reveals consciousness disorders, hemorrhagic lesions on the skin and mucous membranes.
Tularemia: in aerosol infections, symptoms of typhus, fever, headache, cough, symptoms of pneumonia (30-80%). Physical examination reveals typhoid symptoms with no adenopathy.
Smallpox: fever, muscle aches, vomiting, headache, progressing rash 2-3 days later, changing into vesicles. In physical examination rash covering the face, hands and feet.
Botulism: vision disorders, speech disorders, dysphagia, symmetrical descending symptoms, respiratory failure. Physical examination:

Table 5:

Toxin	Toxin source	Toxin characteristics	Lethal dose in µg per kg of body mass
Botulin toxin	Clostridium botulinum	Neurotoxins A, B, E - toxic to humans	0.01
Epsilon toxin	Clostridium perfringens	Neurotoxin; is activated by trypsin in the gastrointestinal tract	0.1
Shigatoxin	Shigella dysenteriae	Inhibits protein synthesis, secondarily damages the endothelial cells of the spinal cord	0.01
Staphylococcus aureus enterotoxin	Staphylococcus aureus	Protein substance, incapacitating agent	Toxic dose 10-15
Abrin	Abrus precatorius	Inhibits protein biosynthesis	0.04
Alphatoxins	Aspergillus flavus, Aspergillus parasiticus	Inhibits protein biosynthesis, strong hepatocarcinogen	3000
Diacetoxins - scirpenol	Fusarium graminearum, F. nivale	Dermatotoxin	4000
Toxin T2	Fusarium: latericum, oxysporum, solani, roseum, tritinctum, viridae, ridinsculum	Dermatotoxins	1200
Ricin	Ricinus communis	Cytotoxin, protein alcaloid derived from ricinus	0.1 per os; 400/L of air, inhalation
Saxitoxin	Protozoa: Gonyaulax, catanella; saxidomus giganteus mollusks	Neurotoxin; causes respiratory muscle paralysis	0.2
Tetradotoxin	Sea fish	Neurotoxin; causes paralysis of respiratory muscle and the respiratory centre	8
Conotoxin	Sea snails conus sp.	Neurotoxin; blocks the sodium and calcium channel; blocks the receptors	6

no fever, no reaction of pupils, paralysis of varying degrees.

Viral hemorrhagic fever: fever, headache, hemorrhagic rash, progressive signs of bleeding, aseptic meningitis, shock, coma. Physical examination reveals progressive hemorrhagic lesions, conjunctivitis, rash on neck and chest [3].

Many countries introduced legislation to enable organization of an effective system of defense against health risks associated with the use of biological weapons, including against biological terrorism. The most advanced country in the fight against terrorism is the United States of America. Active measures in this regard are also taken by: United Kingdom, Canada, France and some other countries such as Poland, Ukraine and Spain.

Currently it is not possible to provide a complete protection for larger, especially accidental human communities against the effects of biological weapons. Vaccines prevent certain diseases, but this way of providing security becomes worthless when the pathogenic agent is not known in advance. In addition, there are no vaccines to many potential pathogens that could be destructive agents of biological weapons. The administration of antibiotics may not be effective until the organism is identified, and will never be successful when we confront strains resistant to antibiotics obtained naturally or by genetic engineering. Antibiotics will not be effective for viral infections either [4,8].

We need a new and broad perspective on the real threat of biological weapons, and a system to prevent the use of such weapons, as well as the most effective procedures for eliminating the consequences of their use. The emergency services and health services should have well-developed and tested procedures of action in circumstances of a threat. Moreover, what is also necessary, is the rapid recognition and accurate identification of risk factors, as well as developed and tested procedures to eliminate the consequences of the use of biological weapons. These actions are related to individual and collective inactivation, and inactivation of the environment, organization of first aid to victims, organization of the system of segregation and transport of patients. It is necessary to keep ready a certain number of beds in well-equipped departments of infectious diseases, which would enable hospitalization of patients with especially dangerous infectious diseases.
It is also necessary to provide a possibility of quick development of an appropriate hospital base. It is necessary to provide adequate supplies of antibiotics, vaccines and antitoxins [7].

There is advanced research on the assumptions of a system of detection and identification of biological threat agents. It is planned to create an effective system of supervision and constant epidemiological monitoring, designed for fast and reliable analysis of the data indicating an increase in incidence in a particular area, and an efficient flow of information. It is expected that daily reports on the incidence of illnesses should be transmitted according to a simple scheme: from local clinics to district and then to provincial sanitary and epidemiological stations [2,9].

The following epidemiological guidelines suggesting the possibility of a bioterrorist attack may be useful in epidemiological surveillance:

1) A large number of patients with similar symptoms
2) A large number of cases of unknown etiology
3) The occurrence of an unusual disease in the population
4) High morbidity and mortality, occurring in connection with the ordinary course of frequently occurring diseases or lack of positive response to routine therapy.
5) Single cases associated with infection by rare microbes: smallpox, pulmonary form of anthrax, viral hemorrhagic fevers
6) Occurrence of uncommon diseases within the same patient with no explanation
7) Occurrence of diseases in unusual geographical areas and seasons
8) Diseases of atypical course in the population at age when they normally do not occur
9) Atypical symptoms
10) Genetic similarity of microorganisms isolated at different times and from different sources
11) Isolation of atypical, genetically modified, or previously existing strains
12) Stable endemicity in a given area associated with a sudden increase in incidence
13) Simultaneous occurrence of similar diseases in areas which are not in contact with one another
14) Atypical disease transmission by aerosol, food and water, which may suggest sabotage
15) Patients with similar symptoms receiving

treatment at the same time
16) The occurrence of symptoms in persons who previously stayed in air-conditioned rooms, in the absence of these symptoms in other persons
17) Unprecedented cases of illness and death among the animals associated with illnesses and deaths among people

Rules of providing medical assistance in cases of biological and chemical attack should be based on specific assumptions resulting from the necessity to work in extreme conditions (8). Special attention should be paid to the efficient admission and segregation of the infected and determination of the order and extent of medical assistance at different stages of medical evacuation. Quick evacuation is a guarantee of success in the fight against mass losses, and accelerates the correct diagnosis of infection/contamination, and specialist treatment [10].

To sum up, in the case of the use of biological weapons, when the agent used in the attack is not known, or if the agent used was initially described as having an infectious and transmission properties, the rules listed below must be followed:
- Isolation of potential sources of infection from a healthy population;
- Seeking to break the chain of epidemic;
- Treating each person exposed to a biological attack as infected;
- Each symptomatic case of infectious disease should be considered as a consequence of biological attack, or contact with a sick person.
- Performing sanitation procedures for the removal of a biological agent that can infect healthy people, including medical personnel and the surrounding environment;
- Use of chemo-and immunoprophylaxis in all cases where it is necessary.

Because of the possible scale of the health threats associated with the use of biological weapons, it is necessary to provide nurses with adequate knowledge and expertise on these issues. Bioterrorism issues should be introduced in the curricula at every level of education.

Proper education and training of health professionals should help all people in the world to achieve optimal state of health. This is accomplished by the promotion of the health of people throughout their lives and reduction of the number of cases and the level of suffering caused most often by illnesses and injuries. For this reason, this chapter presents the main aspects of the types and the applicability of biological weapons. It also presents the principles of dealing with health threats associated with bioterrorist attacks.

This knowledge is essential for the organization of health care, where a physician, nurse or paramedic plays a key role. In particular persons involved in the organization of health care in a society, cooperating with GPs, may have frequent contact with people who need medical assistance, and thus they can observe changes and abnormal responses of the body related to the effects of various biological pathogens.

Acknowledgements:

Original article previously published in the Polish language in *Wojskowa Farmacja i Medycyna*.

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Emergency Medicine

Impact of selected socio-demographic characteristics in adult parents on the frequency of child abuse cases

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Received: 2012.01.16 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Introduction: The authors are conscious and concerned of the issue of domestic violence and decided to define the frequency of child abuse by adult parents.
Materials and Methods: The survey included 285 parents aged 21-72 years, who were individually interviewed on the matter of ridicule, embarrassing, humiliating, excessively criticizing and blaming their own children. The following socio-demographic characteristics of the respondents were considered: sex, age, education level, age of their children.
Results and Conclusions: It was proved that 51.6% of the subjects surveyed habitually ridiculed, embarrassed, humiliated, excessively criticized and blamed their own children; every tenth subject admitted to frequent or very frequent employing those means of abuse towards own children. Male subjects statistically significantly more frequently claimed to have employed abusing own children than female subjects. All subjects under 65 years of age employed child abuse towards own children on very similar levels when compared to subjects over 65 years of age, who statistically significantly more frequently employed ridicule, embarrassment, humiliation, excessive criticism and upbraiding towards own children. The level of education of the study subjects was not a significant factor in using abuse towards own children with the exception of cases of basic, basic vocational and vocational education. The age of an abused child was not a statistically significant factor of child abuse frequency.

Key words: survey – individual interview, child abuse, impact of selected socio-demographic characteristics.

Introduction

Child abuse has become one of the most important issues of modern society. It is assumed that about three hundred million cases of child abuse occur every year around the world. Among various forms of child abuse, four main types are distinguished: neglect, physical abuse, psychological/emotional abuse, and child sexual abuse [1]. In the present report, the authors deal with psychological abuse, which is exposing a child to behaviors that may result in severe psychological traumas, along with chronic depression and suicidal thoughts and behaviors in extreme cases. Psychological abuse means causing psychological pain and suffering by employing excessive control and restriction of child's contacts with its peers,

friends or acquaintances, forced isolation, bondage, intimidation, threats and emotional blackmail. Also such repetitive behaviors as ridicule, excessive criticism, humiliation, refusing hugs and loving gestures, denying emotional responsiveness, name-calling, yelling or swearing at the child, degradation, embarrassment and persuasion of mental illness which aim to corrupt or diminish the child's self-esteem are pronounced to be symptoms of psychological abuse. One of the types of child abuse is sexual child abuse which is most generally described as engaging a child into sexual activities. The other type of child abuse is neglect. Severe neglect or lack of care could seriously endanger child's health or even life. Neglect may include failure to fulfill basic physiological or psychological needs of a child: failure to provide appropriate clothing, malnourishment, denying required health care, lack of attention to schooling, failure to provide the feeling of parents' love and safety which cause health problems and/or developmental difficulties. Abuse could also be economic which means withholding money or controlling all money and the direct victims are usually adults but children could suffer greatly as a result of it [2,3,4,5,6,7]. Moreover, one of the problems, mainly in the least developed countries, is forcing children to labor. Recently, there have been more reports on more "subtle" types of child abuse such as prenatal abuse and institutional abuse. The authors are conscious and concerned of the issue of domestic violence and thus decided to define the frequency of child abuse among adult parents considering the following socio-demographic characteristics: sex, age, education level, age of own children.

Materials and Methods

The survey included randomly chosen parents residing in the following Polish boroughs: Grodzisk Mazowiecki, Jarosław, Żyrardów, as well as cities: Łódź and Kraków (Tables 1,2,3,4).

Methods: qualitative research by means of individual interview
Number of subjects: 285
Age of subjects: 21-72 years
Duration of research: October 2010 – February 2011

Statistic analysis
All data were analyzed using Statistical Analysis System 6.0. Differences between analyzed groups of subjects are on the significance level of $p<0.05$; $p<0.01$; $p<0.001$ (chi-squared test) [2].

Results

Among 285 study subjects, 147 (51.6%) habitually ridiculed, embarrassed, humiliated, excessively criticized and blamed their own children, 115 (40.3%) subjects surveyed claimed to have done it frequently, and 7 (2.5%) very frequently. The correlation between the above mentioned types of child abuse and selected socio-demographic characteristics such as sex, age, education level, age of own children, was presented in Tables 1,2,3,4,5.

Table 1: Frequency of child abuse cases depending on the sex of the parent.

Sex	number/% of subjects surveyed	number/% of subjects surveyed who claimed to have abused their own children
Males	123/43.2	104/84.6 [5]
Females	162/56.8	43/26.5 [6]

#5# to #6# : $p < 0.001$

Table 2: Frequency of child abuse cases depending on the age of the parent requency of child abuse cases against age of parents.

age range	number/% of subjects surveyed	number/% of subjects surveyed who claimed to have abused their own children
from 25 years of age	40/14.0	18/45.0 [1]
26 - 35 years of age	60/21.0	28/46.7 [1]
36 - 45 years of age	60/21.0	28/46.7 [1]
46 - 55 years of age	63/22.1	31/49.2 [1]
56 - 65 years of age	32/11.2	18/56.3
above 65 years of age	30/10.5	24/80.0 [2]

#1# to #2# : $p < 0.05$

The data in Table 1 show that male study subjects employed ridicule, embarrassing, humiliating, excessive criticism and blaming their own children more frequently than female subjects. Those kinds of child abuse were employed by 104 male study subjects, which constitutes as much as 84.6% of all male subjects surveyed and by 43 female study subjects, which makes 26.5% of all

female subjects surveyed. The differences are statistically significant (p<0.001).

The data presented in Table 2 show that parents under the age of 65 years employed child abuse with a similar frequency. Parents above the age of 65 years employed such kinds of child abuse as ridicule, embarrassing, humiliating, excessive criticism and blaming their own children, statistically significantly more frequently.

The data presented in Table 3 show that the education level of parents did not have any significant impact on the frequency of cases of abusing own children. Basic, basic vocational and vocational education levels were an exception. Study subjects with basic, basic vocational and vocational education level statistically significantly more frequently employed ridicule, embarrassing, humiliating, excessive criticism and blaming their own children.

The data presented in Table 4 show that the age of children did not have any significant impact on the frequency of cases of abusing them by subjects surveyed.

Table 3: Frequency of child abuse cases depending on the education level of the parent.

education level	number/% of subjects surveyed	number/% of subjects surveyed who claimed to have abused their own children
Basic	40/14.0	27/67.5 [2]
Basic vocational	37/13.0	26/70.3 [2]
Vocational	35/12.3	26/74.3 [2]
General secondary	45/15.8	17/37.8 [1]
Post-secondary	59/20.7	22/37.3 [1]
Bachelors	39/13.7	20/51.3
Masters	30/10.5	9/30.0 [1]

#1# to #2# : p <0.05

Table 4: Frequency of child abuse cases depending on the age of own children.

age of own child	number/% of subjects surveyed	number/% of subjects surveyed who claimed to have abused their own children
from 3 years of age	30/10.5	13/43.3
4 - 6 years of age	42/14.7	20/47.7
7 - 12 years of age	40/14.0	27/67.5
13 - 15 years of age	42/14.7	28/66.7
16 - 18 years of age	46/16.1	23/60.0
19 - 26 years of age	40/14.0	17/42.5
above 26 years of age	45/15.8	19/42.2

The data presented in Table 5 prove that the sex of the study subjects was significant in rare cases of abusing own children. Male subjects statistically significantly more frequently than female subjects employed ridicule, embarrassing, humiliating, excessive criticism and blaming towards their own children. In frequent and very frequent cases of child abuse, the sex of the subjects was not significant. According to the statistical analysis, the age of the subjects did not have any statistically significant impact on the frequency of abuse towards own children. Similarly, the age of the abused children did not have any statistically significant impact on the frequency of child abuse cases. The education level of the study subjects did not have any statistically

Table 5: Frequency of child abuse cases depending on the selected socio-demographic characteristics of the study subjects.

Socio-demographic characteristic		Child abuse - ridicule, embarrassing, humiliating, excessive criticism and blaming own children (frequency)		
		seldom (number/%)	frequently (number /%)	very frequently (number /%)
all subjects surveyed		115/40.4%	25/8.8%	7/2.5%
Sex	Males	79/64.2% [5]	20/16.2%	5/4.0%
	Females	36/22.2% [6]	5/3.1%	2/1.2%

Socio-demographic characteristic		Child abuse - ridicule, embarrassing, humiliating, excessive criticism and blaming own children (frequency)		
		seldom (number/%)	frequently (number /%)	very frequently (number /%)
Age	from 25 years of age	15/37.5%	3/7.5%	-
	26 - 35 years of age	20/33.3%	8/13.3%	-
	36 - 45 years of age	22/36.7%	6/10.0%	-
	46 - 55 years of age	25/39.7%	4/6.3%	2/3.2%
	56 - 65 years of age	11/34.4%	3/9.4%	4/12.5%
	above 65 years of age	15/50.0%	8/26.7%	1/3.3%
Education level	Basic	24/60.0% [1]	3/7.5%	-
	Basic vocational	20/54.1%	6/16.2%	-
	Vocational	24/68.6% [1]	2/5.7%	-
	General secondary	11/24.4%	4/8.9%	2/4.4%
	Post-secondary	15/25.4% [2]	4/6.8%	3/5.1%
	Bachelors	14/35.9%	4/10.2%	2/5.1%
	Masters	7/23.3%	2/6.7%	-
Age of own children	from 3 years of age	11/36.7%	2/6.7%	-
	4 - 6 years of age	15/35.7%	4/9.5%	1/2.4%
	7 - 12 years of age	22/55.0%	5/12.5%	-
	13 - 15 years of age	23/54.8%	5/11.9%	-
	16 - 18 years of age	13/28.3%	10/21.7%	-
	19 - 26 years of age	6/15.0%	8/20.0%	3/7.5%
	above 26 years of age	6/13.3%	10/22.2	3/6.7%

#1# do #2# : p <0.05 ; #5# do #6# : p <0.001

significant impact on the frequency of child abuse either. According to the research results, only subjects with basic or vocational education level employed child abuse towards own children statistically significantly more frequently than subjects with post-secondary level of education.

Discussion

Child abuse is a socio-psychological phenomenon of diverse origin which is not only narrowed down to such social groups as family, but is also derived from society and culture. Domestic abuse is a result of numerous interacting criteria. In the USA, the percentage of abused or neglected children is 4.5%. In Europe it is slightly lower and ranges from 0.1 to 0.5%. The lowest percentage of child abuse cases is in Scandinavian countries – 0.1%, but in Great Britain it is 0.4%. In Australia, the percentage of abused children aged from 0 to 16 years is 0.5% [3,8,9,10]. In many countries child abuse is becoming more and more frequently noticed and starts to be considered a social issue, which in turn promotes scientific research aiming to prevent escalation of the problem. Poland does not have a long tradition and experience in solving this problem. The lack of common interest in child abuse in general induced the authors to undertake the presented study.

A staggering percent of study subjects (51.6%) claimed to have ridiculed, embarrassed, humiliated, excessively criticized and blamed their own children. Every tenth subject surveyed claimed to have frequently or very frequently abused his/her own child. Among subjects surveyed by us, males statistically more frequently than women abused their own children. This concerns only seldom cases of child abuse. In frequent or very frequent cases of child abuse, the sex of the parent was of no significance. According to the research results, parents aged under 65 years employed child abuse with a similar frequency. Parents above the age of 65 years employed such types of child abuse as ridicule, embarrassing, humiliating, excessive criticism and blaming their own children statistically significantly more frequently. The authors were surprised to find out that the education level of parents does not have a significant impact on employing child abuse. Basic, basic vocational and vocational education levels were exceptions. Parents with basic, basic vocational or vocational level of education statistically significantly more frequently employed

ridicule, embarrassing, humiliating, excessive criticism and blaming towards their own children. Our research results also proved that the age of the abused child did not have any significant impact on the frequency of cases of child abuse.

Similar research results were presented in the report by Bogunia and Gutekunst [11], who in the 1980s reported on values of certain educational methods in parents' opinion as well as on their preferences towards employing certain punishments and awards in children's upbringing. It turned out back then that the most common manifestation of aggression was slapping. The authors will report on the subject of physical abuse separately. In the presented report, the authors focused on psychological abuse. The authors found out that parents are seldom interviewed on the issue of ridicule, embarrassing, humiliating, excessive criticism and blaming their own children and assumed that the phenomenon of psychological abuse is progressing. If such activities as admonishing and reprimanding or banning are considered to be a type of psychological child abuse, then according to Bogunia, admonishing and reprimanding are employed by 12% of parents and banning is employed by 38% of parents [11]. However, the methods applied in the presented report are different from those in the report by Bogunia and Gutekunst [11], which makes the comparison of the results impossible. The authors understand that in order to define the nature of the problem of child abuse and its intensity, a large-scale research on numerous groups of subjects without any selection is needed [12,13]. That is why the authors consider this report to be just a contribution to a general discussion on the issue of child abuse.

Conclusions

1) It was proved that 51.6% of subjects ridiculed, embarrassed, humiliated, excessively criticized and blamed their own children. Every tenth subject surveyed claimed to have frequently or very frequently abused his/her own child.
2) Male subjects statistically more frequently abused their own children than female subjects.
3) Subjects aged under 65 years employed child abuse with a similar frequency. Subjects above age of 65 years employed such kinds of child abuse as ridicule, embarrassing, humiliating, excessive criticism and blaming their own children statistically significantly more frequently.
4) Education level of the study subjects did not have any statistically significant impact on employing child abuse, with the exception of subjects with basic, basic vocational or vocational education level, who statistically significantly more frequently employed child abuse towards their own children.
5) Age of the abused child did not have any statistically significant impact on the frequency of abuse.

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Catastrophe medicine as domain of scientific system

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Received: 2011.12.20 **Accepted:** 2012.03.01 **Published:** 2012.03.27

Summary:

The present article concerns civilization requirements for preventing catastrophes and their consequences. Notions such as rescue acquire particular meaning under extraordinary (special) circumstances evoked by both natural causes (floods, hurricanes, earthquakes) as well as by the effects of technological development.
In time, medicine of catastrophe supported by various areas of science such as strategic management, studies in probability and all kinds of environmental engineering, etc. became an important domain of scientific system.
In 1973 in Mainz it was brought to life under the auspices of the United Nations . Therefore, it became necessary to elucidate the concept of a catastrophe as not everyone realizes the difference between a catastrophe, an incident or even a mass incident. This article attempts to present a systematic review of all levels and types of catastrophes as well as their consequences.
Clearing out the effects of a catastrophe becomes an important moment in its management as it involves accumulation of resources – equipment, technical support and human skills.

Key words: catastrophe medicine, scientific system.

The history of humanity and cultural progress always put a human within a system of clashing adverse circumstances, opportunities for functioning, existence. Civilization of the beginning of 21st century put the idea of catastrophe at the center of perception of the phenomena that accompanied the man in his development. In a way, it spread a shadow over the problem of safety of mankind and situation of man entangled in the variety of, unfavorable at times, issues.

Medical aid, which for ages had been applying a model of rationality, not to say a discourse, developed a domain of dynamic, immediate interventions. It is accompanied by extended resources and forces supporting its structures.

Without them there would be no rationale for its existence and it would not be able to produce the desired results. It is still questionable whether we are dealing with emergency medicine, accident medicine or "catastrophe medicine".

Etymology of the words „rescue" or „rescuer" has a broader temporal meaning than the notion of catastrophe. The former is associated with all forms of bringing aid in various situations – "sudden incidents posing threat to life and well-being"[1]. The suddenness of incidents was augmented by various causes not

always treated as catastrophes. The concept of an incident was always associated with specific dramaturgy of events and involved one or more people. Its consequences were related to detrimental effects of destruction of property, injury to one's body and often to deadly outcome. The sequence of events in an incident was always quite rational, it could be distinctly defined and directly or indirectly prevented.

Scientific and technological development augmented the resources offered by the modern thought, substantially changed the face of the world, man's environment and his contribution to a broadly defined culture. The surrounding nature as well as the perception of a man exploiting it also changed. The notion of "catastrophe" emerged from actions that allowed it to reach the state of reprehensible devastation and is defined as an unpredictable, sudden event, extent of which is difficult to determine.

The state of disaster is often equaled with the state of calamity as these kinds of events are usually associated with massive tragic consequences. Rising threat to human life and health most often reaches an enormous dimension.

Extraordinary frequency and magnitudes of natural disasters often caused by human activity led to an increase in the number of casualties that is unprecedented in history. Wars, defined as deliberate, multi-dimensional and massive destruction that with time reached a global scale, are effects of human activity. The nature of modern civilization contributed to broadening of the concept of war as a small group of people may destroy any living force with great effectiveness. Naturally, it applies to terrorism which nowadays assumed a global level and became the most important problem of the modern world and humanity. Its effects force us to widen the broadly defined medical aid outside the broadly specialized group of medical workers, i.e. doctors, nurses and associated technical personnel.

All of these occupations situated within social structures more than ever are exposed to an increased level of risk. At the present time it assumed a cultural dimension therefore, the burden of medical aid falls on professions that until now dealt with removing material effects of various incidents and disasters. On the other hand, functioning of medical personnel becomes specialized in a broader aspect and imposes integrated actions with other emergency services (fire department, law enforcement). Until now, such an integration was known in military medicine, although it is difficult to say whether it was as multidimensional in structure. The entire medical personnel was obliged to focus on medical issues associated with distribution of aid in case of massive damage of an unpredictable diversity. Therefore, the scope of knowledge in this area should be constantly broadened.

Currently, there is a need for effective actions on part of these services under catastrophic conditions, bordering on wars, associated with an unpredictable diversity of accompanying circumstances. In order to protect the humanity from harm and to eliminate unwanted effects related to them, a resolution was adopted during the 51st session of the Economic and Social Council (ECOSOC) of the United Nations regarding worldwide aid in catastrophes, emergencies, collisions and natural disasters.

As a consequence, during the International Symposium on Catastrophe Medicine in 1973 in Mainz, a new field of medicine was called to life – Catastrophe Medicine. Its main goals focus on problems related to its functioning during catastrophic events as well as trainings to exert effective actions on large populations under conditions of unanticipated disasters.

Poland and other countries worked on problems connected to broadly defined catastrophe medicine as a continuance of ideas formulated in Mainz and during subsequent scientific congresses in the following years. Beside a broad range of dissertations, associated issues were introduced in practice.

Medical aid to the casualties of mass disasters encompassed by "catastrophe and emergency medicine" is defined as ensuring survival of the greatest possible number of victims and using scarce resources to mitigate further threats to their lives and well-being. It also involves the responsibility to evaluate, assort and select

casualties according to the urgency of their needs and ensure transportation.

An essential objective of catastrophe medicine is teaching skills for providing medical aid to the victims (injured, ill, disabled) in various conditions, with limited resources and health care supplies. As "various conditions" one should regard extraordinary, even primitive circumstances determined by the pressure of time. These are usually irreversible situations that require rapid and firm decisions. There is obviously a wide range of situations that are difficult to anticipate and are associated with great risk.

Therefore, catastrophe medicine offers knowledge and prophylactic actions that should be applied when the number of fatalities or victims exceeds the resources offered by classical medicine under normal circumstances. An incident should not always be associated with a catastrophe. However, it becomes similar to a model of catastrophe when the needs of rescue workers surpass the means and supplies at a disposal of health care at that particular time.

Observation of the conditions and state of civilization in the 70's of the previous century led to development of catastrophe and emergency medicine. This independent field of medicine collaborates with other medical disciplines. It also benefits from various areas of crisis management by employing their achievements, scientific methodologies and strategies in its own operation. Therefore, it must rely on wide-range systemic research.

Military medicine is closely related to the goals and roles of catastrophe medicine. Therefore, there is a close co-operation between those two fields, especially when it comes to the organization of military health care system. Methods of securing military forces with medical care during combat operations as well as assignments, schemes and organizational structures of military health care are closely associated with catastrophe and emergency medicine.

Medical aspects of catastrophes and emergencies as well as military health care differ from other medical fields. The latter are holding on to the principles of medical deontology and promote classical doctor-patient relationship. Catastrophe medicine and fields related to it (such as some forms of military medicine) are accompanied by psychological shock. For a doctor it is associated with treating a patient in difficult conditions away from hospital, hindering the process of establishing a relationship, stating a diagnosis, etc.

This area of medicine is often associated with the necessity of saving those who are more likely to survive first. Those with poor prognosis should be provided with appropriate humanitarian care. It may be concluded that the main purpose of catastrophe and emergency medicine is to reduce mortality, morbidity and after-effects of injuries in all disastrous states involving massive losses.

Descriptions and taxonomy of catastrophes

When describing the idea of a catastrophe one must not assume that it is simply an accident on a larger scale, just like a regular car is not a type of truck.

Etymologically, the word "catastrophe" comes from a Latin word "astrum," meaning "a star." It implies that a given extraordinary event is caused by an irregular or unusual position of the stars.

Literature on the matter contains many definitions of a catastrophe. Generally, we call it any local or regional event that disrupts normal functioning of a local community and poses a threat to the lives, health and property of the residents [1].

From a semantic point of view, the word "catastrophe" is described as "a sudden, usually unanticipated event of a mechanical, chemical, geophysical or meteorological nature, carrying tragic and extensive consequences, leading to large losses as well as fatalities." [2]

On the other hand, the penal code states that we may speak of a catastrophe when an event results in considerable destruction of property or harm to people. Such an event must involve at least bodily injury to several people or considerable damage to property. The degree of

bodily injuries is of no significance here. They may be light, as described in article 157 of the Penal Code. Damage to property is regarded considerable when its value exceeds over 200-fold the amount of minimal monthly salary [2].

In medical rescue terminology, "catastrophe" is an extraordinary event resulting in a significant number of casualties and extensive ecological effects, which cannot be managed with available resources and requires outside help [1].

There are fundamental differences between a catastrophe, an incident and a mass incident.

An incident is a limited event, which can be managed with available resources. However, a mass incident is any event involving a number of casualties sufficient to disrupt normal functioning of medical rescue services and hospitals. Such occurrence encompasses small areas and does not pose a threat to a large number of residents. While developing organizational structure and management of such situations we have to employ principles, which could be also applied in case of a mass incident as well as catastrophe.

Classification and nature of catastrophes

There are many classifications of catastrophes. The most popular one divides catastrophes into natural ones – such as floods and hurricanes – and "human," i.e. caused by a man – collapsing of buildings, plane crashes, train derailment, etc. A more exact classification is presented below:

1) Natural disasters (water, earth, fire, air)
   - earthquakes and floods comprise 80% of all natural disasters,
   - floods (high wave), breaching of levees, rapid tides,
   - avalanches, landslides, volcanoes,
   - fires,
   - hurricanes, typhoons,
   - drought.

2) Catastrophes caused by people
   a) wars
      - with the use of classical weapons,
      - with the use of weapons of mass destruction (nuclear, chemical, biological wars)
   b) civilization-related catastrophes
      - communications: - mass collisions on the freeways,
      - train crashes,
      - plane crashes,
      - ship sinking.
   c) industrial and construction:
      - explosions,
      - leakage of poisonous substances,
      - radiation,
      - collapses.
   d) great fires:
      - shopping malls,
      - schools,
      - hospitals,
      - skyscrapers.

3) Secondary effects of catastrophes – hunger, infectious diseases, epidemics. Epizootics, damage to natural environment.

An alternative classification of catastrophes had been functioning for some time, which seems to be more useful for planning of necessary measures to be undertaken at the very beginning of their occurrence. It refers to the types of injuries sustained by the victims. Therefore, one may speak of:

- a "surgical" catastrophe, during which the victims suffer from injuries caused by a mechanical factor, burns or gunshot wounds,
- general medical catastrophe involving general injuries that do not require surgical attention.

There are also toxicological, epidemiological catastrophes, etc.

Information regarding the type of catastrophe contributes to better preparation of hospitals providing medical care to the injured

Classification according to the degree of involvement of medical and logistic resources seems to be particularly useful in the structure of management system.

Three stages may be distinguished in this classification:

1) **Stage I** – local medical and logistic resources are sufficient for management of catastrophe as soon as the response plan is implemented.
2) **Stage II** – local medical and logistic resources

are insufficient and help from neighboring regions is required.
3) **Stage III** – local and neighboring rescue services are overwhelmed and crisis management requires help from regional and national resources.

Planning and training programs always have to involve quick classification of events into one of those three stages. If a disaster is classified higher than stage I, one has to take into consideration the time and effort required to obtain help from the outside.

The following three possibilities are important considering the nature of catastrophes:

- disaster occurs in the neighboring region and local services may be asked for help,
- disaster occurs within the area of operation of local rescue services – this is a typical scenario for which the management plans are prepared,
- disaster involves a body of rescue service.

A local catastrophe results in destruction of equipment and facilities (e.g. flood damaging a hospital, fire station, school, etc.). There is also a possibility that a disaster involves the Emergency Call Center. Such scenarios are usually not taken into consideration, but should not be forgotten or one should not exclude the possibility of their occurrence. Various events rescue services had to face in the past emphasized this issue.

Stages of disaster management should be mentioned at this point.

1) These are:
   - activation stage
   - implementation stage
   - restoration of previous state.

2) Activation stage involves:
   - mobilization and early response,
   - organization of the command and evaluation of the scene of an event.

3) Implementation stage involves:
   - search for victims and providing aid,
   - collection of the injured, selection, stabilization and transport,
   - management at the scene.

4) Stage of restoration of previous state involves:
   - departure from the scene,
   - return to minimal actions,
   - filing a report.
   - For planning purposes, reaction (response) to a disaster may be divided chronologically into a series of subsequent events, during which services undertake appropriate response actions.

In their activities, doctors usually focus on functions relating directly to saving health and lives of the victims. However, knowledge of organizational and management issues is required for planning and training in preparation for catastrophes. Fire brigades of the State Fire Service, police, ambulance teams, hospitals, non-governmental rescue services, power engineering teams, telecommunications companies, communal services, representatives of local and central government, etc. participate in overcoming the effects of disastrous events.

Stage II and stage III catastrophes require involvement of above mentioned teams from other regions. That necessitates an inclusion in the management plan rules for command, cooperation between units and entities working in different hazardous areas on local, regional and state levels.

Regrettably, there is a common drawback of disaster-management training relating to the fact that it is conducted within the frames of rescue services without involvement of public services, leading to great chaos and confusion in case of a true catastrophe.

Proper training program should be conducted in cooperation with those services so that the personnel becomes acquainted and learns about each other's capabilities. For example, one of such scenarios could involve a plane or helicopter crash in a distant region requiring use of bulldozers to make way to the scene of the event. That would allow to make an assessment of how quickly the Office of Public Works can supply the necessary specialized heavy equipment. Emergency medicine specialists should view the problem of public safety in a face of sudden and extraordinary dangers as a whole in the systemic context. Medical rescue should not be compared to providing emergency medical

care in hospital, but treated as a separate entity encompassing various structures. Continuous assessment of threats and prophylactic measures should be considered as well.

Disaster rescue is not an individual service, but results from co-operation of law enforcement, technical, medical and administrative units. The medical aspect is just a small, although important part of the whole problem. Doctors and other medical professionals are helpless if they are not provided with an access to the victims, places suitable for treatment and if this access is not sustained. According to the definition, during mass incidents and catastrophes there is a disproportion between demand for aid and the means of providing it, between the necessity and the possibility. In such conditions aid is a combination of organization and improvisation.

The better it is prepared, the less room there is for improvisation and disorder in the first hours of the event. All of these problems are subjects of interest for catastrophe medicine. Synchronization of actions between various services and social factors becomes a necessary factor. Intense education conducted in local communities about appropriate local and regional structures is supposed to ensure good teamwork with its advantages.

The following are the components of catastrophe medicine:

- medical aid,
- management of resources and supplies,
- sanitary and epidemiological safety,
- logistics,
- psychological aspects of rescue missions,
- secondary effects,
- continuous education of the medical personnel.

The following constitute medical aid in the context of catastrophe medicine:

- anesthetics,
- surgery,
- internal medicine and toxicology,
- gynecology,
- pediatrics,
- psychiatry,
- radiology.

The most important aspect of crisis response is management of optimal functioning of catastrophe medicine. It includes such elements as: planning, organizing, controlling. Logistics offers material basis and transportation facilities for catastrophe medicine and it provides: medical and technical supplies, food provisions, evacuation and communication. Secondary effects focus planning of medical actions on distant consequences of every disaster including infectious diseases, epizootics, plant diseases. Enormous technological installations, uncommon modes of transportation and communication in the neighborhood of large agglomerations carry the risks of various unforeseeable mishaps, effects of which assume the magnitudes of catastrophes. Handling of such tragedies requires multi-level, rationally conducted actions.

Chaos, surrounding to panic, lack of methodological distance may carry only detrimental effects. Another important effect of a disaster refers to the condition of people who nearly died in its course. Even if previously they were seemingly calm and non-aggressive, following sudden traumatic events they undergo a fundamental change. One may even say that they are different people than before. After many analyses it appears that such disorders are characteristic for people who survived plane, helicopter, car or train crashes, were tortured or sexually assaulted, experienced battery or death of a close one.

As a result, even people close to them cannot exert a calming effect on even strong personalities. This psychiatric condition is called PTSD2 and it affects soldiers who watched violent death during war as well as people who survived terrorist attacks. It also influences a large percentage of victims of severe traffic accidents. Policemen, firemen and rescue workers are also exposed to the risk of PTSD.

However, it should be added that, according to research analyses, PTSD is less common in people who experienced natural disasters not caused by human activity. The shock generated by the forces of nature is much easier to rationalize. Nowadays, the necessity of involving methods used in catastrophe medicine for managing various tragic situations became expedient – the rising of global terrorism with its detrimental

effects on a random individual requires that a whole society as well as smaller communities (cities, villages, regions) should prepare themselves for action. A kind of awareness, constant readiness to help, ability to work together in a society became indispensible. These features can be strengthened by a system of designed training programs and organization of exercises utilizing appropriate resources and supplies. This is an effective way of perpetuating the idea and scope of catastrophe medicine.

In the likelihood of various events it becomes an essential requirement for proper functioning of a society familiar with the values of its environment. This all must be accompanied by a broadly understood interdisciplinary knowledge contained within the scope of broadly understood general medicine, management and control supported by a decision-making process. Information is an important carrier for this complex system. It is a stream of data of particular importance. It is important due to the purpose it serves. Therefore, knowledge becomes a reserve of this information.

However, one should remember that there are limitations to knowledge among the elements structuring the system of catastrophe medicine. The main ones are: organizational culture and level of education, qualifications and composure within organizational structures of the system as well as in its environment. Acquired, established knowledge in this field allows for creating further possibilities and profits, but also for transforming and modifying the existing ones. It integrates technology, and technology is broadly understood as:

- equipment (technical),
- human skills (humanware),
- information on the properties and capabilities of the equipment (infoware),
- structures forming the frames of human activity (orgware).

Acknowledgements:

Original article previously published in the Polish language in *Wojskowa Farmacja i Medycyna*.

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Pharmacology & Pharmacy

Tablets for internal use solutions replenishing ion deficiency caused by dehydration

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Received: 2011.12.10 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Introduction: The provision of proper water and electrolyte metabolism for soldiers of Polish Armed Forces serving on foreign missions in tropical and subtropical climate countries is
a serious challenge for the widely understood nutritional, dietary and medical care. The problem of water and electrolyte deficiency may pose a serious threat to soldiers' health and lives, particularly in face of high physical activity in unfavorable climates. This fact served as an impulse for research and development work aimed at development of technology and production of soluble tablets which in field conditions, after dissolving in water, would form a drink with precisely defined electrolyte content and osmotic pressure, thus preventing the system from excessive hypovolemia and hypoionia. The obtained soluble tablets were subjected to quality control tests according to the pharmacopoeial standard.
Material and Methods: The formula was developed and uncoated tablets designed to dissolve were prepared. The tablets were subjected to quality control tests in the current pharmacopoeial standard.
Results: Two basic formulation compositions of soluble tablets were developed, two different disintegrating compounds: Vivastar type P and Vivasol were used. While maintaining the uniformity of the tablet mass, the material was characterized by a high coefficient of hygroscopy. The measured disintegration time (dissolution) of the tested tablets ranges from 4'31" to 6'14" minutes. The dissolution rate is much more affected by the tablet mass than the percentage share of the disintegrating substance proportional to the tablet mass.
Conclusions: Direct tableting technology of crystalloids after some modifications may form the basis of the manufacturing process of supplement tablets. The disintegration time (dissolution) of the tested tablets induces to undertake research on the development of effervescent supplement tablets.

Key words: soluble tablets, electrolytes, osmotic pressure, dehydration, hypovolemia, hypoionia.

1. Background

The problem of dehydration is a common problem related to human activity. Pathological dehydration may be caused by disease-related factors and occur as a result of diarrhea, vomiting or blood loss. However, dehydration occurs more commonly as a result of increased human activity, particularly during prolonged physical effort. This process may be intensified by climatic conditions (heat and low humidity). In such cases, loss of water is caused by excessive perspiration, which is the body's defense

against excessive heat. During intense physical effort, the amount of water lost with perspiration may reach up to 1.2 liters per hour [1].

The loss of water upon perspiration is always accompanied by a loss of electrolytes. A drop in the electrolyte levels is associated with their secretion with sweat, and the loss is directly proportional to the content of these electrolytes in sweat. The electrolyte content of sweat may be significantly different depending on factors that accompany perspiration. Thus, electrolyte supplementation is required during intense physical effort. The goal of this supplementation is to prevent complications due to stroke conditions. Of highest importance is probably replenishment of sodium and potassium, as well as chloride ions. Ion supplementation is required particularly upon long physical effort [2]. Sodium ions are excreted with sweat in largest amounts, and therefore should be supplemented first [3,4]. The average concentration of sodium ions in sweat is between 20 and 140 mEq/L [4-6]. In addition, secretion of sodium and chloride ions with sweat is higher during physical exercise compared to perspiration that is due only to heat [5].

One should note that supplementation of fluid deficiency caused by excessive perspiration with plain, electrolyte-free water may cause hypoionia, which seems to be particularly dangerous in relation to potassium ions and their effect on cardiac function. When determining the electrolyte composition of supplementation fluid one should remember that the quantity of potassium levels in sweat may be falsified by potassium ions being flushed off the skin [7]. Physical effort in hot conditions leads to the loss of higher amounts of water compared to electrolytes. This results in the increase in osmolarity and hypernatremia. Thus, electrolyte deficiencies should be supplemented using isotonic or slightly hypotonic fluids [8]. When determining the composition of the electrolyte deficiency supplementation fluid, one should also remember that addition of carbohydrates in the amount of ca. 5.5% is important due to their effect on the absorption of the fluid and reduction of the consequences of physical effort [9].

2. The goal of the study

As part of this study, an attempt was made to formulate a tablet for preparation of isotonic solutions in field conditions, which would provide the required supplementation of electrolytes lost upon excessive perspiration. The composition of the proposed tablets was established in an alternative manner based on average sweat composition determined from the literature and on the composition of a multielectrolyte isotonic fluid used for parenteral treatment of hypovolemia.

3. Reagents and equipment

List of reagents:

- double distilled water
- magnesium chloride · $6H_2O$ (POCh-Gliwice),
- potassium chloride (Lach-Ner-Czech Republic)
- calcium chloride anhydrous (POCh-Gliwice)
- sodium chloride (POCh-Gliwice)
- trisodium citrate · $2H_2O$ (Lach-Ner-Czech Republic)
- D-glucose (Lach-Ner-Czech Republic)
- sodium acetate anhydrous (POCh-Gliwice)
- zinc sulfate (POCh-Gliwice)
- iron chloride · $6H_2O$ (POCh-Gliwice)
- sodium dihydrogen sulfate (POCh-Gliwice)
- potassium iodide (POCh-Gliwice)
- sodium carbonate anhydrous (POCh-Gliwice)
- citric acid (POCh-Gliwice)
- sodium bicarbonate (POCh-Gliwice)
- disodium hydrogen phosphate · $2H_2O$ (POCh-Gliwice)

List of equipment:

- disintegration time meter – Erweka ZT 222;
- technical laboratory balance – Radwag;
- analytical laboratory balance – Radwag;
- pH-meter N-5170E with glass electrode ERH-131 – hydrometer.
- high-speed mixer – Erweka
- universal dryer – SUP-4, Sp. Met. Warsaw
- Oscillating tablet press – EK0 Erweka Korsch
- hardness meter – Erweka TBH 225D
- friabilator – F2, Erweka
- electronic caliper – Mitutoyo-Japan

4. Methodology of the experiments

The methodology of the study included the following elements:

1) establishing a formula and preparation of soluble tablets,
2) performing the following quality control tests according to the current Polish Pharmacopoeia VIIIth edition standard:
   - determination of tablet disintegration

(dissolution) time,
- hardness assessment
- abrasion resistance assessment,
- dosage accuracy assessment;

3) measurement of pH and conductivity of the solution formed after tablet dissolution,
4) statistical analysis of the obtained results.

5. Results and discussion

5.1. Establishing the formula and the technology of soluble tablet preparation

Two basic compositions of soluble tablets were developed, with two different disintegrating agents used so as to obtain variant disintegration/dissolution times: Vivastar type P (starch glycolate sodium salt) and Vivasol (croscarmellose sodium), thus forming four test series designated as Tablesol I and II and Tablestar I and II. The following tables present formulation compositions of the tested tablets and the proposed electrolyte composition of the fluid after dissolution of a tablet of particular series.

The biologically active substance provided for in the formula composition were homogenized on 0.5 mm sieve and mixed in a high-speed mixer. Disintegrants were added and the blend was mixed again. Tablets were pressed out of the tablet mass using an Erweka EK0 impact tablet press, aiming at obtaining the average mass as declared in the technological manual. Morphological parameters of tablets are listed in Table 5, while average tablet mass values are listed in Table 6.
The pressed material was characterized by high hygroscopicity, leading to problems with punch sticking during the tablet pressing process. However, the tablet mass was uniform, which translated into statistical distribution of tablet masses in the tested series. Slight statistical deviations from the average tablet mass are confirmed by the standard deviation and variability coefficient values. For proper industrial production of these tablets, production conditions typical for production of effervescent tablets would be appropriate.

5.2. Determination of tablet disintegration (dissolution) time

Determination of the disintegration time of pharmaceutical formulations is very important for the assessment of the quality of the obtained formulation. In cases of wrong formulations, e.g. misuse of excipients, the drug formulation would not undergo disintegration, thus preventing the active substance from being released. Measurement of disintegration time may serve as basis for conclusions regarding the way other quality control studies should be performed.

The disintegration (dissolution time) is the time, after which a tablet immersed in appropriate liquid undergoes disintegration or dissolution with no tablet particles remaining on a 2.0-mm mesh, except for the fragments of insoluble tablet shell. It is acceptable that soft mass containing no hard, not-moistened core is left on the mesh.

The tablets are placed in tubes, weighed down with rings (depending on tablet formulation) and immersed in a beaker containing appropriate liquid. The experiment time depends on the type of tablet. In line with pharmacopoeial requirements, tablets for solutions should be dissolved within not more than 3 minutes. For comparison, effervescing tablets must be dissolved within not more than 5 minutes (disintegration with gas production). pH and conductivity of the solution obtained after dissolution of a model tablet in water was measured. The results are listed in Tables 7-8 and summarized by statistical analysis.

The measured disintegration (dissolution) time of the studied tablet series was in the range of 4.31 to 6.14 minutes. A clear impact of disintegrant on the time of complete transfer of tablet contents into the solution may be observed. The mass of the tablet has a larger impact on the dissolution rate than the percentage content of disintegrant in proportion to the tablet mass.

Tablets of average masses of 2.7-2.8 g dissolve faster than tablets of masses of 4.0-4.2 g. The disintegration time of the obtained tablets as compared to the FP VIII standard encourages taking up studies on switching the production technology from soluble tablets to effervescent tablets or modifying the mass ratio of the disintegrant that facilitates dissolution.

Assessment of the mechanical strength of the tablets

One of the conditions required so that the tablets do not become damaged, crushed or

powdered during transport, storage and application is to maintain appropriate mechanical strength. In practice, quality control is achieved by the measurement of tablet hardness and resistance to abrasion. Pharmacopoeial abrasion measurement involves the assessment of percentage loss of tablet mass after the test compared to mass prior to the test. This loss should not exceed 1%. The tested tablets, despite good average hardness, were characterized by mass loss of 2.37 to 6.67%. This is due to the nearly 100% content of crystalloids in the tablet mass.

Conclusions

1) Tablets for preparation of isotonic solutions to supplement electrolytes lost in field conditions due to excessive perspiration are an example of innovative approach to the problem of hypovolemia.
2) The composition of the proposed tablets was established in an alternative manner based on average sweat composition determined from the literature and on the composition of a multielectrolyte isotonic fluid used for parenteral treatment of hypovolemia.
3) The technology of direct tableting of crystalloids may become, after some modifications, a basis for the supplementation tablet production process.
4) Disintegration (dissolution) time of the studied tablets encourages us to initiate studies to develop effervescent supplementation tablets.

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Emergency Medicine

Analysis of sustained injuries among children in Wieluń District

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Received: 2012.01.10 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Introduction. Injuries have been a global problem of medicine since the beginning of mankind. This particularly refers to the youngest individuals.
Aim of the work. The aim of this study was to analyze the injuries sustained in children, based on data from the Hospital Emergency Department at SP ZOZ Wieluń healthcare facility, which made it possible to find out more about this problem.
Material and methods. This analysis is based on data from medical records of the emergency service, surgical outpatient unit and emergency unit.
Results. The data were introduced into a spreadsheet and analysed quantitatively with correlations.
Discussion. A detailed analysis leads to a very important conclusion, i.e. the highest percentage of injuries among children occurred at school and at home, at places where in fact children should be taken care of by adults. **Conclusions**. Finding out more about the problem of injuries in children within a given area will enable individuals and institutions involved in the treatment and prevention to take targeted actions to improve the situation and reduce injury rates among children.

Key words: children, injuries in children, injuries.

Introduction

Injuries in children are one of the greatest problems of developed countries. Therefore, they cause more deaths in children than all other paediatric diseases in total. The data recorded by the Police Headquarters show that about 500 children are killed on the spot and nearly 10,000 are injured each year only in road accidents in Poland. Analyzing the data in terms of trimodal distribution of the time of death after injury shows that 50% of children are killed on the spot, while the overall number of deaths due to injuries caused during road events is 800 - 1,000 cases per year [6,12]. These figures are equivalent to the annual loss of population of 3-4 medium-sized schools.

It should be remembered that statistically, one fatal accident corresponds to dozens of new disabled individuals, hundreds of occupied hospital beds, several thousand visits to the admissions units and several months of inability to learn, which entails absenteeism of children's guardians at work. Taking into account a more detailed analysis, injuries usually result from: being hit by a car, knocking down of a cyclist and,

subsequently, injuries sustained by a passenger of the car involved in the accident. This group represents approximately 60% of all causes of injuries in children.

Others are due to falls from heights (trees, window, furniture), 25-30% of cases. We cannot forget those 10-15% of children who sustained injury at home. In this group burns, crushing and poisonings dominated. Therefore, knowledge of the circumstances and causes of injuries among children in a given area is an important element that makes it possible to create targeted prevention programs. Continuous decrease in the number of births should be a significant stimulus to actions aimed at reducing injury rates among children [1,3-5,10,14].

The statistics presented above led the authors to conduct a study on the number and characteristics of injuries that occurred in children in Wieluń city and district (province Łódź). In the commune of Wieluń there are the following schools: 12 primary schools, 4 lower secondary schools and 11 upper secondary schools. The calculations of the District Office of Wieluń, Faculty of Education, Culture, Sport and Tourism show that the total number of children living in this area is 14,376, out of whom 12,049 are children who receive their education at schools. Others are children of preschool age [9].

Aim of the work

The aim of this study was to analyze the following data: age and gender of children who sustained injuries, analysis of the location of injury, mechanism of injury, injury type and the range of activities performed by a witness on the spot.

Material and methods

The analysis of sustained injuries was based on data from the Independent Public Health Care Facility in Wieluń and Hospital Emergency Unit that operates at the hospital. Data collection was performed by entering codes in specially prepared cards from Surgery and Injury Outpatient Unit, admission area of the Hospital Emergency Unit, and cards used by Medical Rescue Teams while dealing with cases outside the hospital.

Results

The analysis of data from the Surgery and Injury Outpatient Unit included 1,652 cases seeking help. Out of the total number of admitted children, the largest group were boys, who constituted 1,048 cases. The remaining 604 cases were girls. When it comes to age, injuries dominated in the group of 14 year-olds (177 cases) and 16 year-olds (171 cases). The group of children at the age of 15, 12 and 13 years was similarly numerous (respectively 157, 152 and 149 cases). In all the described cases, blunt injury was the most popular (78.27%) in both boys and girls. Penetrating injuries constituted only 21.07% of all reports to the clinic. Particularly noteworthy is the analysis of the place and circumstances of injury, since in most cases the injury took place at home (33.72%) and school (33.17%), where children remain under adult supervision.

Public places (cinemas, swimming pools, shopping centres, etc.) and the street represented respectively 12.17% and 11.02% of cases. The mechanism that caused the highest number of injuries among children was one-level fall (1035 cases). Taking into account the location of the injury, which usually was secured in the clinic, the largest group were wounds of the upper limbs, followed by fractures of the upper limbs. The last element analysed by the authors was hypothetical determination of days on which the child should be excused from classes at the school with particular emphasis on physical education lessons. The obtained result amounts to a considerable number of 70 years.

The Hospital Emergency Unit has three medical rescue teams. Two of them work at the same unit, while the other one works at a sub-station located 23 km from Hospital Emergency Unit base. In the analysed group, these teams usually (75%) administered aid in the field to injured boys. The largest group among boys and girls were adolescents at the age of 18 (25.42%), 17 (22.03%) and 16 (11.56%) years. Other age groups constituted around 3% of all interventions. The team which reacted most often (61.86%) in all events was a resuscitation ambulance. It intervened most often in events which occurred in the streets of Wieluń (60.17%), while the second site of events was home (26.27%). In public places, injuries in children occurred in 8.17%.

The mechanism of injury causing 53.39% of all injuries was a communication event and, in 21.19% a fall. The foregoing material draws attention to the number of individuals that were under the influence of alcohol during the events, which could be a direct cause of their occurrence. This group included 15% of all children. The activities carried out by a medical rescue team on site were mostly the introduction of intravenous access (33.91%), dressing of the wound (23.56%) and immobilization of fracture (17.83%). In connection with injuries and accompanying pain, the teams administered mostly: Pyralginum inj. 1 g/2 ml (23.81%), Tramadoli hydrochloridum inj. 50 mg/ml (14.29%) and NaCl 0.9% 500 ml (14.20%). Other administered drugs included anti-oedematous medicines and sedatives in 2.5%. Most injuries were classified according to the code S 00, according to ICD - 10, as: S01, S09 in 39.59%. Other codes are associated with fractures of the upper and lower limbs.

After being provided with first aid, 68.64% of the injured children were referred and admitted to the paediatric surgery department. The remaining number of children was directed straight to the outpatient surgery and injury unit (21.19%), where after having the injury secured, they were referred for treatment in a regional outpatient facility. A small number of children remained in the observation unit for further diagnostics (8.47%), and 1.69% of children were sent to intensive medical care unit.

Like in the case of teams providing help in the field, in the emergency department most admissions concerned boys at the age of 18 years (60%), 17 years and 16 years (21.62%). Other age groups accounted for approximately 5% of cases. More than a half of children (57.43%) was transported by an emergency ambulance to the department, and about 42% reached hospital using their own transport (brought by the parents). The dominating injury in the children transported to the site was a blunt injury, both in boys and girls. Most of the injuries occurred in the street (35.81%) and at home (20.27%) as a result of a fall and road traffic injury - 39.86% and 37.84%, respectively. Many injuries resulted from violence against children (9.56%).

Very important for the authors was the information concerning the presence of a witness and the fact whether he/she provided first aid. Unfortunately, in almost a half (47.97%) of all data collected, there was no information on the presence of a witness. According to the available analyses, in 25% of cases a witness was present during the occurrence of an injury, and in 27.03% the witness was absent. The steps taken by casual witnesses included attempts to stop bleeding (9.46%) and placing the injured person in a safe position (4.73% of cases). Children who were provided with help in the emergency department were intoxicated in 10.81% of cases, which was found on the basis of breath smell and observation of their behaviour. In most cases, injuries of the head and fractures in the upper limbs were diagnosed, dressed and treated (S00 - 38%, S01 - 29%).

Discussion

In the presented material, a group of children from Wieluń district was analyzed. The age of children who sustained various injuries ranged from 1 day to 18 years. The collected data and the analysis showed that injuries were most frequent in the population of boys. This was true both for surgery and injury outpatient unit, emergency unit and medical rescue teams. The age group which was admitted, diagnosed and treated most frequently were 17- and 18-year-olds, who in most cases were provided help in connection with head injury. Only the surgery and injury outpatient unit treated usually injuries of the limbs, and then wounds and fractures. The described injuries resulted most often from a single-level fall or road traffic accident. One very important problem observed in the study was the fact that most injuries took place at home and at school, i.e. places where the child should be the safest and remains under supervision of parents or other adults.

Another observation was a very small number of cases in which witnesses provided first aid at the scene. In merely 10% of situations, a witness provided help to the child in the form of bleeding control. This indicates little knowledge of our society on the principles of providing first aid. It was observed that in about 15% of cases, the child was under the influence of alcohol

while sustaining injury, which could be the direct cause of its occurrence.

Conclusions

According to the WHO's (World Health Organization), the promotion of security is a complex process of coordinated action at different administrative levels. It begins with local activities followed by regional, national and international actions. Those involved in the promotion of safety are not only people associated with the medical environment, but also different types of communities, workplaces, schools and NGOs. Their activities include all efforts, jointly established and implemented to modify structures, the environment and human attitudes related to security in a particular manner. In Western countries, various prevention programs targeted at selected groups, types of accidents, communities and age groups have been implemented in recent years. International experience shows that mono-disciplinary programs are not very effective. The need to integrate the activities of institutions involved in the promotion of safety at various administrative levels and regions was also demonstrated.

Only "massive" actions will result in the reduction of injury rates among children. However, one must bear in mind a very important fact, namely various specifics of injuries in particular regions of the country. Therefore, when taking any measures to improve general safety, one should know the situation in the area. This will enable creation of prevention programs with a wide range of possible implementation options. Effective policy in this area should be based on a wide scope of different preventive measures consistently applied in a coordinated manner for a long time. [2,7-8,11-13].

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Emergency Medicine

Hydrogel and hemostatic dressings in body injuries

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Received: 2012.02.18 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

A simple procedure of first aid for burns can be quickly carried out by an amateur, or any person providing first aid, allowing to stop the process of tissue damage by heat and causing a significant pain relief. After applying a hydrogel dressing to a burn wound, cooling of the wound starts (the heat is pulled out from the body to the gel). In case of cooling the patient's body with hydrogel burn dressings, a large loss of body temperature can be avoided in patients who require transport over long distances.

Uncontrolled hemorrhage remains a leading cause of traumatic death. Despite advances in medical intervention and protective equipment, fatal traumatic hemorrhage remains one of the most challenging problems for both military and civilian medicine. As a result, much attention has been focused on the development of alternative methods of controlling hemorrhage, including topical hemostatic dressings. Hemostatic dressing works by interacting directly with red blood cells and platelets to form a cross-linked barrier clot. There have also been concerns related to side effects, specifically thermal injury from the exothermic reaction, although documented occurrences are relatively rare.

Key words: burn, burn dressing, burn wound, hypothermia, hemorrhage, wound, dressing, clot, chitosan.

Thermal injuries of the skin can be substantially reduced by cooling the burned areas. One of the main effects of such a treatment is the inhibition of further and deeper penetration of the heat into the skin. Emergency procedures consist in eliminating the heat accumulated at a deeper level of the skin, by its 'pulling out' towards the surface, which allows for avoiding secondary injuries of these parts of the skin. If no cooling is applied, burn classified initially as a second-degree burn, turns into a third-degree burn, as a result of heat penetration. Shortly after cooling with hydrogel dressings, most of the patients report pain reduction. The anaesthetic effect after applying hydrogel dressings is a result of heat emission to the outside of tissues (which inhibits the penetration of the temperature into the body) and blocking of the release of substances that belong to tissue mediators (e.g. thromboxanes, prostaglandins, and leukotriens). Mediators (intermediating substances) are also a key element in developing the burn syndrome. Their release in high amounts leads to an increased permeability of the capillaries with formation of oedema and hypotension due to vasodilation which may lead to ARDS (acute respiratory distress syndrome).

The most popular burn dressings include hydrogel dressings, e.g. Water Jel – Burn Dressing (Fig. 1). Commercially available hydrogel dressings have a specific composition and properties.

Their matrix is a special gel produced by mixing 94% of demineralised sterile water with a gelling agent. Its consistency is similar to the one of a popular preparation Defi-Gel [1].

Figure 1: Hydrogel dressing – gel in the packet together with the dressing.

Table 1: Bacterial growth among 15 most common microorganisms after a contact with gel enriched with tea tree oil (modified according to Torsov in 1995).

Microorganisms	Bacterial growth after:		
	30 min	60 min	240 min
Staphylococcus aureus	+	+	negative
Streptococcus pyogenes	+	+	negative
Streptococcus agalactiae	+	+	negative
Streptococcus faecalis	+	+	negative
Escherichia coli	+	negative	negative
Klebsiella pneumoniae	+	negative	negative
Enterobacter cloacae	+	negative	negative
Serratia marcescens	+	negative	negative
Proteus vulgaris	+	negative	negative
Pseudomonas aeruginosa	+	negative	negative
Acinetobacter calcoaceticus	+	negative	negative
Clostridium perfringens	+	+	negative
Clostridium difficile	+	(+)	negative
Candida albicans	+	+	negative
Candida tropicalis	+	+	negative

Some of the hydrogel dressings include also natural oils with bacteriostatic properties (oil from tea tree). Their addition reduces the risk of infection of the burn wound, and disinfects the already infected wounds. The spectrum of action of the oil from tee tree includes 15 most common microorganisms [2] (Table 1).

The carrier material of the gel, used in hydrogel dressings, should be resistant to tearing and allow a simple application of the dressing on the wound. Water Jel dressings use a special knitted material made of polyester, highly resistant to tearing and allowing a simple application of the dressing on the burn. In dressings of large sizes, i.e. emergency blanket, the carrier material is sheep worsted wool, with properties that allow for carrying large amounts of gel on its surface. Due to that, such dressings are heavy and must be carried in special tubes allowing for their easy use, when needed. Other producers of dressings for burns usually use a carrier material made of polyurethane foam which is not as resistant as polyester. Another disadvantage is that any compression squeezes nearly the whole gel out of the dressing. As a result, a dry polyurethane foam covers the wound, and the gel is squeezed out onto the surface of the dressing. All dressings are sterile and packed in disposable packaging; some of the products are labeled with information on the percent of body surface that can be protected with the dressing, with a classification into adults and children. The most common size of the available dressings is: 5x15 cm (e.g. small burn wounds), 10x10 cm (e.g. hand), 10x40 cm (e.g. the upper or the lower limb), 20x45 cm (e.g. back or stomach), 20x55 cm (e.g. hand with protection of the burned fingers) and rescue blankets from 91x76 to 244x183 cm (Fig. 2).

Figure 2: Hydrogel dressing.

There are also special dressings for specific body parts, as in case of burn wounds of the face

causing problems with cooling; there is a special dressing in the form of a face mask, size 30x40 cm, allowing the protection of the injured ears, which often get burned as a result of the influence of such factors as high temperature in the region of the head (Fig. 3). The structure of this type of hydrogel dressing (properly placed openings for eyes, nose, and mouth) allows for using it in intubated patients as well [1].

Figure 3: Hydrogel face mask dressing.

Figure 6: . Application of a hydrogel dressing on a burned body area.

The most common and effective cooling system used in hydrogel dressings acts by collecting the heat from the skin surface and transferring it to the hydrogel layer (Fig. 4). The heat is transferred directly from the burn to the gel, by means of thermal conductivity. This leads to thermal dissipation over the whole surface of the gel, and thus the surface conducting the heat to the outside increases, which was marked with blue arrows in Fig. 5. The "buffering" effect of the gel layer allows for a faster and more effective heat removal directly from the burn wound, with a lower loss of heat of the adjacent tissues. As a result of this process, the temperature of the tissue under the burn wound is becoming much reduced, which in turn leads to a decrease in tissue damage, inhibition of burn spreading into the tissues and soothing effect on pain (Fig. 5). In the gel layer, the heat spreads – thermal convection, marked with yellow arrows in Fig. 5.

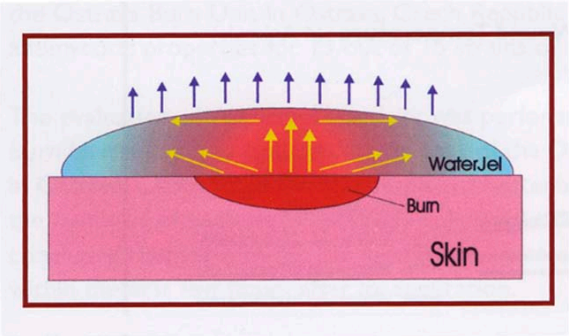

Figure 5: The principle of operation of the „Water Jel" system.

The most common cooling technique has so far been the use of cold (15-20°), preferably running water, for at least 15 minutes. The indication for water use is the fact that this is a factor quickly and effectively reducing the temperature of the skin subjected to heat damage. A major disadvantage of the traditional method (cold water) as the first aid in burn wounds is a high risk of local hypothermia, which can expand. The cooling time of up to 15 minutes is supposed to limit hypothermia and its expansion. This rule is not true for burned surface of more than 10%, because this situation requires large quantities of cold water. The use of large quantities of cold water as a cooling factor may lead to a sudden body temperature drop due to large amounts of heat being removed from the body in a manner difficult to control. Using water as a cooling factor requires also a free access to the cooling substance itself, which is often difficult to achieve in pre-hospital conditions. Apart from newborns and small children, there are also other groups of patients with an increased risk of hypothermia after the use of cold water as a method advised in first aid of burn wounds:

- Patients with extensive burns.
- Patients with burns of the back.
- Elderly patients
- Patients in the state of shock.
- Multiple injuries.

In case of these groups of patients, cooling of burns should be very careful, with constant monitoring of vital signs and body temperature. Cooling with hydrogel dressings allows for

hypothermia control by gradual thermal conduction from deeper layers towards the body surface, until stabilisation of the temperature at 36.6°C. Hypothermia is a common phenomenon in case of burns covering larger body surfaces and with longer times of heat conduction [3, 4].

Patients with burns in whom the body temperature decreases due to cooling to 30°C or less, should be protected at intensive care units. This fact has been observed by many physicians all over the world who deal with treating burns and it led to their questioning of the need to use the method of cooling with cold water as a means of first aid for burns. The risk of hypothermia and further health complications which may occur, cause an increased mortality among patients treated at burn units. The meaning of body temperature in the context of burn management was clearly stated in the data from studies conducted at burn treatment centres in the whole world. The studies showed that body temperature reduction by 1°C below 36.6°C on admission to hospital is the cause of increased mortality among patients by 43%.

There have been studies in which a series of measurements of body temperature were conducted in young and healthy individuals and in real cases – patients with burns, brought in by Emergency Medical Services, provided with hydrogel dressings [5]. The observations showed that using hydrogel dressings causes a gradual reduction in body temperature, up to 36.6°C, in burn casualties. The observed effect was also present in case of covering large body surfaces with a rescue blanket, with no hypothermia noticed in those patients (Table 2).

An indisputable advantage of hydrogel dressings is their long storage period, with expiry date of 5 years from the moment of production. The possibility of storing at -5 - +35°C. A long shelf life and a high amplitude of temperatures at which it can be stored allow for equipping the ambulances with these dressings. Owing to that, it is possible to act quickly and effectively at the site of occurrence and to fully secure the burned patients in pre-hospital conditions.

Despite advances in interventional medicine and protective equipment, massive haemorrhages caused by injuries remain one of the main causes

Table 2: Time of cooling the burn wound to the level of the body temperature, with the use of a hydrogel dressing.

Cooling time	Temperature in the burn wound
	Hydrogel dressings
Start	80.5 °C
after 30 seconds	78.4 °C
after 1 minute	71.2 °C
after 2 minutes	52.1 °C
after 3 minutes	44.7 °C
after 4 minutes	**36.6** °C

Figure 6: Different forms of haemostatic dressings

of death of such patients and thus one of the main challenges to the current civilian and military medicine. Uncontrolled bleedings are at present the cause of almost 50% of fatalities among soldiers, on the battlefield, before evacuation to hospital. Mortal haemorrhages due to injury are the cause of 80% of deaths among civilians (studies conducted on the territory of the USA).

The constantly increasing number of hostilities in hardly accessible areas and an increasing number of cases with the use of guns in civil conditions requires an effective protection of the haemorrhages as a part of the first aid (Fig. 5). In order to meet these requirements, our effort was focused on developing alternative methods of bleeding control, including special dressings for haemorrhage control. A few preparations have been developed which were mostly introduced for use on battlefields, in military conditions: a standard dressing containing chitosan (HemCon), powder dressing including zeolite (QuickClot) and dressing with granulated chitosan (Celox). The dressing with chitosan

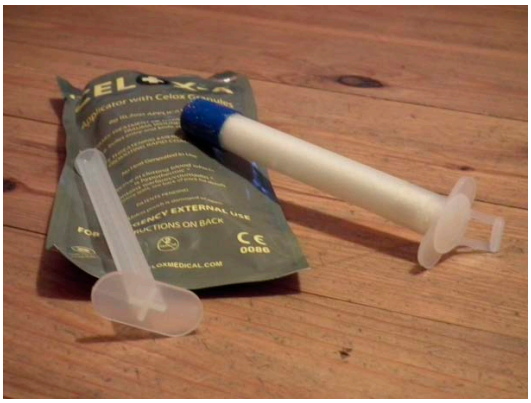

Figure 7: Haemostatic dressing with an applicator

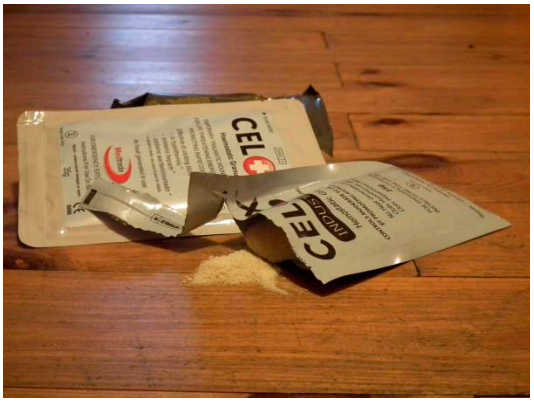

Figure 8: haemostatic powder

Figure 9: Haemostatic gauze.

is a quite rigid plate forming a mucoadhesive physical barrier at injury site. Zeolite is a hard granulate, quickly absorbing water from blood and concentrating natural coagulation factors at bleeding site. The dressing with granulated chitosan acts through a direct interaction with red blood cells and platelets, forming a cross-linked barrier clot, irrespective of the application conditions (irrespective of the blood clotting factors) [6, 7, 8].

Studies on the effectiveness of these agents show that some products have their adverse effects, especially heat injuries caused by exothermic reactions after using preparations from zeolite. However, documented cases of such injuries are infrequent. Preparations including granulated chitosan (Celox) bond to the surface of red blood cells and platelets and to produce a gel-like clot or plug without producing high energy (this is not an exothermic reaction). They work independently of the body's normal clotting mechanism and can hypothermic or even heparinised blood. An additional advantage of dressings with granulated chitosan (Celox) is the fact that they do not cause allergic reactions in the users. It is possible because chitosan is a natural polymer extracted from the shells of shrimp and is subjected to the process of deep purification (rafination) during which proteins causing potential allergic reactions are removed. Possible penetration of the granulate to the blood flow causes its biodegradation because chitosan is a natural polysaccharide (polymer consisting of sugars) under the influence of lysozyme (enzyme naturally occurring in the body) (Fig. 7, 8, 9).

Comparative parallel studies of Celox produced on the base of chitosan with two haemostatic agents commonly used in the military (HemCon and QuickClot) were conducted, with the use of a standard dressing from gauze. The experiments were conducted under conditions of a fatal wound with bleeding from groin in 48 adult pigs fed and prepared for surgery in standardised conditions.

It was decided to use the model of haemostatic study, which is the closest to the conditions of groin injury on a battlefield and procedures of first aid. The reason for recreating the groin wound was the current tendencies among injuries on the battlefield, where the majority of wounds includes the lower limb, especially in the region of groin, and the upper limb, in the region of groin. Some wounds are only superficial and can be easily controlled (limited) by a direct compression, application of a compression dressing or other conventional techniques of bleeding control. The greatest difficulties are connected with wounds with anatomical structure making it difficult to control bleeding. An example of such injuries is groin wound and thus it was decided to use such a wound in these studies.

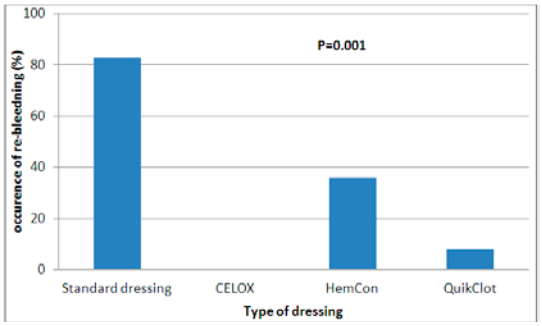

Figure 10: Percent of cases of re-bleeding during studies.

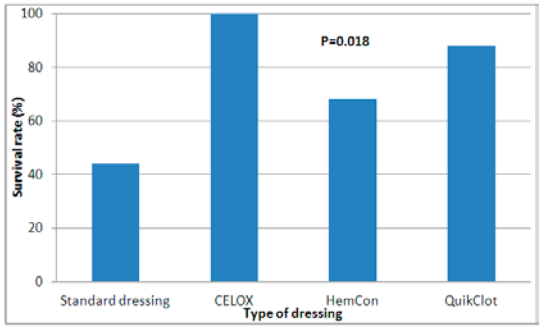

Figure 11: Survival rate for the whole study time.

Additionally, the adopted model was supposed to create a fatal bleeding wound with the fastest possible recreation of methods of first aid on the battlefield. It was decided to recreate a 3-minute bleeding, before protecting it, which reflects the realities of a fatal wound. There are no uniform data on the mean time until protection (the first aid) from the moment of bleeding onset, under the conditions of a battlefield. Adapting a 3-minute bleeding time allowed the researchers to reflect the time of waiting for the first aid team in battlefield conditions.

In the conducted study, the dressing with granulated chitosan (Celox) was performing similar to other dressings with chitosan. It did not produce any significant heat during application. The wound temperature was 37.2°C. Moreover, similarly to other dressings with chitosan, Celox was easy to remove. After coming into interaction with blood, it produces a soft, slightly viscous, gel-like mass, which can be easily removed with hand, without the use of tools. The remaining material can be easily washed off the wound by means of saline solution. One of the main advantages of this agent is the possibility to use it in the form of granulate. In some situations, non-exothermic dressing is very useful, which can easily adapt to the shape of the wound. In many aspects, Celox seems to be combining the advantages of HemCon and QuicClot, without revealing the disadvantages of those two. It was found that this agent is as effective as HemCon and QuickClot in controlling the bleeding, and this is the only dressing which significantly increases the survival rate as compared to a standard dressing from gauze.

A conclusion from observation was that the real reactional layer of Celox is only 1 mm thick. This ability helps in creating a capsule of unabsorbed preparation around a soft "dome" made of the agent bonded to blood. The remaining agent, not bonded to the wound, can be used again for controlling the next haemorrhage. The possibility of a "multiple use" allowing for potential control of re-bleeding is a feature of haemostatic agents, not possessed by the currently used agents.

In this study of objects treated with the use of HeHcon, there was a higher incidence of re-bleeding and a higher mortality than in case of Celox and QuickClot, and a lower incidence of re-bleeding and mortality than in case of a standard gauze. It was found that when used in accordance with its purpose, the haemostatic agent HemCon in the form of a layered plate was very effective, but in some situations this form was completely ineffective, with potential fatal results. The basic reason for such a wide range of effectiveness figures, is the physical form of that dressing. The use of HemCon was more difficult than of other materials. It seems to follow from the rigidity of the layered plate, applied to a narrow wound in conditions of a poor visibility of its contents.

In spite of the repeatability of the application method, the dressing did not always adhere to incised blood vessels. Instead of that, it adhered to the surrounding tissue. However, in case of a proper adherence to blood vessels, the application was effective. Difficulties with applying the HemCon dressing suggest that wide and flat wounds are be more appropriate than the deep and narrow ones, when the application follows the indications. No possibility of a universal use of the dressing may require more precise trainings. Generally, 8 out of 12 (67%) animals subjected to therapy with HemCon survived until the end of the study, but no statistically significant result was achieved, as compared to standard dressings from gauze.

The QuickClot dressing acts through exothermic reaction. This is the heat generated in the region of QuickClot application that causes problem of thermal damage to tissues of human organs as a result of increased body temperature, up to 61.0°C on average. The Z-Medica company developed a new composition of the preparation, which does not produce such an exothermic reaction any more. Studies on the new formula (preparation) have shown that it does not cause such thermal damage. According to the studies, the agent proved to be very effective; 11 of 12 (92%) animals survived the time of the study and one remaining case was connected with the occurrence of re-bleeding. The survival rate of animals treated with QuickClot (as compared to a standard dressing from gauze) was substantial ($p = 0.072$).

During autopsy of the mentioned fatal case, it was found that the majority of the preparation moved to a cavity in the tissue, running across the bundle of blood vessels; only a small amount of the agent was left in place, acting directly on the incised vessels. Although the dressing was applied in accordance with the manufacturer's instructions, the dislocation of the substance was a probable cause of death. The QuickClot preparation is mechanically relatively easy to use. However, it may require some additional training in order to make the right decision on its use, taking into consideration the risk of thermal damage.

It is commonly believed that early control of bleeding may limit the early and late mortality by reducing a substantial loss of blood, hypotension, coagulopathy, and abnormal metabolism or infections [9, 10]. The results of this study, conducted on a model of uncontrolled bleeding in pigs showed that Celox improved bleeding control and increases the survival rate. Celox is a preparation substantially increasing the possibility of managing severe bleeding owing to its easy application. It should be placed directly on the wound and then compressed. The wound should be pressed for a short time, in order to squeeze the granulated chitosan out into the wound and to stop blood outflow. During that time, Celox will form a clot and obtain an appropriate endurance.

The required time and compression force depend on the pressure of outflowing blood. In case of less severe wounds, it is enough to compress the dressing with a finger for a few seconds. In case of more severe wounds, it is advised to compress it strongly for 5 minutes, or as long as it is required by the circumstances. If the blood starts flowing again from the wound (and we are sure that Celox covers the whole surface of the wound), one should just hold pressure for a longer time, and when necessary, use additional amounts of Celox preparation. Owing to its properties and easy application, this dressing from granulated chitosan is close to a perfect haemostatic dressing.

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Catastrophe Medicine

Anticipated Threats on the Territory of Poland

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Received: 2011.01.12 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

The development of accident and emergency medicine is accompanied by the development of identifying and monitoring the ever growing number of threats, both human-dependent and natural, which are indentified more and more effectively. The "Atom Club" is growing, China has joined the "Star Wars" arms race, and stemming the increase of ecological and biological threats is producing diminishing returns. The authors reviewed the most important threats, focusing on the least known – those from the outer space – and also on attempts made to defend ourselves from them, like the "Don Quixote" programme. Another focal point is the effect of an electromagnetic impulse covering vast areas if a nuclear weapon is detonated in the ionosphere, a fact which has been kept secret so far. The most spectacular disasters of the last decades are discussed: earthquakes, tsunami waves, hurricanes and floods. The most powerful toxic substances, their labelling, classification and properties are also detailed. Other issues in the article include: radioactive contamination, INES scale (nuclear reactors' accidents), construction and transport disasters which, as the authors point out, occur mainly due to wrong decisions, irresponsibility and lack of imagination.

Key words: accident and emergency medicine, forces of nature (elements), terrorism, toxicology.

1. New threats

The development in accident and emergency medicine is accompanied by the development in identifying and monitoring the ever growing array of threats. A new threat can occur almost unnoticed by the public opinion. On 11 January 2007, for instance, China has successfully shot down its own satellite using an anti-ballistic missile launched from the ground. Hence, China has joined the "Stars Wars" club.

A hackers' attack on the Estonian government's computer systems in May this year, has made the public aware that a science-fiction scenario about cyber-terrorists and cyber-spies has started becoming a reality. The websites of the Ministry of Foreign Affairs and the Ministry of Justice, and many others, were completely blocked.

All forms of web reconnaissance, espionage or sabotage have been experienced by government agencies responsible for the safety of the web in the USA, Japan, Taiwan, the UK and France. New means of terrorist attacks have been noticed, i.e. dioxins and polonium. The threat of new genetically modified biological agents being created and then used by all

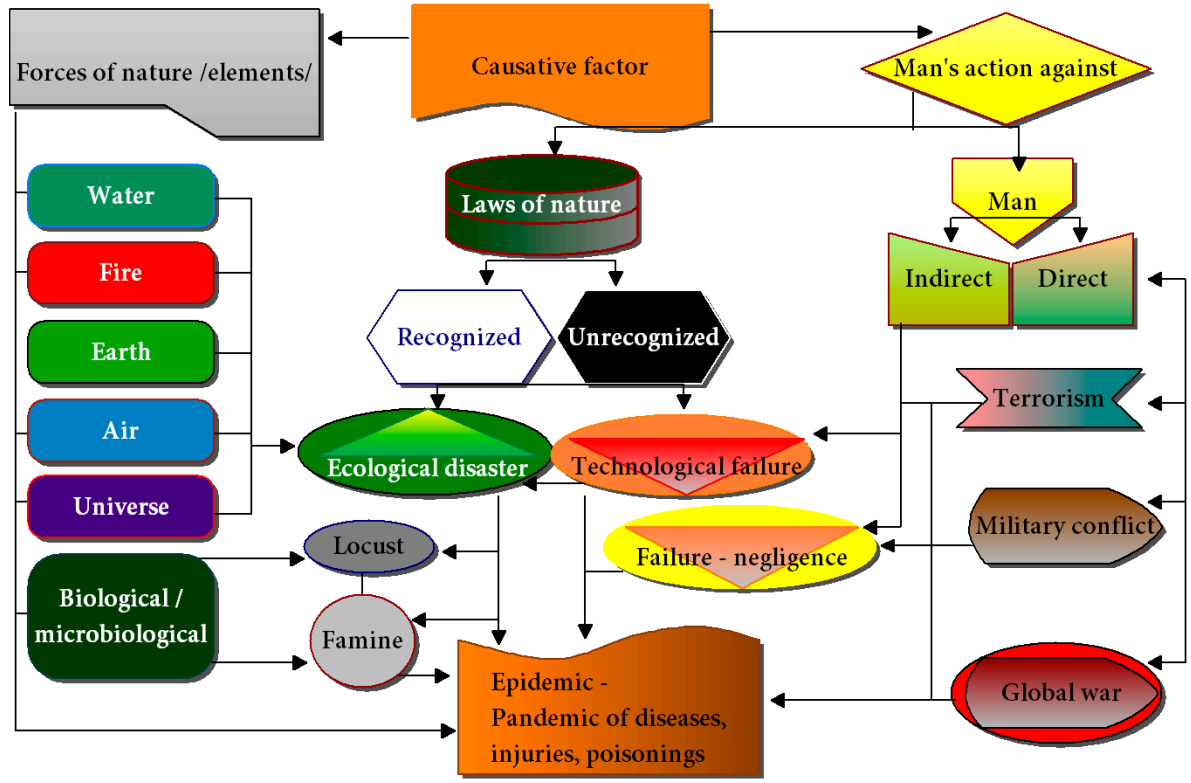

Figure 1: Classification of disasters.

sorts of madmen (like the Aum Shinrikyo cult, also "Supreme Truth") is still growing.

2. Electromagnetic Impulse (EMI)

An electromagnetic impulse being a result of a thermonuclear explosion in the upper parts of ionosphere can damage the power, telephone and Internet, transistors and microprocessors – all the modern civilization – on an area covering millions of square kilometres.

In July 1962, 400 km above a lonely island of Johnston on the Pacific Ocean, 1300 km from the Hawaiian Archipelago, an American nuclear head exploded with the power of 1.4 megatons of TNT. As a result of the explosion, the Compton effect occurred generating an electromagnetic impulse, which spread as far as 1500 nautical miles. The power grid shut down on the whole Hawaiian Archipelago; in Honolulu, automatic sprinklers turned on, soaking the textile storehouses. The cause was immediately classified as secret information. In the American movie "The Day After" – after a nuclear war – there was a scene with a motorcycle (of the main character) whose engine suddenly stopped, and long lines of other vehicles on the highway, brought to a standstill. It was not explained that it was all the effect of the EMI which preceded the attack of Soviet ballistic missiles. After neutralizing the anti-ballistic systems, the rockets could reach their targets undisturbed. The authors did not take into consideration the fact that anti-ballistic Command Centres can be made immune to EMI, though it is extremely expensive because, for example, it requires installing optical fibres immunized by a stream of fast electrons from a nuclear accelerator.

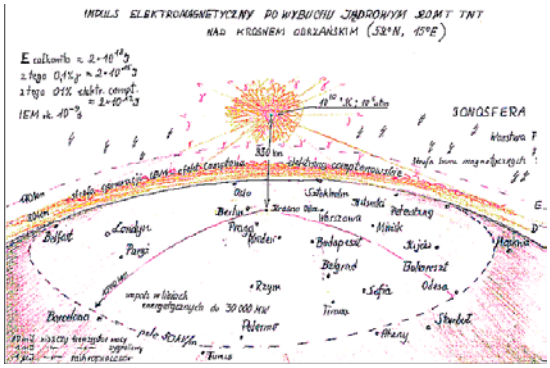

Figure 2: The range of an electromagnetic impulse after a nuclear explosion.

In case of a nuclear explosion equal to 20 megatons of TNT in the centre of Europe, for instance 350 km above Krosno Odrzańskie city (52 N, 15 E), the electronic systems and devices (e.g.

watches) and the power grid would be damaged from Belfast (54 N, 6 W) to Odessa (46 N, 31 E) and from Barcelona (41 N, 2 E) to St. Petersburg (60 N, 30E). Of course, all the supply chains and the healthcare system on this area would become completely disorganized.

3. Earth's Defence – threats from the outer space

Between 16 and 22 July 1994, the Hubble telescope orbiting the Earth and radio telescopes and telescopes on the ground were pointed at Jupiter, to which the Shoemaker-Levy 9 comet was heading. The comet was detected the previous year (cat. No. 1993 e) after it fell apart to 23 pieces, having diameters ranging from 1 to 3 km. The first piece, marked with letter A, having a diameter of 1 km, gave out the amount of energy equal to 225 000 tons of TNT on impact with the planet and the ball of fire reached the height of 1000 km above the planet's surface. The biggest piece – G – 3 km in diameter, caused an explosion equal to detonating 6 million one-megaton bombs, which is 6 000 times more than the combined power of the nuclear arsenal on Earth.

If our planet was at risk of a similar event, the astronomers penetrating the solar system would find out about it only about 10 months before the happening. It would be too late for defence – bearing in mind present technological capabilities.

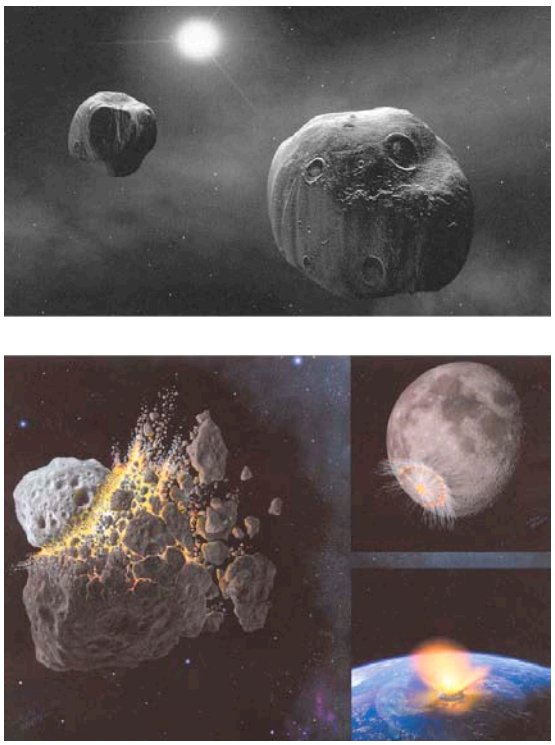

Figure 3: A catastrophic collision of asteroids.
Wiedza i Życie , paźdz. , 2007

A super-accurate rocket loaded with hundreds of megatons of TNT would reach the orbit of Mars at best. Even if it did break the comet apart, its fragments could still hit Earth. The further the distance, the less energy is required to change the trajectory and various scenarios of effective actions are possible.

Only in the previous century over one hundred non-periodic comets were discovered; comets which are unpredictable, with a parabolic or close to parabolic orbit, such as Shoemaker-Levy 9 and because of unknown reasons they enter the solar system or leave the Oort cloud located about one light year from the Sun. As a result of numerous collisions, planetoids (there are hundreds of them on the outskirts of the solar system) are knocked out of the Kuiper belt and start their long journey changing their trajectories many times, eventually hitting the Sun after 10 to 100 million years.

More than 400 000 asteroids (planetoids) are on the orbits between Mars and Jupiter. The orbits of some of them intersect with the Earth's orbit, e.g. Apollo, Icarus, Hermes with diameters between 0.5 and 1.5 km and the biggest – Eros – with a diameter of 22 km. Fortunately, they do not pose a threat to Earth in the upcoming centuries. The cataloguing of these objects, calculating orbits and the probability of threats have been carried out for more than a dozen years. The first stage finished in 2008 by cataloguing 90% of objects with a diameter equal to or higher than 1 km. The second stage will take another 20 years and will result in cataloguing 90% of objects with a diameter of more than 140 m. The European Space Agency is preparing the "Don Quixote" mission, which is aimed at changing the trajectory of a 500-metre planetoid by hitting it with the Hidalgo space probe travelling at the speed of 10 km/s. A probe named "Sancho" will serve as an observer.

It is assumed that a 20-metre-diameter asteroid was the cause of an explosion in 1908, which took place on an altitude of about 4500 m above the taiga in the region of Podkamiennaja Tunguska river and knocked down trees on an area of 3000 m2. The power of the explosion was estimated to be equal to 1 500 nuclear bombs of the same type

as the one dropped on Hiroshima. Four hours later, St. Petersburg would have been in the same place on the trajectory. Today 5 million people inhabit that region.

Only 29% of our planet's surface are lands, of which 4% is uninhabited; on the remainder surface, the population density is over 3 people/km2. Most of the unwanted guests from outer space hit the oceans and uninhabited areas. Every day about 100 tons of interplanetary matter falls on Earth – dust and small particles – most of which is unnoticed by us.

We can notice with peaceful serenity that during this lecture we have come closer to the Magellanic Clouds by approximately 150 000 km and that in a few million years there will be a collision of that galaxy with our galaxy, and that this sky and Earth will most likely cease to exist.

4. Forces of Nature on Earth

When we return to Earth, we can conclude that forces of nature are difficult to harness and often unpredictable. By causing threat suddenly, they leave us little time for an effective preventive action or rescue efforts. Let us take Tsunami for example. On Sunday morning 26 December 2004 it turned an idyllic holiday on paradise islands into hell. It was the last day of life for 140 thousand people.

4.1. Tsunami

Tsunami is a name devised by the Japanese to describe an enormous wave on the Pacific Ocean – a result of underground earthquakes and volcano eruptions. Tsunami can also be caused by an underwater nuclear explosion or an impact of an asteroid on the ocean. That kind of wave is fairly short on an open ocean (1-2 m) but its width is a few to ten or so kilometres and it spreads with the speed of a jet plane; when approaching the land, it grows in inverse proportion to the depth of the water, reaching a height of a few dozen metres and, before it hits the land with the speed of a speeding car, it causes a sudden ebb. The Thai fishermen knew that the amount of water that ebbed was going to come back, so they ran uphill to a temple. No one died on their small island on the second day of Christmas 2004. On the neighbouring islands and on the coast of Indonesia, the angel of death had a busy day. The death toll reached 80 thousand people of many nationalities.

The earthquake under the ocean, 38 km from the island of Sumatra had the power of 9 degrees and was the fourth since 1990. The Tsunami wave travelled the whole Indian Ocean with the speed of 800 km/h, reaching the African coast in 7 hours.

4.2. Earthquakes and volcano eruptions

Earthquakes occur mainly in areas where the fric-

Figure 4: Tsunami in Asia – 1994.

tions between tectonic plates are the strongest. Nearby Sumatra there is the Burma plate; southern Europe and Caucasus are within the range of a less active Eurasian plate and the Pacific Ocean is in the range of the Pacific Ring of Fire – the most active seismic zone. It is a belt extending along the coasts of both south and north America, New Zeeland, Micronesia, Indonesia, Japan and the Kuril islands.

In upcoming years the volcanologists predict an increase in the activity of Vesuvius and Etna. In the past two thousand years the Vesuvius has

killed over ten thousand people. Currently the danger zone is inhabited by 600 000 people – many of whom might not manage to escape in time, or may hesitate if an evacuation is ordered.

The most powerful earthquakes since the beginning of the 20th century were in Chile – 9.5o in 1960; Alaska – 9.3o in 1964 and in 1957 – 9.1o; Russia in 1952 – 9.0°, also in Sumatra in 2004 – 9.0o. In terms of the number of casualties, the biggest three were in China: in 1920 – 200 000 killed (8.6o), in 1927 – 200 000 (7.9o) and in 1976 a record number of 255 000 casualties (7.5o). The one on Sumatra totalled 140 000, similarly as in Japan in 1923 (7.9°).

In terms of material damage caused by an earthquake the list is topped by the destruction of Kobe on 17 January 1995. One of the biggest container ports in the world stopped working, 100 thousand buildings turned into debris burying 6430 people and the damage was estimated at USD 100 billion. In a few years, the Japanese rebuilt the city and the port and the whole economy revitalized (GDP grew by 2%). Similarly, the Turkish economy revived quickly after the destruction of Izmit in 1999, where 15 000 people died and material damage reached USD 14 billion (4.7% of Turkish GDP).

Figure 5: Kobe after an earthquake in 1995.
Source: http://bolgraph.com.pl/ftp/publikacje/3595.pdf.

In Poland, a few times in every century, very weak earthquakes can be felt, especially in the south. In a global village we live today, many of our globetrotting citizens have experienced the threat of earthquakes. Our rescue teams have also taken part in rescue efforts in distant countries around the world.

4.3. Hurricanes, Tornados, Typhoons

Hurricanes, tornados and typhoons have not attacked our country yet, unlike the densely populated tropical regions on the coasts of South Asia, the Caribbean or Florida. The climate changes observed in Europe and the increasing power and number of storms and local tornados can be intermittent weather anomalies, happening many times in the past, though not documented very well. Therefore, they cannot be compared with today's situation. All in all, we are not in danger of "huracinos" festivals, warning systems, shelters and mass evacuations, like those experienced every year in different parts on the coast of Florida or the Gulf of Mexico. Local tornados cannot be compared with American tornados, which leave vast areas of the southern states devastated, because it is a different scale. Similarly, one cannot compare the Polish Tatry mountains to Himalayas or a regular car to a sports car. European hurricanes knock down trees and tear the roofs off and have the speed of 80-120 km/h. Whereas the Caribbean hurricanes start at twice the speed. In terms of power, extensiveness and course of events the Caribbean hurricanes and Asian typhoons are very similar. They are accompanied by heavy rain, inundation and flooding of the lowlands located in the deltas of rivers and on the coasts.

4.4. Floods

Floods occur everywhere on our planet except for deserts and areas covered in ice. They are caused by forces of nature but their course and size can be a result of irresponsible human actions. The flood which took place in our country in 1997, had been long foreseen. The cause behind its dramatic results was human economic activity

Figure 6: Threat of flood on the territory of Poland.

conducted for many years in the regions of the Lower Odra Valley without taking into account the extraordinary situation, i.e. a lot higher than the average risk of periodical flooding.

The upper water limit was set based on water level from the year 1901, the highest level recorded in the last 200 years. In 1997 the water level in the Upper Odra was exceeded by 2 metres. It was not taken into consideration that due to economic activity the natural floodplains, which in 1901 significantly lowered the level of the flood wave, had disappeared. The regulation of Odra had not been finished, the planned retention basins were never built. Whereas the floodplains, e.g. in Wrocław city, had already been urbanized.

Since 4 June 1997 it had been raining regularly in the south-west Poland. Daily precipitation was equal to the monthly average. On Sunday 6 July, a flood alert was issued in five voivodeships [administrative regions]. Behind the southern border, the Morawy region was severely affected by the flood. The next day, Opolskie and Katowickie voivodeships were in a state that could be described as a cataclysm. After a week, the flood covered 17 of 49 voivodeships according to the then administrative division. The whole of the Odra Valley and most of its upper tributaries were affected by the flood. The river basins of upper Wisła and Warta rivers were less affected. Even some small rivers in Mazowieckie voivodeship overflowed. Fifty people were killed and over 150 000 evacuated people had to stay away from their homes for 7 weeks. Material damage was estimated at over PLN 10 billion, 1350 locations were flooded, including 2 big cities and 180 villages. A total number of 130 bridges and 1300 km of roads were destroyed. The healthcare system of Wrocław city was paralyzed. Most of the hospitals located in the lower part of the city were flooded.

5. 5. Industrial and Chemical Threats

5.1. Poisonings

In Polish epidemiology of chemical poisonings at the turn of the century, poisonings with medications comprise 80% of all hospital admissions, the remaining 20% include (respectively): poisonings with crop protection chemicals, toxic industrial fumes, other industrial and chemical poisons. Oral poisonings comprise about 80% of all cases, poisoning by inhalation about 15% (an increase from 5 to 15% in a quarter of a century), absorption through skin 4-8%.
In statistics of accidents and disasters involving Toxic Industrial Chemicals (TIC), the top place is taken by rail and road transport. The following places are taken by accidents and disasters in industrial plants – mainly fires and explosions.

5.2. Fires

It is important to remember that every fire causes a release of existing toxic chemicals and new ones, formed at high temperature – not only carbon monoxide. For instance:

- burning wool, cotton, silk and polyurethanes release **hydrogen cyanide**;
- burning polyurethanes cause the formation of isocyanides and **bicyclic organophosphates**;
- PVC, i.e. polyvinyl chloride – **phosgene** and **hydrogen chloride**;
- Teflon and other materials containing fluorine – **hydrogen fluoride**;
- polyamides, wool, silk, phenolic resin – **ammonia**;
- coal, mineral oils, sulphur compounds – **sulphur dioxide**;
- nitrocellulose, polyamides – **nitrogen oxides**.

These are in fact materials found in every household, and not only in the industry. Most of the toxic fumes released due to a fire form explosive mixtures when mixed with air and pose a major threat of explosion, thus stimulating the fire. The ashes are toxic as well. Many rescuers and volunteers who cleared the area after the 9/11 attack on the World Trade Centre towers found out about it themselves.

5.3. Toxic Industrial Chemicals (TIC)

Potentially the biggest threat to the industrialized countries is the storage and transport of toxic industrial chemicals, mainly intermediate substances for the production of various chemical products, which are stored and transported in large quantities, i.e. ammonia, chlorine and sulphuric acid.

Fortunately, there has not been any huge tragedy in Poland due to accidents of tank trucks carrying chemical substances so far, though a few such accidents happen every year. Here are a few examples from a long list of TIC accidents:

In 1968 near Jackowice nearby Łódź city, rail tanks containing chlorine derailed. Seven people died due to unawareness of threat, 15 were saved.

In 1985 four rail tanks with propane and butane gas derailed in the centre of Września town. Had they exploded, it would have been one of the most dangerous disasters of the 80s in Europe.

In 1989 in Białystok city, three Russian rail tanks carrying 150 tons of chlorine derailed. Death loomed over the city. No one died, though no safety regulations were followed during TIC transport.

Here are a few examples from a long list of chemical accidents in industrial plants:

On 26 June 1971, in Czechowice-Dziedzice town, in the local oil refinery, the biggest chemical disaster in Poland in the 20th century took place. As many as 37 people were killed, and over 100 suffered injuries, burns and poisonings. The reason was a lightning bolt which had struck the tank no. 1 and started a fire. Because the embankments were not fully sealed, the burning oil spread around the other tanks. Two other tanks burnt along with the pump room and a section producing engine oil. The fire was put out after 60 hours. People living nearby were evacuated.

July 1976, in Seveso, Italy, 20 km from Milan in MESA chemical plant: a sudden pressure surge opened up a safety valve in the reactor releasing 2 tons of hot chemical substances containing two kilograms of TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), C12H4Cl4O2 – one of the most toxic substances with a lethal dose for a human being of 0.04 mg/kg of body weight. TCDD is a by-product during the production of a popular herbicide – 2,4,5-T (2,4,5-trichlorophenoxyacetic acid). TCDD causes overall emaciation and a possible death after two weeks. It is also embryotoxic, teratogenic and carcinogenic, it releases free radicals by inducing peroxidation of lipids. The mechanism of action is that TCDD binds to the cytosolic aryl hydrocarbon receptor forming a complex with it. This complex is absorbed by the cell nucleus, where it binds to the DNA. This substance contaminated 1500 ha of a densely populated area for many years ahead, excluding it from any economic activity.

Third December 1984, in Bhopal, India. At night, within one hour, 30 tons of methyl isocyanate (CH3-CNO) used for synthesis of pesticides, were released into the atmosphere from the Union-Carbide pesticide production plant. It is a very toxic liquid, creating an explosive mixture when mixed with air and causing carbamylation of proteins. It has a highly irritating effect on the respiratory system, it damages the walls of pulmonary alveoli resulting in pulmonary edema; it also damages the corneas causing refractive disorders, blepharitis (chronic eyelid inflammation) and cataract. Over 3000 people died, most of them surprised in their sleep by a sudden shortness of breath and pulmonary edema. As many as 100 000 people fell ill, 200 000 were evacuated.

During a disaster with TIC there is a risk of losing health or life as a result of ignorance of the nature of the threat and procedures in case of such an event or lack of efficient warning and information system. The ones living in the immediate vicinity of the industrial plants using TIC are not trained in rescue procedures in case of a disaster due to fear of panic and protests such a training might trigger. In case of a highly unfavourable coincidence during a major chemical disaster, there may be more than 100 000 casualties, e.g. the whole city of Włocławek after blowing up all the ammonia tanks when full.

5.4. 5.4. Warning signs – levels of hazard

TIC transported by road and rail are significantly more likely to cause a disaster. Rescue teams can read warning signs in such cases – symbols understandable in every language, or digits from 0 to 4, representing the level of health hazard written inside the so called diamond [colloquial: fire diamond].
In terms of toxicity, there is a unified division into three classes of toxic substances in the whole European Union:

T+ *highly toxic substances*, for which lethal doses depending on the way of absorption are as follows:
LD_{50}< 25 mg/kg of body weight – orally,
LD_{50}< 50 mg/kg of body weight – through skin,
LD50< 500 mg/m3/4 hours – inhalation.
T toxic substances:
LD_{50}= 25-200 mg/kg of body weight – orally,
LD_{50}= 50-400 mg/kg of body weight – through skin,
LD_{50}= 500-2000 mg/m^3/4 hours – inhalation.

Xn harmful substances:
LD_{50}= 200-2000 mg/kg of body weight – orally,
LD_{50}= 400-2000 mg/kg of body weight – through skin,
LD_{50}= 2000-20000 mg/m3/4 hours – inhalation.
Xn and T labelling can be found on plant protection chemicals.

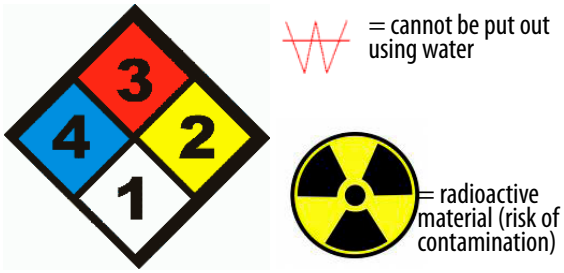

Figure 7: FIRE DIAMOND.
A system of immediate risk assessment in accidents with dangerous materials

SECTOR		YELLOW	RED	BLUE
RISK		Explosion	Flammability	Health
LEVEL	0	None	None	None
	1	After heating	From a direct flame	Low ± filtering masks
	2	Strong chemical reactions – be cautious!	Ignites when heated	Hazardous to airways. Requires protection.
	3	When shaken, hit or heated – explodes	Ignites in ambient temperature	Highly hazardous. Wear protective clothes.
	4	Highly explosive!	Ignites in every temperature	Very hazardous. Requires full isolation.

Among the most toxic substances, the top spot is taken by the aforementioned *TCDD – 2,3,7,8-tetrachlorodibenzo-p-dioxin*, with a lethal dose (LD) of 0.04 mg/kg of body weight. Slightly less toxic are natural venoms of tetraodontidae fish – tetrodotoxin and saxitoxin – and venoms of some Australian clams.

The following places are taken by *organophosphate chemical warfare agents* (CW) – acetylcholinesterase inhibitors, with the strongest one being *VX*, O-ethyl S-[2-(diisopropylamino)ethyl] methylphosphonothioate: $C_2H_5O(CH_3)$-P-(O)-S-$(CH_2)_2$-N-$(CH(CH_3)_2)_2$ – a volatile liquid, colourless and odourless, LD = 0.14 mg/kg of body weight or 50 mg/m3/min. It is a strong acetylcholinesterase inhibitor and contains choline residue. This similarity ensures quicker onset of action when compared to other organophosphate toxic agents. It is quickly absorbed through the skin (when in liquid form). Contaminates an area for a very long time.

Next on the list is SOMAN – code: GD; according to the American classification, all these compounds are marked with the letter "G" at the beginning. In Germany the organophosphate CW had also the cryptonym "Trilons". *GD: Phosphonofluoridic acid, methyl-, 1, 2, 2-trimethylpropyl ester;* $C_6H_{13}O$-$(CH_3)P(O)F$, very toxic and volatile, odourless and colourless liquid. It hydrolyses fairly quickly in alkaline environment and increased temperature, during which it releases hydrogen cyanide, similarly to other organophosphate chemical warfare agents. It was first synthesized in 1944 in the laboratory of IG Farben in Germany. It almost instantly forms a complex with acetylcholinesterase which cannot be reactivated and is resistant to detoxification. Anti-lethal factor, a measure of treatment effectiveness, never exceeded twice the LD_{50} dose, whereas for Sarin and VX, the LD_{50} dose was increased several or several dozen times. Lethal doses are LD_{50}= 1.2 mg/kg of body weight or 40mg/m^3/min.

Another one is S*ARIN; GB (Trilon 46); methylphosphonofluoridic acid isopropyl esther*. It is a very toxic liquid, volatile and odourless. Synthesized also in IG Farben in Germany in 1938 as a chemical warfare agent. Easy synthesis made it useful for **terrorist attacks** – it was used in 1994 in Matsumoto and in 1995 in Tokyo subway. It is a lot more susceptible to detoxification than Soman – the complex with acetylcholinesterase is formed a lot slower; LD_{50}= 28 mg/kg of body weight through skin or 70 mg/m^3 through inhalation.

It should be noticed that LD doses are only theoretical – no one allows conducting lethal experiments on humans.

The weakest and oldest in this group is *TABUN – GA (Trilon 83): ethyl ester of dimethylphosphoroamidocyanidic acid,* $(CH_3)2N(CH_3)P(O)CN$. Very toxic colourless or brownish liquid, odourless or with a faintly almond odour. Synthesized in Germany in the beginning of the 1930s as an agent against the potato beetle. It proved a lot more

harmful for mammals and was immediately classified as secret. LD_{100}= 7 mg/m^3, 150mg/m^3/min or through skin: LD_{50}= 23 mg/kg of body weight.

All the agents mentioned above belong to a class of highly toxic substances marked with the symbol **T+**. Tabun, Sarin and Soman are characterized by a short latency period, whereas in case of VX gases the period is significantly longer.
Multiple sub-toxic expositions can lead to a chronic poisoning with various atypical symptoms.

6. Radioactive contaminations

Between 1950 and 1963, due to over 300 experimental nuclear explosions in the northern hemisphere, a nuclear fallout consisting of medium- and long-lived radioactive isotopes contaminated air, water and soil in our country to a far greater extent than the Chernobyl disaster in 1986 (with the exception of iodine isotopes, whose concentration in the air in the first days after the Chernobyl disaster exceeded previous expositions by far).

Radioactive dust after a nuclear explosion in the atmosphere contaminates the immediate vicinity of the explosion and a strip of land depending on the direction of the wind in the lower parts of the atmosphere. Moreover, some of the isotopes travel long distances in the upper parts of the atmosphere and land in unpredictable places, contaminating different areas in a spot-like manner.

After the Chinese experiments, an ionized radioactive cloud passed our territory twice. It circled the Earth twice and during its presence an increase of heart attacks by a few percent was noticed.

After the Chernobyl disaster, no statistically significant negative health consequences related to thyroid, cancer or any other, were noticed. Research on the Japanese population, which survived the explosion of the atom bomb in Hiroshima, indicated that increased mortality between 1950 and 1982 applied only to those who had been no further than 2 km from the centre of the explosion and absorbed a dose not smaller than 0.5 Gy (0.5J/kg). After the Chernobyl disaster, no one in Poland was exposed to even a tenth of that dose.

It is worth mentioning that there have been more accidents in the nuclear energy industry.

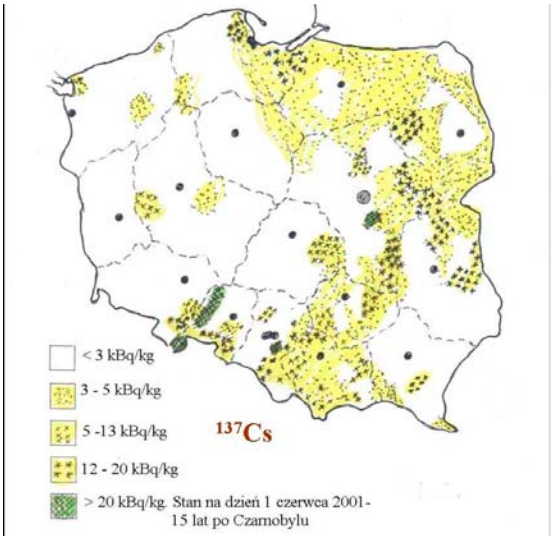

Figure 8: Radiological map of Poland - 2001 r.

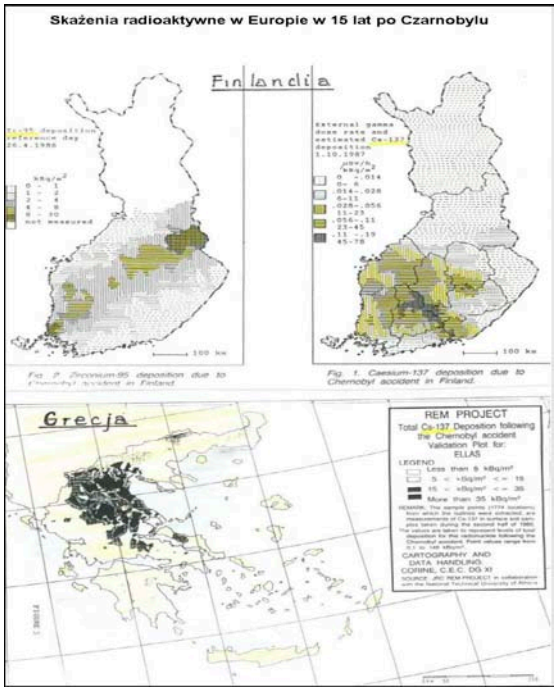

Figure 9: Finland and Greece –15 years after the Chernobyl disaster.

According to INES (International Nuclear Event Scale) Chernobyl had level 7 – the most dangerous level of threat. Level 6 was given to a serious accident in 1957 in a nuclear fuel processing plant in Kyshtym, the then Soviet Union, which lead to contamination of a vast area and the need to evacuate the local population. In the same year, an accident in a nuclear reactor in Windscale (now Sellafield, Cumbria) in UK resulted in contamination of fields in part of the county. Though the contamination was rather not serious, the isotopes concentrated in the milk of cows, so

the local dairies had to dispose of the milk. The accident was classified as level 5. The same level was associated with the nuclear plant accident in Three Mile Island in the USA in 1979 where there was only a minor contamination outside the premises of the plant. The list of minor accidents and incidents without any contamination outside the premises is substantially longer and it gets longer almost every year.

Genetic experiments on drosophila flies proved that increasing the background radiation eight-fold during a lifespan of one population can cause lethal consequences in 15 to 18 ascending generations. In the light of the above, the question whether humanity will live to see the year 2600 without resorting to genetic control over natural selection remains open.

7. Construction and Transport Disasters

Fortunately, major building disasters such as the fire in Gdansk shipyard during a concert in 1995 or the collapse of a vast roof (100x150 metres) on the premises of International Katowice Fair Ltd. on a chilly night on 28 January 2006 during International Fair of Pigeons, do not happen too often.

Figure 10: Fire in Gdansk shipyard – 1995.

Those guilty of negligence are always found and it is always a group of people responsible for a string of negligence. Irresponsibility, lack of imagination, incompetence and wrong organization from top to bottom led to a tragedy both in Gdansk shipyard and in Katowice. The only difference is details. The shipyard event produced an "epidemic" of burns and showed that the local healthcare system was not prepared for dealing with multiple similar injuries (202 people burned) efficiently.

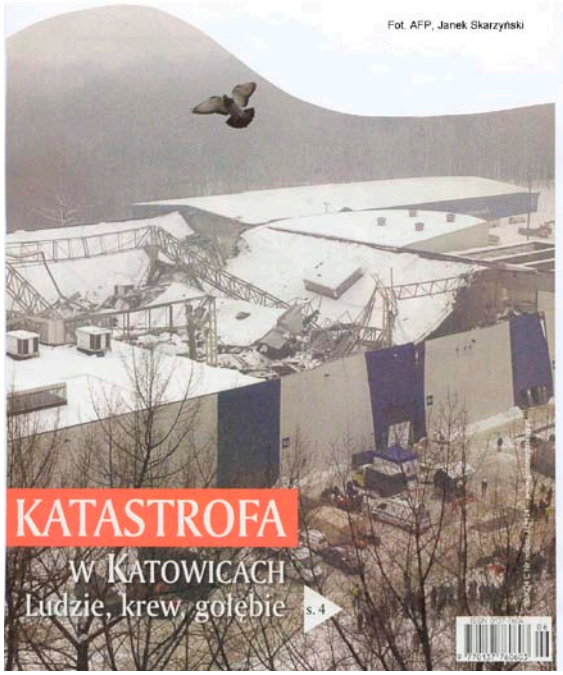

Figure 11: Disaster in Katowice - 2006.

Similarly, transport disasters and accidents usually have many causes which entwine just before the collision. Such cases are well documented, especially in documents regarding major plane crashes, disasters at sea, rail and coach accidents, e.g. Polish coach which crashed near Grenoble in France.

Number of people killed in Poland each year in ordinary everyday and holiday road accidents is far greater than the number of people killed in many spectacular disasters. Every year, 6 to 9 thousand people are killed on roads and 60 to 70 thousand are injured. The number of accidents remains fairly steady at 50-60 thousand a year. As much as 80% of road accidents are due to the driver's fault, such as speeding (20-25%), failure to yield right-of-way to other cars (20-24%), failure to yield right-of-way to the pedestrian (18-20%), illegal turning, overtaking, cutting in and even red-light running (5%). Pedestrians cause less and less accidents – a decline from 27% to 17% within 8 years. Lack of roadworthiness comprises only a small fraction of all the causes of road accidents and bad conditions of the roads affect the decisions of frustrated drivers only indirectly.

It is worth noting that impatience of young drivers and their excessive trust in their reflex cause them to participate in accidents a lot more often than drivers in their thirties and forties, not to

mention drivers in their fifties (young drivers cause twice as many accidents as them, regardless of gender).

8. Conclusions

The review of natural threats indicates that only few of them can be prevented and this requires enormous effort of many people, e.g. the "Don Quixote" mission of the European Space Agency to change the trajectory of an asteroid [2002AT4 or 1989ML]. We can harness the element of water running in river banks and stop it from overflowing each year. Tsunami on the other hand leaves us with no other choice but to flee, provided the warning system should not fail. The areas where earthquakes occur can be utilized with the use of costly technology resistant to weak and moderate quakes. The example of Kobe shows that even the Japanese are not always successful in such efforts.

Most disasters Poland is struck by are caused by lack of imagination and irresponsibility – usually of many people at a time. We can prevent this mechanism by implementing new procedures but it increases bureaucracy and allows evading responsibility in cases previously not experienced, hence without proper procedures. The existence of laws which for many years have been evaded with impunity due to financial reasons or simply because it has been easier, will eventually lead to a disaster like the fire in Gdansk shipyard or the collapse of the roof during Katowice International Fair.

Accident and emergency medicine is not at risk of stagnation and there is no risk of unemployment among paramedics. Neither there is among ER staff in hospitals, air ambulance staff, nor those writing the law codes. Scientific, technical and organizational development implemented in many rescue specialties will result in a decrease in casualties, suffering and material damage. Unfortunately, at the same time we detect and monitor more and more threats that we were unaware of or new threats which emerged along with development.

Acknowledgements:

Original article previously published in the Polish language in *Wojskowa Farmacja i Medycyna*.

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Pharmacology & Pharmacy

Second-generation antihistamines in the treatment of allergies on the example of loratadine

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Received: 2011.12.12 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

This paper discusses the use of loratadine as a second-generation histamine H1 receptor antagonist in the treatment of allergic diseases. Pharmacokinetics, metabolism and physicochemical parameters of loratadine are reviewed. Commercial Loratadine-containing products are presented.

Key words: allergy, antihistamine drugs, loratadine.

Allergic diseases are a serious social and medical problem, considered by the experts to be the epidemics of the 21st century. The number of individuals suffering from allergies has doubled every 10 years since the 1950s [1,2]. The problem pertains to all age groups from infants to the elderly and is manifested as atopic dermatitis, bronchial asthma, allergic rhinitis and conjunctivitis in the form of hives and angioedema as well as gastrointestinal allergies [3,4]. Newer and newer factors may become allergens, including not only pollens or insect venoms, but also animal fur, mites, foods (e.g. milk, fruit), as well as medicines, cosmetics, chemicals [4]. The International Study of Asthma and Allergy in Childhood showed that allergies are less prevalent in less-developed countries, which is in line with the hygienic theory of allergy development [5]. Studies conducted in 2006 showed that the number of patients with allergies in Poland had increased, the suspected cause being the change in living conditions and lifestyles, increased exposure to pollutants and chemicals used in households, agriculture and industry [6,7]. A conclusion may be drawn that excessively polluted environment, as well as excessively hygienic lifestyle may impact the development of allergies, as evidenced for instance by children's homes in Łódź, where a lower incidence of allergies (12.5%) was observed as compared to the overall population (25.4-40.2%) [8,9].

Second-generation antihistamines were introduced to therapy in the 1980s. One of these second-generation antihistamines is loratadine, characterized by strong and long-lasting antiallergic activity. In contrast to the first-generation antihistamines, loratadine does not cross the blood-brain barrier, shows selectivity when used at therapeutic concentrations and reveals high affinity to peripheral H_1 receptors, allowing to avoid induction of somnolence (in the majority of population) [10-19]. The use of loratadine does not impair the ability to drive or use machines [13,16,20].

Loratadine has beneficial antiallergic properties – it inhibits the release of mediators from mast cells and basophils (animal studies) and is characterized by an additional anti-inflammatory effect [16,17,21]. It has no cholinolytic properties (allowing it to be used in glaucoma and prostatic hyperplasia) or antiserotonine properties (not causing a body mass increase). Loratadine is administered by oral route, and its long half-life allows for once-daily administration [17]. The efficacy of loratadine is identical as that of the first-generation drugs, although inter-individual differences may be observed [16]. Upon the use of loratadine, skin reactions to histamine and allergens (skin allergy tests) are suppressed for up to 7 days after discontinuation of the drug [21]. Loratadine was not shown to induce tolerance after administration for 28 days [13,22]. Loratadine has no cardiotoxic effects, even in combination with antifungals (ketoconazole, itraconazole) or macrolide antibiotics (erythromycin, clarithromycin) that inhibit the metabolism of loratadine, thus increasing its plasma levels [13,18,22,23].

The use of loratadine in pregnancy is allowed only in absolute necessity, because the drug is classified as FDA category B [10,24,25]. Category B includes drugs for which animal tests had been conducted showing no adverse effects on the fetus but there had been no tests on humans, or the animal tests had shown adverse effects on the fetus but studies in groups of pregnant women did not confirm any hazard for the fetus. [27,28]

Loratadine should not be used when breastfeeding as loratadine and its metabolite pass to mother's milk, and the concentration of loratadine in milk is higher than that in the serum [10].

Loratadine is used in the treatment of symptoms of allergic rhinitis, both seasonal and perennial (sneezing, running nose, itchy nose, rhinitis, nasal mucosal swelling, itching and burning sensation, lachrymation), as well as symptoms of acute and chronic hives (erythema, pruritus and blisters) [10,12, 13,15,20,28-30].

The drug is administered at a dose of 10 mg daily in adults and children (aged 2-12) with body mass of > 30 kg. Children with body mass of < 30 kg should receive 5 mg/day of loratadine. Dosing to patients with hepatic or renal insufficiency or to elderly patients should start at 10 mg every second day [13,18,20,21,24,31].

Contraindications for use include hypersensitivity to any of the ingredients of the product or pregnancy (pregnancy category B) [13,20].

Most common adverse effects include: somnolence, headaches, insomnia, increased appetite, nervousness. Much less common adverse effects include: headaches, anaphylactic reactions, tachycardia, palpitations, dry mouth, nausea, gastric mucositis, abnormal hepatic function, rash, alopecia, fatigue [10,13,20,24].

Pharmacokinetic parameters of loratadine

Loratadine is rapidly absorbed; only 40% of the dose is absorbed after oral administration [12]. The onset of action is observed after 1-3 hours

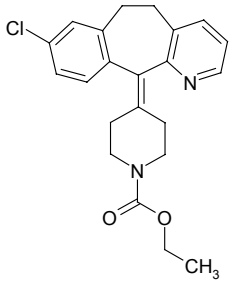

Figure 1: Structural formula of loratadine

and the maximum effect is observed 8-12 hours after administration [10,14,22,24,32]. The steady state concentration may be observed after 5 days of use [13,14,22]. Intake with meals may increase the absorption by up to 40%, and the amount of the metabolite by 15% [13]. The degree of plasma protein binding for loratadine is 97-99%, while decarboethoxyloratadine binds plasma proteins to a much lower extent - 73-76% [14,20,28]. Loratadine is metabolized in the liver, where it is transformed by cytochrome P-450 3A4 and 2D6 enzymes [12,14,25,18-21,33] to its main metabolite, decarboethoxyloratadine, which is also pharmaceutically active and contributes to loratadine activity persisting for over 24 hours [15,20,22,23,32,34,35].

About 40% of the ingested dose is excreted by kidneys and 42% by the gastrointestinal tract in the

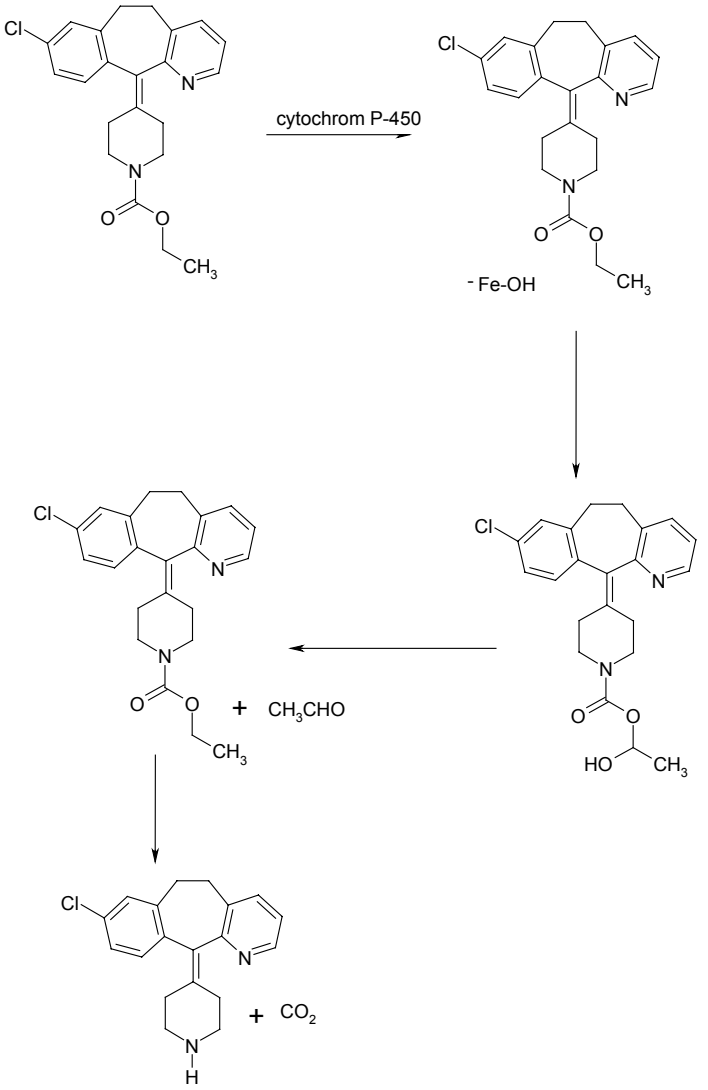

Figure 2: Metabolism of loratadinee

form of conjugated metabolites within 10 days from administration [13,20,22,28,32]. About 1% of the drug is excreted as unchanged compound. The half-life of loratadine is 8.4 h, and the half-life of its main metabolite is 28 h [13,20,22,24,32].

Physicochemical properties of loratadine

Loratadine is w white or nearly white crystalline powder with melting point of 131oC to 137oC, molecular weight of 382.89, virtually insoluble in water, poorly soluble in diethyl ether but well soluble in such organic solvents as ethanol (760 g/L), methanol, acetone, 2- propanol and chloroform [12,29, 43,44]. Experimental solubility of loratadine in water is 0.000011 mg/mL [12].

A broad pH range can be observed in the gastrointestinal tract; therefore, a question arose whether different pH values might affect solubility of loratadine in particular segments of the gastrointestinal tract, and thus whether they might enhance loratadine absorption. Loratadine was observed to have the lowest solubility at the pH of 6.5-7.5 (0.004-0.006 mg/mL) and the highest solubility, of 4.59 mg/mL, at the pH of 1.2. In addition, a significant difference in the pH value may be observed between the pH values of 1.2 and 2, with solubility dropping to 1.32 mg/mL at the latter value [38].

The octanol/water partition coefficient of 3.8 was determined experimentally for loratadine [12].

According to the biopharmaceutical classification system (BCS), loratadine is a class II drug (poorly soluble and well absorbable substance). Low solubility of the drug limits its bioavailability (despite good absorption, only about 40% of the dose enters circulation). In order to improve the bioavailability, solubility of loratidine should be improved. This may be achieved by addition of surfactants as micellar stabilizers or by the use of autoemulsification systems [38,39].

Commercial loratadine-containing products and their composition

Loratadine 10 mg is available in commercial products in the form of tablets, capsules and syrups. In addition, it is also present in combination with pseudoephedrine in Clarinase extended-release tablets at the dose of 5 mg. [28]

In most cases, solid oral formulations of loratadine are simple, with the most common excipients being lactose, starch (potato, maize, modified starch) and magnesium stearate. Surfactants are not used to increase solubility.

Formulation of loratadine syrups is based on plain syrup, with flavor-enhancing additives (peach flavor) and preservatives (sodium

benzoate), as well as sorbitol or glycerol to avoid crystallization of sugars.

Pharmaceutical loratadine-containing products, in which appropriate ratio of starch and lactose is used (plain granulate) are fully biodegradable and often referred to as residue-free products. Components of the granulate are a combination of excipients which may be safely administered to children above 4 months of age.

Table 1: Qualitative composition of commercial products formulated as tablets and capsules containing 10 mg of loratadine and extended-release tablets containing 5 mg of loratadine and 120 mg of pseudoephedrine.

Trade name	Excipients
Alerfan	lactose, potato starch, magnesium stearate
Aleric	microcrystalline cellulose, modified starch, lactose anhydrous, crosspovidone, colloidal silica, magnesium stearate, stearic acid
Claritine	hydrated lactose, maize starch, magnesium stearate
Flonidan	lactose, maize starch, gelatinized starch, magnesium stearate
LoraHEXAL	lactose, magnesium stearate, maize starch, silica
Loram	lactose, magnesium stearate, maize starch, silica
Loratadine	calcium hydrogen phosphate, maize starch, sodium benzoate, magnesium stearate, colloidal talc, silica, polyvidone
Loratine	microcrystalline cellulose, corsspovidone, magnesium stearate
Rotadin	lactose, potato starch, magnesium stearate
Loratan (capsules)	PEG 400, glycerol, 20% hydrochloric acid, gelatin, sorbitol, ethyl p-hydroxybenzoate sodium salt, propyl p-hydroxybenzoate sodium salt, Cochilean red, patent blue.
Clarinase (extended release tablets)	lactose, maize starch, polyvinympyrrolidone, magnesium stearate, butylparaben, calcium sulfate, Carnauba wax, acacia gum, oleic acid, granulated sugar, talc, titanium dioxide, microcrystalline cellulose, white wax, natural zeina soap.

Table 2: Qualitative composition of commercial syrups containing 1 mg of loratadine per 1 mL of syrup.

Trade name	Excipients
Claritine	propylene glycol, glycerin, citric acid monohydrate, sodium benzoate, sucrose, peach flavor, purified water
Loratan	sucrose, glycerin, propylene glycol, sodium benzoate, citric acid, peach flavor, purified water
Loratine	sucrose, glycerin anhydrous, propylene glycol, citric acid, methyl para-hydroxybenzoate, wild strawberry flavor, purified water
Rotadin	sodium benzoate, sucrose, propylene glycol, glycerol, citric acid anhydrous, vanilla flavor AB-710, strawberry flavor 22754-00, purified water.

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Emergency Mediciney

Cold Injuries

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Received: 2011.12.20 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Significant hypothermia is an increasing clinical problem that requires a rapid response with properly trained, well-equipped personnel. Although the clinical presentation may be such that the victim appears dead, aggressive management may allow successful resuscitation in many instances. Initial management should include CPR if the victim is not breathing or is pulseless. Further core heat loss should be prevented by removing wet garments, insulating the victim, and ventilating with warm humidified air/oxygen (42–46 °C), to help stabilize core temperature. If possible, core temperature and cardiac rhythm should be monitored in the pre-hospital setting and CPR should be continued during transport. In-hospital management should consist of rapid core rewarming of a severely hypothermic victim with heated humidified oxygen (42–46 °C), centrally administered warm IV fluids (40–43 °C), and peritoneal dialysis until extra-corporeal rewarming can be accomplished. Post-resuscitation complications should be monitored; they include pneumonia, pulmonary edema, cardiac arrhythmias, myoglobinuria, disseminated intravascular coagulation and seizures. The decision to terminate resuscitative efforts must be individualized by the physician in charge.

Key words: hypothermia – initial management, ventilation with warm air/oxygen, administration of warm IV fluids, peritoneal dialysis, extra-corporeal rewarming of blood

Current methods of hypothermia management yielded many unpleasant experiences suggesting that emergency services providing first aid should be properly trained and provided with appropriate technical equipment in order to effectively and rationally save lives and prevent deaths.

Every year, with the advent of cold autumn weather, we receive information that people die of hypothermia even though "true" frost has not come yet. According to the reports by the mass media (based on the data acquired from the Polish Police Headquarters – more recent data is not available – W.K.) during autumn 2002, before the commencement of winter (from mid-September until mid-December), 214 people lost their lives because of to hypothermia.

As this information was not based on statistical data it should be presumed that the true number

of cold victims until the beginning of spring 2003 was much higher.
This data was quite surprising for many of us because the frosts were yet to come and temperatures well below 0 °C were not expected until January, February and March.

In January 2006, until the 23rd day of the month, over 240 people died due to hypothermia during cold weather with temperatures persisting below -20 °C (Table 1).

Table 1: Fatalities due to hypothermia

Years	Fatalities
2005/2006	240 **)
2004/2005	90 *)
2003/2004	314
2002/2003	312
2001/2002	305

* Data gathered until the end of January 2005 – announced by TVN
** Data from the end of January 2006 announced by the mass media

Past several winters in Poland were not very severe and the few cold fatalities did not create the need to conduct prophylactic actions in that subject. Consequently, surgery and anesthesiology textbooks also devoted too little space to thermal injuries.

Both medical school alumini as well as doctors without direct contact with cold victims do not always know how to provide aid using modern techniques [1-5]. Reducing the number of hypothermia victims depends not only on prevention, first aid training and advancement of therapeutic methods but also on proper technical equipment [6-10]. One should remember that almost every life of a cold victim in Poland could have been saved if medical aid had been provided in time. Knowledge, experience as well as providing emergency services with appropriate technical means are necessary in order to effectively combat the aftermaths of the cold.

Effects of cold temperatures on human body

Systemic effects exerted by the cold on human organism and impeding function of vital organs are referred to as *hypothermia*.

General awareness of the topic should increase proportionally to the development of car industry, mountaineering as well as winter and water sports.
Prevalent, erroneous opinions laying at the background of our notions regarding hypothermia strengthen our beliefs such as the one that remaining in water for more than 5 minutes must result in death. Clinical experience indicates that a human can survive longer in cold water than it was believed until now [10].
A significant number of people who "drowned" in ice-cold water and were retrieved led doctors to change their views on hypothermia and inclined them towards continuing rescue actions in such cases [11,12].

Hypothermia may also affect victims with multi-organ damage and shock sustained in traffic accidents, which may happen not only during period of cold weather but also in the summer. One must be also aware of the possibility of hypothermia occurring during mass accidents (not only earthquakes, war or shipwrecks) [13].

For the past few years, in an era of terroristic attacks that may take place all around the world, it must be taken into consideration that victims exposed to hypothermia due to low temperatures or cold water may require proper and effective first aid in every location and at every time of the year.

There is also a question worth asking – what is the reason for an increasing number of victims of hypothermia in Poland each year?
In recent years the homeless, unemployed, elderly and sick as well as alcohol – and drug-dependent people increasingly often have become victims of cold weather.
The following factors contribute to hypothermia and frostbite occurrence – malnourishment, chronic and wasting diseases, convalescence following an illness or injuries with sustained blood loss, cardiovascular diseases.

Local injury due to low temperatures, causing damage to cells and tissues exposed to the cold is called **frostbite**. It may occur in humid, windy weather, even when air temperature remains above 0 °C.
Exposed parts of the body are at the greatest risk of frostbite: face, ears and nose, hands as well as feet. Immobility and tight or wet clothing also

contribute to the injury. Shoes that are wet or that constrict toe motions and impede blood flow also play a role in development of frostbite.
There are also chilblains, which are formed as a consequence of long-term exposure of tissues to low temperatures. [3, 4, 6, 9, 13]

Hypothermia

Sometimes the cold victim is still alive when found but dies when we begin to administer first aid even though hypothermia is not accompanied by other injuries or illnesses.

Hypothermia – is characterized by lowering of core body temperature to 35 °C or less. It is a result of reduced ambient temperature, at which human organism is unable produce sufficient amount of heat necessary for proper functioning. It is a life-threatening state, which can be fully prevented [2, 5-8].
It may be caused by: staying in open spaces at low temperatures without appropriate protection from the weather, immobility, trauma or post-traumatic shock, cold water below 21.1 °C.

The following are the signs of impending hypothermia:
- shivers as signs of heat loss,
- disorientation and memory loss,
- sleepiness and feeling of exhaustion,
- impairment of motor coordination,
- slurred speech,
- numbness.

The following signs herald hypothermia in children:
- bright-red and cold skin or
- signs of apparent death.

The following factors increase the risk of death due to hypothermia:
- air temperature below +10 °C,
- alcohol abuse or acute intoxication,
- drug use,
- psychiatric disorders, Alzheimer's disease,
- insufficient body cover and wet or damp clothing,
- age: below 15 or above 65 years,
- malnourishment and homelessness.

Cooling the body to 35 °C or less results in cardiac arrhythmias, slow and shallow breathing. Acidosis develops as a consequence of slowed down blood flow through the tissues and decreased gas exchange.

Stages of hypothermia

Hypothermia can be distinguished into the following stages:
- **mild hypothermia with body temperature ranging from 34 °C to <36 °C** accompanied by:
  - shivering,
  - loss of motor coordination,
  - moderate disorientation,
  - at 36.0 °C metabolic rate increases,
  - at 35.0 °C shivering intensifies, victim is unable to properly assess the situation.

- **moderate hypothermia with body temperature ranging from 30 °C to 34 °C** accompanied by:
  - clouding of consciousness at 33.0 °C
  - cessation of shivering and mydriasis at 32.0 °C
  - blood pressure may be difficult to determine at 31.0 °C.

- **severe hypothermia with body temperature of 30 °C or less** accompanied by:
  - **at 28-30 °C:**
    - bradycardia and decreased respiratory rate,
    - increased muscle stiffness,
    - loss of consciousness,
    - ventricular fibrillation.
  - **at 27.0 °C the findings are:**
    - loss of deep tendon, skin and vascular reflexes,
    - signs of clinical death,
    - asystole.

Sometimes the cold victim is still alive upon finding but dies when we begin to administer first aid even though hypothermia may be unaccompanied by other injuries or illnesses. It indicates that our experience in that subject is insufficient and treatment is sometimes wrong or unsuitable.
There have great advancements in this area of medicine for the past several years. [15]

People with symptoms of hypothermia should be provided with prompt medical attention immediately after they are found. However, before medical services arrive, the hypothermic patient should be:
- placed in a well-heated room,
- protected from further effects of weather

conditions,
- stripped of wet clothing,
- the following areas should be warmed first:
  1) chest,
  2) head and neck,
  3) inguinal areas – heat sources such as electric blankets, hot water bottles, etc. should be placed there all the while protecting the skin from burns. [13,14]

Rules of conduct at the site of an accident – life-saving.

The goal of these interventions is to ensure survival of hypothermic victim. Therefore:
- medical personnel should in any case consider the degree of hypothermia during administration of first aid,
- all emergency medical teams should be outfitted with necessary equipment for warming patient as well as thermometers allowing measurements of body temperature around 30 °C or lower (on the tympanic membrane, in the esophagus or rectum).
- emergency medical teams working in low-temperature areas (GOPR – Mountain Volunteer Rescue Service, WOPR – Water Volunteer Rescue Service) should also have proper equipment and experience in warming patients.

It was established that the most critical period of time for medical personnel administering aid to a person in hypothermia is the first 30 minutes from the moment of finding her/him because during that time:
1) the hypothermic victim must be kept alive,
2) body temperature must be sustained and protected from decreasing any further,
3) patient must be transported from the site of an accident to a specialist medical center as soon as possible.

Hypothermic patients are often victims of traffic accidents, construction disasters or building collapses and reaching them is not always easy. General condition of a patient with multiple injuries often does not allow transfer with just any mode of transportation without proper stabilization. Sometimes, rapid transportation of a victim from the site of an accident outdoors to hospital is not possible and treatment must be initiated immediately at the site. [15]

In such instances one must proceed effectively and remember that due to progressive reduction of body temperature **all vital functions:**
- heart rate,
- respiratory rate,
- metabolism, or
- cognitive function
- gradually slow down.

Hypothermia may also lead to development of other symptoms. Therefore, medical personnel must pay attention to:
- pulse – counted for at least 45 seconds – slowing down or becoming irregular,
- breaths – becoming slow and shallow,
- speech slowing down,
- lack of response to verbal or painful stimuli,
- reduced ability to move,
- skin becoming cold and
- decreasing rectal temperature.

Patients may present with other changes, which cannot be identified at the site of an accident and indicate poor prognosis. These are:
- biochemical changes in peripheral blood,
- change in oxygen and carbon dioxide content in blood,
- heart rate becoming irregular,
- hypovolemia,
- distinct difference between skin and rectal temperatures.

Patient management directly at the site of the accident

Pre-hospital care at the site of accident should be administered according to a simple scheme and an established management plan, which takes into consideration all stages of hypothermia (Table 1).

Patient should be placed in a horizontal position in order to prevent orthostatic fall in blood pressure. It may also occur as a result of inflow of cold blood from extremities to the heart leading to development of cardiogenic shock. Horizontal position is supposed to facilitate proper perfusion of central nervous system and cerebral cortex despite the lowered blood pressure. This position is also important for patients retrieved from water, who often suffer from sudden hypotension [12-15].

Hypothermic patient should be supplied with pre-warmed, humidified oxygen or air. This is

a well-established method of "core rewarming" used for many years not only in the United States, Canada and Australia, but also in Europe.
Hypothermic but conscious patients should be given hot, sweetened or high-calorie drinks without alcohol or caffeine. Alcohol dilates skin vessels leading to increased loss of heat from patient's body to the environment through radiation, and caffeine, through its diuretic effect, decreases the volume of circulating blood.

As patient's temperature may still decrease despite rewarming, it requires constant monitoring. At this stage, preventing further heat loss is the prime challenge for the rescue team [16].

Prevention of cardiogenic shock

Before initiation of shock management, the patient should be thoroughly examined.

One should remember the basic ABC rule of management:
A = (airway) – checking patency of the airways,
B = (breathing) – sustained breath – ensuring proper breathing,
C = (circulation) – preserved circulation – restoration of heart rate and blood pressure.
In hypothermic patients there is also:
D = (degree) = degree of hypothermia (body temperature measurement).

Vital functions should be thoroughly examined:
- pulse and heart rate (for at least 45 seconds),
- respiratory rate,
- blood pressure,
- body temperature, e.g. on the tympanic membrane, in the oral cavity or rectum.

Attention: One should also remember that measuring body temperature with traditional mercury thermometers does not yield results adequate with those taken with special thermometers designed for measuring temperatures below 35 °C in the esophagus or on the tympanic membrane.
- assess: state of consciousness, pupil width and reaction to light, answers to questions and clarity of thought – it may be helpful for diagnosing severe hypothermia,
- while examining the patient, one should remember that pain perception is reduced in those patients and it is necessary to conduct routine physical examination in order to exclude: additional traumas, frostbites, damage to soft tissues, fractures, etc.
- Proper management should be initiated if any of the above is found.

Life-saving interventions

Patients diagnosed with sole bradycardia do not require cardiopulmonary resuscitation. However, it should be immediately initiated in those retrieved from cold water.

Cardiopulmonary resuscitation should be initiated always when necessary and when indications for it exist (Table 2).

Table 2: Hypothermia* – management plan at the site of the accident

	Symptoms	Menagement
37.5ºC	Normal body temperature measured in the oral cavity.	
	Mild hypothermia: body temperature from 34 to < 36ºC	
36ºC	Perception of cold	Change the wet clothing for warm and dry one, put on warm socks, a hat and a scarf, goggles. Protect the head and neck from the cold, perform physical exercise. External warming: a bath, fire – only with body temperature higher than 35ºC.
35ºC	Shivers	Administer high-calorie, hot and sweet drinks, but no alcohol or caffeine.
	Moderate hypothermia: body temperature from 30ºC to 33.9ºC requires administering first aid and hospital treatment	

	Symptoms	Menagement
34ºC	Unstable gait, disorientation, Apparent alcohol intoxication.	Do not perform excessive, rapid movements. Do not warm externally apart from the chest and trunk.
33ºC	Muscle stiffness	Administer hot, sweet drinks. Administer air/oxygen humidified and warmed to 42-46ºC.
32ºC	Cessation of shivers	Monitor heart rate and breathing. Protect from arrhythmias.
>32ºC	**Cessation of shivers - cardiovascular collapse - urgent transportation to hospital**	
31ºC	Semiconscious	Do not ad minister food or drinks.
Severe hypothermia: body temperature below 30ºC requires administration of first aid and hospital treatment		
30ºC	Unconscious Lack of response to verbal and painful stimuli	Do not administer anything orally. Maintain airway patency, oro-pharyngeal tube, safety position, changing body position every 2 hours to avoid formation of decubital ulcers. Monitor pulse and breathing.
29ºC	Bradycardia and bradypnea	Initiate mouth-to-mouth breathing support according to the rate of patient's own breaths (slow and shallow breathing).
28ºC	Cardiac arrest Lack of pulse and breaths, pupils dilated	Maintain airway patency, carry out mechanical ventilation using mouth-to-mouth (through a mask) or mouth-to-nose method; maintain 12-15 breaths / min. and 80-100 chest compressions / minute.
27ºC	White-gray, cold skin	Do not stop administering first aid! Continue resuscitation as long as you can.
Severe hypothermia: body temperature below 20ºC requires administering first aid and hospital treatment		
>20ºC	Patient is not presenting any signs of life	Do not quit administering first aid!
Remember about calling the emergency services to every cold victim! PROTECT THE PATIENT FROM BOUNCING/SHAKING IT MAY LEAD TO CARDIAC ARREST		

* Hypothermia – body temperature below 36.0ºC (thermometer for measuring body temperatures below 36.0ºC).

In such cases mouth-to-mouth ventilation using a mask is the best method as it provides the victim with humidified, warmed air exhaled by the rescue worker. Warmed and humidified 100% oxygen can be also administered through a warmer powered from a car battery or a 12V power supply in a car, an ambulance or a helicopter (Figure 1).

Figure 1:

In case of ventricular fibrillation in a hypothermic patient, we immediately administer three subsequent shocks from a defibrillator and, if ineffective, proceed with CPR and patient rewarming. If the victim's body temperature remains below 30 °C, defibrillation and drugs given during cardiopulmonary resuscitation may prove ineffective. Hypothermic heart is unresponsive to electrical stimuli and the heart muscle may be damaged with too frequently repeated shocks. Drugs, on the other hand, will not exert an effect

on a cold heart muscle because their metabolism is slowed down in the hypothermic liver. Therefore, they will accumulate and exert their effects upon rewarming of the patient, which may result in toxic concentrations of antiarrhythmic agents [8]. Their amounts should be decreased and intervals between subsequent doses prolonged.

Initiation of resuscitation, moving or repositioning of the hypothermic patient must be conducted very carefully. Massaging or putting pressure on her/his limbs is prohibited as it may relocate cold blood with accumulated waste products from patient's limbs to central circulation. Heart may respond to contact with cold venous blood from peripheral circulation (with low pH) with an arrhythmia or asystole, which may end tragically for the patient.

Methods of patient rewarming

Basic methods of rewarming hypothermic patients are:

- **passive – external – rewarming method (PER = passive external rewarming)**, used in: mild and moderate hypothermia. It reduces heat loss to a minimum through covering the patient with blankets and insulating material – it is effective during persistent shivers and ambient temperature above 21 °C. The advantages of this method are: non-invasiveness, simplicity and maintaining contractions of peripheral vessels. It may be used in deep hypothermia, as an auxiliary method;

- **active method:**
  - **external – transdermal rewarming – (AER = active external rewarming)**, when heat is transferred directly onto the skin through placing heating packs (chemical reaction) or hot water bottles in axillary fossae, alongside of the arms, chest and abdomen as well as inguinal regions, but also by using heating lamps, electric blankets and sleeping bags warmed with a stream of hot air. Active external rewarming is recommended only in moderate hypothermia because the heat transferred to the tissues stimulates peripheral circulation. **It may be effective when used together with core rewarming (ACR) in severe hypothermia**;
  - **internal – core – body rewarming (ACR = active core rewarming)** is the basic therapeutic management of severe hypothermia: cardiac arrest, unconscious patients, bradycardia. It includes: ventillation with warmed oxygen/air, which should be used already in pre-hospital care. Infusing warmed fluids into large veins, peritoneal dialysis or hemodialysis with warmed fluids, rinsing pleural cavities, gastric or intestinal lavage using warm fluids.
- **active – internal – method of body rewarming in severe hypothermia together with active transdermal rewarming** can be more effective, although heat should be directed at the thorax only. Warming of the extremities causes: increased metabolic rate in the periphery and increased hemodynamic demand.

Methods mentioned above diminish the patophysiologic effects of rewarming. [8]

However, clinical experience demonstrated that application of **active external rewarming** in cases of **severe hypothermia** before core rewarming and initiated cardiopulmonary resuscitation leads to increased metabolism and cellular oxygen demand. Often, it is even the cause of myocardial infarction and increased mortality in patients undergoing such treatment compared to those receiving active core rewarming.

Active external rewarming increases the flow of cold blood from peripheral vessels e.g. lower limbs and their muscles, through the heart. Therefore, it may be expected that such interventions will result in deepening of hypothermia in vital organs, especially the heart

Rewarming methods

Ventilation with oxygen/air warmed to a temperature 42-46 °C transmits heat not only to the face, nose, throat and neck, but also to the blood vessels located proximally to the airways that carry blood to the brainstem containing many vital centers. Heat transmission may be increased through intubation.

Such interventions quickly lead to rewarming of the central nervous system, regaining consciousness and stimulation of functions of centers regulating: breathing, thermoregulation and heart rhythm. It also causes gradual warming of thoracic organs: lungs and heart. It prevents further

heat loss from the hypothermic organism caused by respiratory heat loss.

Inhalation rewarming is non-invasive and may be initiated at the scene of the accident and performed without any waste of time throughout the way to hospital and continued on arrival.

Active external rewarming – using an electric blanket powered by a 12V (from a VRLA gel battery, a car cigarette lighter socket or a 230/12V transformer) or a 230V power supply. Heat is transferred directly from a blanket to the trunk – chest and abdomen – but not the limbs, to avoid a "thermal shock." (Figure 2.)

Figure 2: Electric blankets powered with 12V or 230V supply.

Extracorporeal rewarming: extracorporeal circulation, hemodialysis with regulated blood temperature.

Administering infusion fluids warmed up to temperature 40 – 43˚C via large veins .
Lavage with warm fluids: stomach, colon, pleural cavity, peritoneal dialysis.
Storing medications and infusion fluids at 15-30˚C in special, insulated, electrically heated containers. Using cold drugs while administering prehospital first aid may cause additional reduction in patient's temperature.

Effectiveness of rewarming

There are various ways to accelerate and increase the effectiveness of rewarming of the hypothermia victim:

- ***Active external rewarming*** – using an electric blanket powered with a 12V (VRLA gel battery, car cigarette lighter socket or 230/12V transformer) or a 230V power supply, hot water bottlers, warm bath or packs releasing heat of +37˚C (chemical reaction) – **we can achieve *core rewarming* at the rate of 0.5 ºC – 1 ºC per hour.**
- ***Ventilation with air/oxygen humidified and warmed to 40.5-42.2˚C*** **– we can achieve *core rewarming* at the rate of 1 ºC to 2.5˚C per hour.**
- **Central administration of fluids warmed to 40-42˚C** such as 5% glucose solution in 0.9% saline or 5% glucose ***at 150-200 ml/hour*** **– we can achieve gradual *core rewarming* at a rate of 0.5˚C to 1˚C per hour.**

- **Peritoneal dialysis with potassium-free fluids warmed to 40.5 – 43.3˚C, (maximally 2L at a time) – we can achieve core rewarming at a rate of 2.5˚C per hour**. However, it is associated with the risk of infection or bleeding and requires large amounts of dialysis fluid.

- **Lavage:**
  - ***of the stomach and urinary bladder with fluids warmed to 40 – 42˚C, or***
  - ***pleural cavity with fluids warmed to 40 – 42˚C*** **–we can achieve *core rewarming at a rate of* 2.5˚C per hour.**

- ***Extracorporeal circulation*** **– we can achieve core rewarming of 1˚C to 2˚C – for every 5 minutes** at a flow rate of 2-3 liters per minute.

- ***Using hemodialysis*** **– we can achieve core rewarming**, although this method is significantly slower and less effective than extracorporeal circu-lation. [17-20]

Further treatment

Acutely hypothermic patients often require fluid infusion into central veins before being transferred to the Emergency Department in order to fill the vascular bed. Great water loss occurs under such conditions due to evaporation and sequestration of fluid into the "third space." There are difficulties in maintaining proper blood pressure. Interventions that restore the volume of circulating blood may be also used when hypotension is due to its substa-ntial loss.

Venous catheters, infusion sets, urinary catheters as well as endotracheal tubes alike should be protected from the cold before their use and stored in heated containers. (Figure 3)

Infusion fluids: should be warmed before as well as during administration (to the temperature

Figure 3: Heated container.

of 40-43˚C) in order to protect the heart from further cooling.

Bottles containing infusion fluids and infusion sets: should be placed in a device that warms both the bottle and the tubing along its entire course – from the bottle to the puncture site.
Such warming dev-ice may be powered by a portable battery or a 12V power supply in an ambulance. It should protect the patient from infusion of cold fluids and effects of ambient cold air. Therefore, it should effectively prevent deepening of hypothermia.

A protector insulting the bottle and infusion set from the surrounding cold ensures that hypothermia victim receives warm fluids. It also helps avoid heat loss and protects fluids from cooling. Infusion of warm fluids increases body temperature and contributes to stabilization of general state of the hypothermic patient (Figures 4).

In cases of severe hypothermia with asystole the rescue team is focused on cardiopulmonary resuscitation and quickly transferring the patient to hospital for rewarming and further resuscitation. Treating such individuals outside the hospital is controversial.

Patients should be carefully covered with blankets or placed in sleeping bags prior to transportation on an airplane or by a helicopter. Their heads should be protected from cold air generated by a helicopter rotor [21] as this is the way organism loses 22% of heat (Figure 5).

Monitoring of heart rate, respiratory rate and temperature should take place during the entire time of transportation and resuscitation equipment should be always ready for use.

During transportation, the patient should be supplied with humidified, warmed oxygen/air for active core rewarming. It is a very important factor for treatment of hypothermia, stabilizing patient heart, lung and brain temperatures.

Figure 4: Protector insulting

An unconscious patient should not receive any drugs or fluids orally until regaining consciousness and ability to swallow.
Hot drink supplementation is not sufficient for warming patients in severe hypothermia. However, they may be helpful in treatment of moderate hypothermia.

Figure 4: Blanket and sleeping bag

Hypothermic patients – after gaining intravenous access – s**hould be given infusions of fluids warmed up to 40-43˚C:**

- 5% glucose or
- 5% glucose solution in 0.9% saline at a rate of 150-200 ml per hour.
- We should either use adequate devices for warming infusion fluids or place the bottle with infusion fluid in a temperature-controlled bath.
- **Ringer's solution is not recommended** for infusion in such cases because lactate metabolism decreases in the hypothermic liver.

Attention: Hypothermic patients must not receive fluids that had not been warmed.

When hypothermia occurs due to prolonged stay in cold water, the more tragic are the effects of premature termination of rewarming and resuscitation. Such victims are often considered drowned too early and their resuscitation is not always properly conducted till the very end.
Hypothermic patients should be transported to hospital as fast as possible.

Hospital management

Following the delivery of a hypothermic patient to hospital, further management should be conducted according to a proper scheme. (Table 3) Effectiveness of treatment increases in proportion to the progress of knowledge on pathophysiology of hypothermia. Mortality among victims of hypothermia may be low, especially in case of young people.

1. Mild hypothermia (body temperature: from 34 to < 36˚C)

Mildly hypothermic patients reveal good prognosis in terms of survival as long as they were rewarmed quickly. External rewarming is sufficient: using heat from an electric blanket or other sources.

In conscious patients we can use methods of external passive rewarming by protecting them from heat loss using blankets or a sleeping bag, as well as active rewarming with the use of an electric blanket, hot water bottles, warm bath or heat-releasing packs (chemical reaction) placed along the arms, neck, chest, abdomen and groin. However, it should be noted that it is not possible to monitor and record ECG during a bath.

Table 3: Hypothermia * - hospital management scheme

	INTERVENTION	PRECAUTIONS
37,5˚C	Normal body temperature measured in the oral cavity	
	Mild hypothermia: body temperature: 34 to <36ºC—Protect from further effects of cold.	
36˚C	Keep moving but without exertion. Warm bath	Do not massage cold limbs! Do not administer drinks containing alcohol or caffeine
35˚C	Administer hot, sweet, high-calorie drinks. Recommend staying in a warm room for a few hours. Protect from further heat loss.	
	DIAGNOSE COEXISENT INJURIES—OBSERVE THE PATIENT FOR 48 HOURS	
	Moderate hypothermia—body temperature: 30˚C to 33.9˚C — requires hospital treatment	
	Protect from arrhythmias	Do not perform excessive movements.
34˚C	Rewarm only the chest and trunk.	Do not rewarm externally aside from the chest and trunk
33˚C	Administer hot, sweet drinks. Administer oxygen or air humidified and warmed up to 42-46ºC through a face mask	Do not ad minister cold oxygen or air.
32˚C	Give intravenous fluids warmed up to 40-43ºC: 5% glucose in 0.9% saline,. or 5% glucose. Monitor: pulse, respiratory rate and ECG. Do not ad minister any oral fluids other than gel glucose	Do not ad minister cold drinks. Do not overload the circulation with intravenous fluids
31˚C	Monitor breathing and body position. Change the body position every 2 hours to prevent decubitus ulcers.	Do not give food or drinks.
	Severe hypothermia: body temperature below 30ºC requires hospital treatment	
	If necessary intubate the patient. If necessary defibrillate.	Intubation may cause ventricular fibrillation.
30˚C	Maintain the patency of the airways and conduct assisted respiration with humidified air or 50% oxygen warmed up to 42-46ºC through a mask at a rate of 12-15 breaths / minute.	Do not administer i.v. drugs if body temperature remains below 30ºC., e.g. lignocaine, propranolol.

	INTERVENTION	PRECAUTIONS
29˚C	Cardiac massage: 80-100 chest compressions / minute. Peritoneal dialysis with warm fluid and/or warming blood with extracorporeal circulation	Do not defibrillate when body temperature remains below 30ºC.
>28˚C 27˚C	Patient does not exhibit any signs of life.	Maintain resuscitation: until core temperature reaches 35ºC - until patient is declared dead!
Severe hypothermia: body temperature below 20ºC—requires hospital treatment		
>20˚C	Patient does not exhibit any signs of life	Do not quit CPR – until patient is declared dead!

* HYPOTHERMIA – body temperature below 36.0ºC (thermometer for measuring body temperatures below 36.0ºC)

2. Moderate hypothermia (body temperature: from 30ºC to 33.9˚C)

Treatment should involve all basic recommendations mentioned above except for active external rewarming. Additionally, the following should be performed if necessary:

- cardiopulmonary resuscitation – in any case of asystole diagnosed based on auscultation for 45 seconds or an ECG,
- heart rate and respiratory rate should be monitored for a long period of time.

One should remember that:

- abolished light reflex response, attenuated reflexes, inability to determine blood pressure, lack of reaction to pain – are not basis for declaring a hypothermic patient dead,
- following general rules for declaring death in a hypothermic patient may delay initiation of proper therapeutic life-saving interventions,
- rewarming does not equal reversing the process of hypothermia, especially in patients who pass from moderate to deep hypothermia over a long period of time.

One should also remember that external whole body rewarming is a very risky intervention; it may lead to dilatation of peripheral vasculature and hypotension as well as relocation of cold blood returning to the heart. It leads to further decrease in temperature of internal organs. It contains large amounts of lactic acid, lowers blood pH and may contribute to development of ventricular fibrillation.
The key to success in rescuing such patients is **passive rewarming**, which stabilizes temperature through protection against further heat loss.

The most effective treatment in this group of patients is a **method of active core rewarming** through direct transmission of heat to the inside of the body: through administration of warmed, humidified oxygen or air for inhalation and infusion of warm fluids into central veins.

After proper circulation and breathing is restored at hospital, patients may be additionally rewarmed externally through direct transmission of heat onto the chest and abdomen, but not the limbs, under constant monitoring of core body temperature.

3. Severe hypothermia (body temperature below 30˚C)

Initiation of out-of-the-hospital treatment in case of patients suffering from severe hypothermia requires supplying emergency vehicles with appropriate equipment and trained personnel. Heart rhythm monitoring should be started at the site of the accident although it should not delay transport to hospital.

Endotracheal tube should be placed in order to ensure airway patency and enable ventillation with warm, humidified oxygen or air. Careful intubation may protect the patient from ventricular fibrillation. Defibrillation should be carried out if ventricular fibrillation appears, all the while remembering that a heart cooled down to a temperature below 30 ºC does not always respond to electrical stimuli and administered medications. Defibrillation may prove effective only after rewarming the heart above this critical temperature.

During treatment of hypothermia we should:

- monitor body temperature,
- monitor results of laboratory tests: blood gasses, potassium and glucose levels, base excess,

correcting them when necessary

Attention:

- core temperature may be lower than measured skin temperature and we should make sure it does not drop any further,
- complications that may occur during rewarming: arrhythmias or pulmonary edema as a result of fluid overload.

Treating a patient in severe hypothermia with asystole requires rapid, direct actions and core reheating of internal organs.
Any injuries in such patients may be treated in a similar fashion as in patients with hypothermia up to 32 °C and results are often better than in patients with normal body temperature.
Measurement of esophageal core body temperature, as the closest to the temperature of the heart, is more accurate than that taken on the tympanic membrane or in the rectum.

Laboratory tests to be done at hospital.

If possible, the following tests should be performed immediately after arrival in the hospital:

- blood gass,
- complete blood count,
- prothrombin time,
- serum levels of: glucose, electrolytes, urea, creatinine, amylase, liver function tests, ECG, chest x-ray and urinalysis.

Methods of rapid core rewarming at hospital:

- **ventilation with humidified oxygen/air warmed up** to 42-46°C,
- **central infusion of fluids** warmed up to 40-43 °C at a rate of 150-200 ml/hour while watching for the signs of fluid overload,
- **peritoneal dialysis** with 2 liters of potassium-free fluid warmed up to 43°C. Peritoneal lavage is a less complicated intervention. It may be carried out in severe hypothermia resulting in rapid warming of internal organs.
- **hemodialysis**, although slower and less effective, is also very practical due to relatively small invasiveness from a surgical point of view,
- **extracorporeal circulation** used in treatment of severely hypothermic patients – if available, it allows for quick and controlled rewarming.
- rewarming through a gastric tube – used in many European hospitals when extracorporeal circulation is not available,
- **pleural cavity lavage** may be very helpful and allows for rewarming at a rate of 2.5 °C per hour, but is associated with potential complications and should be performed only when other means are not available.

These methods allow for quick core rewarming in victims of hypothermia.

Extracorporeal circulation is the method of choice in severe hypothermia but available only in large, well-equipped Medical Centers.

Terminating life-saving efforts

Hypothermic patients not exhibiting any signs of life should be treated vigorously because otherwise they will not survive without central nervous system deficits. Interventions aimed at increasing body temperature above 35 °C can be terminated if a patient warmed up to this temperature is in asystole and remains unresponsive to administered treatment. Doctor's decision regarding termination of resuscitation should be always individualized and made separately by taking all circumstances into consideration.

Effective treatment of hypothermia requires that every Emergency Facility and Emergency Department should be staffed with well-trained personnel experienced in providing medical aid and methods of resuscitation of hypothermic patients. Severe hypothermia may accompany every disease. Therefore, doctors must know its symptoms and methods of treatment.

Conclusions

- Introducing a hypothermia treatment algorithm should facilitate understanding of the problem and improve the effects of rewarming and therapy.
- The following methods should be applied in treatment of hypothermic patients: cardiopulmonary resuscitation, temperature stabilization through ventillation with warm, humidified oxygen/air and infusion of warm fluids into central veins.
- Rewarming and treatment of a hypothermic patient at hospital may require intubation, placing a central line, peritoneal lavage with warm fluids or application of extracorporeal circulation.
- During the post-resuscitation period, the

patient requires careful observation at hospital due to the possibility of respiratory, hematologic and renal complications.

- Examinations of heart temperature in hypothermic patients undergoing rewarming procedures revealed that effectiveness of rewarming as well as increase in temperature are greater if the patient is ventilated with humidified air warmed to 44 °C and receives infusions of warm fluids.
- One should remember that using Ringer's solution may be dangerous for the hypothermic patient due to decreased lactate metabolism in the hypothermic liver.

Acknowledgements:

Original article previously published in the Polish language in *Wojskowa Farmacja i Medycyna*.

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Emergency Medicine

Systems of medical segregation in mass casualty incidentse

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Received: 2011.01.12 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

There are many systems of medical segregation currently used in the world for those injured in mass casualty incidents. Although different from each other, they serve one purpose – to do as much as possible, for the highest number of victims. This article presents the main systems of medical segregation. They an essential component of knowledge of Emergency Medical System teams.

Key words: logistics, triage, mass casualty incidents.

Introduction

Mass casualty incidents constitute one of the most difficult, proficiency-demanding emergency service operations in Poland and around the world [1]. The term "mass casualty incident" refers to an event, in which the number of casualties and types of injuries they sustained exceeds the response capabilities of local emergency services, creating a disproportion between the demand for emergency medical aid and the means ensuing from human and material resources of emergency services [1,2]. Beside the mass events observed until now that resulted either from natural causes like earthquakes and tsunamis, or human error such as collapse of the exhibition hall in Katowice, since the end of the Cold War we have been observing a constant increase in the level of terroristic threat as evidenced by the terrorist attacks involving large numbers of casualties in New York, London or Madrid that occurred in the last decade. Rescue operations carried out under those conditions require conducting a triage.

History of triage

The word "triage" comes a from French word "trier" meaning "to segregate". The history of medical segregation of casualties reaches the times of Napoleonic battles, during which the chief surgeon of Napoleon's army, barron Dominic Larrey created "flying hospitals" as a part of military health care system [3,4]. Personnel traveled on horseback through the battlefield and assisted to soldiers with the best prognosis for recovery. Slightly injured soldiers were helped first, so that they could return to battle immediately. It resulted from military logistics, as the main goal of military medicine was not to save lives of soldiers, but to win the battle. Another important moment in triage development was when John Wilson described the rules of medical segregation in mass casualty incidents in 1846, dividing casualties into three groups depending on sustained injuries. The first group consisted of victims with minor injuries, the second group suffered severe injuries and the third – fatal ones. With time, rules of triage were modified and it was used during World War I and II to finally be adapted to the conditions of civilian health care.

One should remember that triage is a dynamic process of patient assessment that requires awarding segregation priority and adjusting rescue operations to victim's condition [5]. Segregation priority, once granted, may change in accordance to changes in patient's condition. The process of patient evaluation – widely known triage criteria - should be based on: severity of injuries, their effects on vital organ functions (respiratory and circulatory system), individual characteristics of the patients (general health status, age) and analysis of the mechanism of injury. Such appraisal, despite the drama of the situation and extraordinary emotions that are associated with it, should be conducted on the grounds of rational reasoning while maintaining calm and thorough assessment of the situation.

Currently used triage algorithms differ from those from Napoleonic times. In the sphere of civilian health care they are adapted to the system of rescue services of a given country [6]. Several triage systems are available (START, SIEVE, SORT, SAVE, etc.). Nevertheless, international guidelines were prepared for dealing with mass casualty incidents, resulting in unification of all segregation procedures. General classification of medical triage systems including examples of scales is presented in Figure 1.

START System

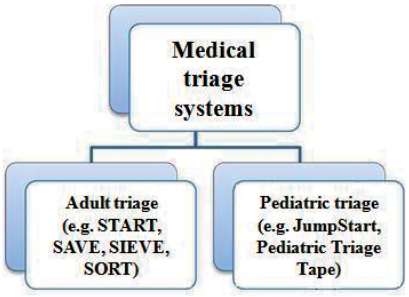

Figure 1: Types of medical triage systems.
Source: author's archives.

The START system was created in the 80's of the twentieth century by a team of doctors from Hoag Memorial Hospital in California working together with the Newport Beach fire department. It is currently one of the best known and most often used segregation algorithms in the world [1,7].

The grounds for this system is allotment of patients to appropriate categories depending on three physiological parameters: respiratory rate, heart rate/peripheral perfusion and state of consciousness (Fig. 2). The first step of START algorithm involves selection of patients who can walk by themselves and require only ambulatory help. They are assigned green identification tags and directed to the waiting area for thorough examination at a later time. Patients with yellow tags belong to the second category. In this group we can include people who are not exposed to immediate danger of life loss, but their injuries require attendance within 24 hours from the event. People in life-threatening condition that require urgent medical aid and the quickest possible transport to a specialist center are given red tags. Patients with minimal chances of survival, without preserved breath and pulse, with extensive crashing injuries, skull wounds with visible brain tissue damage and burns encompassing almost entire body receive black tags. Help will be granted to them at the end, after attending to people with better prognosis.

Assessment of key physiological parameters under the circumstances of a mass casualty incident should not last longer than 30 seconds. It begins with assessment of breathing. If breath is not detected despite securing patency of the airways, the patient is given a black tag without a pulse assessment. If breathing returns spontaneously or tachypnoe >30 breaths/minute appears after securing the airways, then patient receives a red tag. If breathing is preserved at a rate below 30 breaths/minute, the next step in the algorithm involves assessment of pulse or capillary return. If capillary refill time lasts longer than 2 seconds or radial pulse is absent, the patient receives the red tag of urgency. Sometimes, prolonged capillary refill time, decrease in pulse pressure or lack of radial pulse is a result of bleeding from damaged blood vessels. In such cases, bleeding should be stopped before moving on to evaluation of the next patient. When the above parameters are normal, the victim should be examined with regard to the level of consciousness. When the patient follows simple orders, he is given a yellow tag. If it is otherwise – he receives a red one.

Regardless of the applied triage system, the most important role is attributed to the emergency medical team arriving at the scene. The person in charge of the emergency medical team assumes duties of a medical coordinator at the site of the

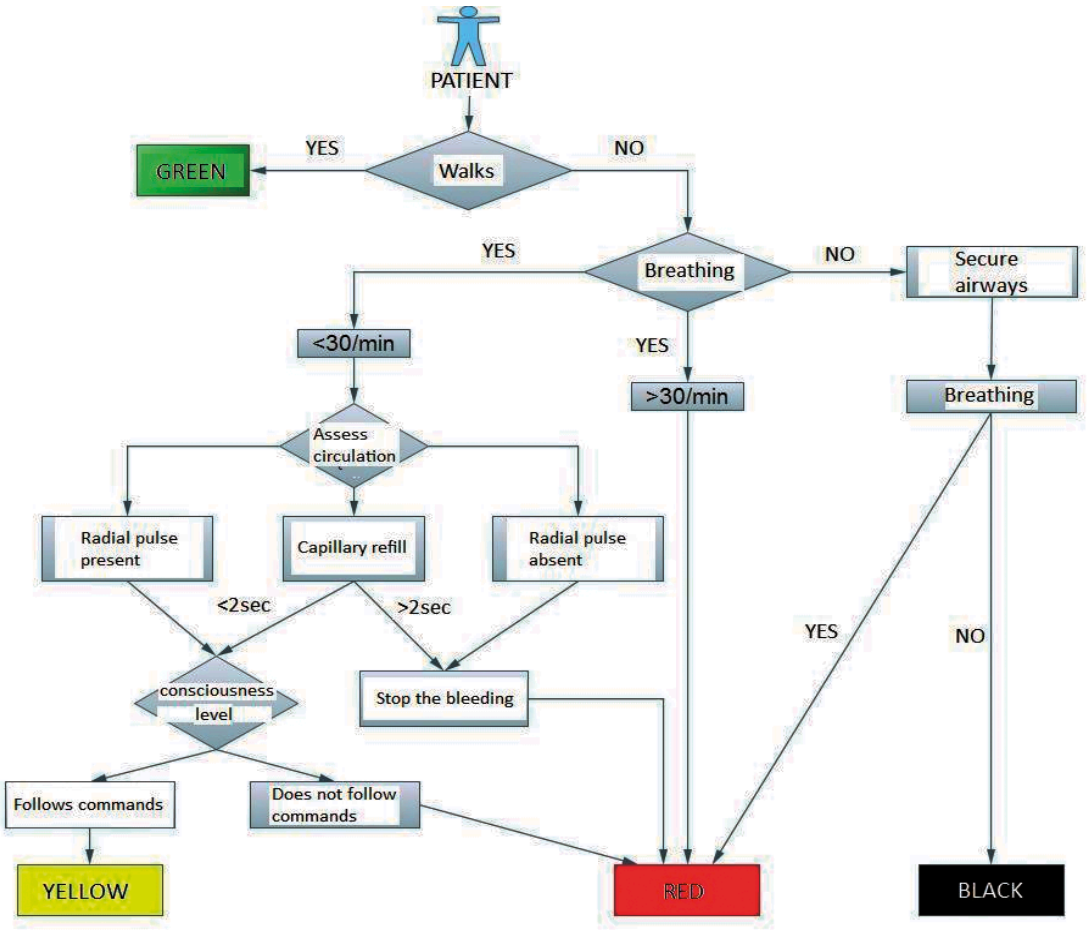

Figure 2: START scheme.
Source: author's archives.

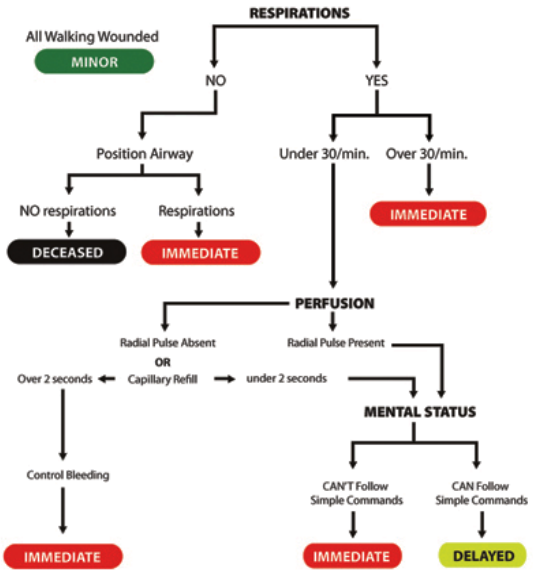

Figure 3: An ex ample of triage armbands.
Source: author's archives.

Figure 4: An ex ample of triage armbands.
Source: author's archives.

incident and his team is responsible for assessment of the situation and organization of rescue actions [8,9]. In order to conduct triage efficiently, people responsible for segregation use various cards or triage armbands. An illustration of such bands is shown in Figure 3.

SAVE system

During catastrophes, e.g. earthquakes, where the number of casualties is enormous, rescue is prolonged and it is impossible to transport patients to hospitals in the first phase of the rescue operation, it is often necessary to attend to patients and hold them (even for several days) in special field hospitals organized at the site [10]. Triage conducted under such circumstances differs from traditional segregation systems. Therefore, a SAVE (Secondary Assessment of Victim Endpoint) system was developed allowing for segregation and securing of casualties with limited medical resources for a period of a few hours to even several days. SAVE scale evaluates prognosis of patient survival on the basis of trauma scores and determines expected benefits with regard to available medical resources [9,11].

Among parameters evaluated in this segregation system, we take into consideration the type of sustained injury and age. Elderly patients with burns covering more than 70% of body surface, who cannot be treated at the site due to necessity of involving significant medical resources (both human and equipment), are assorted to the waiting area. The opposite is true for young people with GCS of 12, who only require securing of the airways (securing airway patency will consume minor resources while considerably increasing chances of survival). They will be directed to the zone of urgent medical aid.

Among representative elements of victim assessment taken into consideration when applying SAVE system, we may distinguish the following: Glasgow coma scale (GCS) assessment, evaluation of limb injuries (MESS scale), chest injuries associated with disruption of vital functions, abdominal injuries with hypotension resistant to treatment, spinal cord injuries.

STM system

The STM system (Saccotriagemethod) is based on evaluation of three parameters: breathing, pulse and best motor response [6,12]. Patient may maximally receive 12 points and the minimum number of points is 0. Patient is assorted to one of three groups based on that number. Patients with 9 to 12 points have high evacuation priority level. Those, who received 5-8 points come second and persons with 0 to 4 points constitute a group for deferred evacuation (Table 1).

TRIAGE SIEVE

Triage SIEVE, which is also called a screening segregation system, is most commonly used in Australia and Great Britain. Similar to the START system, triage SIEVE distinguishes 4 categories of patients. They are allocated to particular categories on the basis of vital function assessment: respiratory rate, heart rate or peripheral perfusion. In this system, capillary return, considered unreliable at low ambient temperatures, was replaced with pulse rate examination.

Table 4: Scheme of an STM system

Assessed Parameter	Value	Points
respiratory rate (/min)	10-24 25-35 >36 1-9 0	4 3 2 1 0
heart rate (/min)	61-120 >120 41-60 1-40 0	4 3 2 1 0
motor response	follows orders localizes pain withdraws from pain flexion or extension response no response	4 3 2 1 0

Analogous to the START system, the green-labeled group [category T3] is not in a life-threatening condition and patients' symptoms require merely ambulatory aid. Also, the lives of patients in T2 category (yellow) are not immediately endangered. They should be attended to within 4 hours from the event. Category T1 (red) refers to patients in urgent need of lifesaving actions. According to Triage SIEVE there is also a fourth category of patients [T4]. This group was not assigned a color. It consists of patients with minimal chances of survival and their rescue was postponed until after patients from group T1 and T2 are attended to [6,9,13].

JumpSTART System

In 1995 doctor Lou E. Roming introduced the JumpSTART system. This is a specific modification of the START system accommodated to segregation

of pediatric patients below the age of eight [10,14]. Patients older than 8 years are evaluated according to adult algorithms. Medical triage of patients below the 8th year of life is conducted in a way similar to adults – according to the ABCD scheme. The main difference is in the proceeding in the absence of breath after securing airway patency. If it were an adult, the victim would have been considered dead. In case of a child, an additional assessment of peripheral pulse should be completed. If breathing is absent but pulse is preserved, the rescuer should perform 5 rescue breaths. Child is declared dead and assigned a black tag if rescue breaths prove unsuccessful or both breathing and pulse are absent. A red tag is also reserved for patients weighing under 10 kg, requiring suction of airway secretions and for children suffering from open fractures, burns covering over 10% of body surface and large wounds even if the physiological parameters are within normal ranges·

It should be remembered that a child is not a "little adult." Child's physiological and psychological response to injury differs significantly from adult's. Due to a relatively small body mass, the effect of a force exerted on a child is proportionally greater than in case of an adult. Therefore, one should suspect internal injuries in a child despite the lack of external signs of injury. This is why red color is also reserved for patients weighing less than 10 kg, requiring suction of airway secretions or children suffering from open fractures, burns covering more than 10% of body surface and large wounds even if the physiological parameters are within normal ranges.

The next problem regards evaluation of consciousness level using AVPU scale (A-alert, V-voice, P-pain, U-unconscious). One should remember that the level of consciousness is a very sensitive indicator of perfusion disturbances in children. A child able to focus attention on one thing is not suffering from consciousness disruption [14].

PediatricTriageTape

In case of pediatric triage we observe a method similar to the Braslow Tape, which simplifies calculations of doses of medications and sizes of rescue equipment during resuscitation of pediatric patients. It is called a PediatricTriageTape [14]. This is a tape divided into four segments. Each one of them contains an appropriate triage algorithm "triage sieve" with segregation criteria adjusted to a specific age group, constituting sort of a Cheat Sheet for medical rescue personnel.

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Emergency Mediciney

Injuries caused by body overheating

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Received: 2011.11.20 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Injury and heat stroke are life-threatening states, requiring immediate help and fast treatment. Body overheating caused by physical effort (heat cramps, heat injury and heat stroke) pose a serious problem during military actions.
Body overheating is accompanied by serious biochemical, physiological and haematological disorders - including life-threatening conditions, which required immediate medical treatment

Key words: hyperthermia, hyperthermia-favouring factors, heat exhaustion, sunstroke, immediate treatment.

Some time ago, the American researchers published shocking data according to which over 600 people died in Chicago, due to the heatwave between 12 and 20 July 1995. More than 3300 people were admitted to Intensive Care Units and 21% of them died during their hospital stay.

According to publications from other countries, with a climate similar to that of Poland, the first fatalities appear with only 2-3 days of temperature reaching the level of 32°C or more in the shade. This is followed by a sudden increase in mortality and morbidity due to body overheating.

The number of admissions due to heat stroke in such periods has increased tenfold compared to the previous years, i.e. from 0.2/1000 to 2.3/1000 cases and the highest number of patients were admitted after 6-7 days of persistent heat [2].

In Europe, weather forecasts on gradual climate warming are coming true. A heatwave in the south of France, Spain, and Portugal from mid-June to mid-July 2003 caused not only a series of fires but also a disastrous "epidemic of death" among people, due to hypothermia, i.e. body overheating.

According to other sources, heatwave in 2003 led to over 15000 fatalities in France only and these were only estimates (and only thorough). Although Poland has a moderate climate and the periods of scorching summer heat are usually short, the recent years have witnessed temperatures reaching 32°C or even more (35-36°C in the shade) from mid-May to end-September, normally accompanied by increased air humidity.

In the available statistical data, the fatality rate due to body overheating on hot days in Poland is not given. It is only known that Emergency Medical Services record more sudden illness calls then and a higher number of patients present to emergency rooms at hospitals, for medical help.

Such weather conditions are very tiring and sometimes even dangerous or fatal for many individuals, especially the elderly, the sick and the young children.
Moreover, it should be remembered that weather conditions on such days may be extreme for individuals employed at work places as smelting plants, mines or in other industries, as well as for professional sportsmen and for soldiers serving in other climates than in Poland.

Overheating concerns people of all ages, and especially the ones that travel to countries where the climate (compared to the Polish one) is warmer, with high insolation, considerable air humidity, and temperatures reaching 40°C in the shade, or much more.
Such weather conditions can found in south Europe or Mediterranean countries already, but also in Israel or Arabian Peninsula: Kuwait, Saudi Arabia, and currently especially Iraq.

Armed Forces stationed in Iraq should therefore be previously adapted to summer weather conditions of that country. This may be necessary, especially for military tasks connected with a significant physical effort.

The level of tolerability of hot weather is influenced not only by the temperature but also by air humidity.
Many hours of work connected with physical effort in hot environment or in insolated places, as well as breathing with hot, humid air results in adverse consequences of overheating.

This is a result of extremely increased body temperature due to:
- No acclimation to the existing conditions or
- Disturbed mechanisms of thermoregulation and
- Heat stored in the body, with no possibility of its exchange with the environment.

1. Factors favouring hyperthermia

Hyperthermia is favoured by the following factors:
- Dehydration,
- Hard work or extensive effort – at high environmental temperatures and considerable air humidity,
- Physical exhaustion,
- Cardiovascular diseases,
- Chronic diseases – e.g. diabetes,
- Stress,
- Covering oneself up too warmly,
- Decreased heat radiation from the body caused by medicines disturbing thermoregulation,
- Sedatives and hypnotics,
- Drugs, especially amphetamine,
- Old age or physical disabilities.

2. Consequences of a long-term and uncontrolled increase in body temperature

In hot environment, after the period of increased perspiration, the human body stops producing sweat, and there follows uncontrolled increase in body temperature, exceeding 40°C or even reaching 44°C.
The consequences of long-term and uncontrolled increase in body temperature can be as follows:

- **heat cramps,**
- **sun stroke,**
- **heat exhaustion or**
- **heat stroke.**

Body overheating is accompanied by severe biochemical, physiological, and haematological disorders – that may be even life-threatening, and requiring immediate treatment (Table 1).

The activation of defence mechanisms leads to increased heart rate and cardiac output, and then to translocation of blood to skin vessels. This may result in heamodynamic abnormalities and decreased blood pressure, leading to ischemia of muscles and internal organs, and especially brain, kidneys, liver, and heart.

With a long stay in a hot and humid environment, there appear disturbances of thermoregulatory mechanisms and a significant loss of water and electrolytes: decreased or even stopped perspiration, and then body overheating and disturbances of the central nervous system, leading to life-threatening conditions.

2.1. Heat cramps

Hard physical work in conditions of exposure to heat concerns many areas of life. Hot environment activates thermoregulatory mechanisms

that are aimed to protect the body from overheating. This results in increased perspiration; the evaporating sweat absorbs significant amounts of warmth from the body through the skin. This may lead to a loss of 1-3 litres of sweat in one hour, and then to considerable dehydration and increased loss of ions of sodium, potassium and chlorine.

In normal conditions, the 24-hour perspiration involves excretion of sodium, potassium and chlorine in the amounts presented in Table 1.

Table 1: *

Volume and composition of the sweat				
Mean volume	Concentration of electrolytes (mEq/l)			
(ml/day)	Na^+	K^+	Cl^-	HCO_3^-
500 - 4000	30 - 80	0 - 5	30 - 70	0

* After: H.A. Harper: Terapia płynowa i elektrolitowa, in: Chirurgia w zarysie, /editor/ J.L. Wilson, PZWL, Warsaw 1973, page 148

2.1.1. Symptoms
In individuals performing a hard physical work in hot environment, there usually appear (at the end of the day) painful cramps of muscles involved in the most intense physical effort.

2.1.2. Mechanism of action
These disorders are directly connected with a loss of considerable amounts of sweat containing ions of sodium, potassium, and chlorine.

Body temperature, heart rate and blood pressure values remain normal.

2.1.3. Treatment
Water and electrolyte deficits should be corrected as fast as possible.

2.1.4. Prognosis
After correcting water and electrolyte deficits, the symptoms disappear relatively fast and entirely.

2.2. Sunstroke

This is a pathological condition caused by staying long in the open air on a sunny and hot day, bareheaded, that is with the head directly exposed to sun.

2.2.1. Symptoms
In young children – after a longer exposure to sun – the fever may be a basis for a diagnosis of sunstroke.
The skin on the face is very red and hot, while the remaining skin surface is pale and cool. Body temperature can be increased. There may appear vomiting, stiff neck and headaches, and the patient can be agitated, with disturbed sense of direction. A temporary loss of consciousness may develop into a more persistent state which can be life-threatening and requiring immediate treatment.
Sunstroke may be accompanied by heat stroke, inhibiting correct diagnosis.

2.2.2. Mechanism of action
Due to a direct exposure of the head to sun, the head becomes overheated, giving symptoms of cerebromeningeal irritation.

Children, elderly persons and bald people are at the highest risk of this kind of thermal injury when directly exposed to sun and bareheaded. Thin skin and skull bones (which are not fully fused in young children in the area of fontanelle) are not an effective barrier against heat. The regions of the brain directly adjacent to the skin in these areas easily get overheated.

2.2.3. Treatment
The patient should be located in the shade and cold. When body temperature is increased, it should be lowered as fast as possible by removing excessive clothing, and applying cold compresses on the head. The skin of the head should be sprinkled with cold water and ventilated with air from electric fan, causing increased water evaporation with simultaneous cooling of the skin.

In case of lost consciousness, the patient should be placed in a lateral position. Cardiopulmonary resuscitation should be introduced when required.

2.2.4. Prognosis
Prognosis concerning survival is usually favourable, although there may appear haemorrhages from the gastrointestinal tract and foci of cerebral malacia.

2.3. Heat exhaustion

It is a life-threatening condition – requiring immediate treatment.

Heat exhaustion is a result of exhausted thermoregulatory mechanisms of the body due to a

longer stay in high environmental temperatures and air of increased humidity. There occurs a secondary loss of water and ions: chlorine, potassium, and sodium. This condition develops within a few days of heat and usually after a longer stay in a hot microclimate.

2.3.1 Symptoms
Disturbed thermoregulation is accompanied by a collapse of peripheral circulation. Many organs become injured at the cellular level, which results in disturbances of the function of:

- heart, liver and kidneys,
- coagulation system,
- thermoregulatory mechanisms and perspiration – manifested by a hot and dry skin,
- central nervous system, manifested by:
  - Confusion,
  - Delirium,
  - Lost consciousness.
- Body temperature raised to over 40.6°C

According to the literature data, mortality ranges from 10% to 80% in such cases and depends on the level of overheating [1].

2.3.2. Immediate care
The patient should be undressed and placed in a cool place. His/her body temperature should be lowered as fast as possible, down to 38.0°C – within 30 minutes by [2]:

- bathing in cool water,
- wrapping in wet, cool sheets or blankets,
- sprinkling the body with cool water in the form of aerosol,
- lavaging the stomach or colon with cool saline,
- directing the air from an electric fan onto the patient's skin – thus increasing the process of transferring the heat from water evaporating from skin surface to air.

When cooling the body of the patient, the temperature should be continuously monitored with electronic thermometer placed in the rectum, in order to avoid extreme cooling and hypothermia.

It is also required to:

- monitor ECG and central venous pressure.
- administer oxygen and, when necessary, intubate the patient and introduce assisted breathing,
- in case of cardiopulmonary arrest, cardiopulmonary resuscitation should be started,
- start intravenous infusion of fluids – in order to correct water and electrolyte deficits, which should improve blood circulation,
- the fluids should be infused slowly, taking into consideration the fact that the heart muscle might have been injured and the renal function might have been disturbed.

If this is required by patient's general condition, he/she should be transferred to Intensive Care Unit to undergo appropriate adjunctive treatment.

2.4. Heat stroke

Heat stroke is a result of a prolonged stay at high environmental temperatures and considerable air humidity. This condition develops within a few days of heat and usually after a longer stay in a hot microclimate, when thermoregulatory mechanisms become exhausted and the body temperature reaches 42.2-43.3°C. Heat stroke is a life-threatening condition requiring immediate care.

It should be remembered that ***early diagnosis*** and immediately introduced ***treatment of heat exhaustion inhibits the development of heat stroke***, and the faster the body temperature is lowered to 38.0°C, the lower the mortality among the victims of this form of body overheating.

Patients with a diagnosed heat stroke, e.g. in Saudi Arabia, are admitted to field, air-conditioned "Departments of Heat Stroke Treatment" where after being undressed, placed in horizontal position, and wrapped in wet gauze or sheet, they undergo cooling by having the body surface sprinkled with water in the form of aerosol, at a temperature of around 15°C and dried with a flow of air of room temperature, from electric fan. That is how the temperature on the skin surface can be lowered to 30-32°C, at a rate of 0.3°C every 5 minutes.

2.4.1. Diagnosis
Heat stroke may occur in individuals of all ages, but it usually concerns very young or elderly people.
The diagnosis is mostly based on symptoms and results of laboratory tests.

There follows a peripheral circulatory collapse and a secondary loss of water and ions of sodium, chlorine, and potassium.

Immediate care provided to the patient, a fast transport to hospital, and introduction of appropriate treatment allow for detecting and diagnosing a heat stroke in its early stage and on subjecting the patient to appropriate treatment, which may prevent from fatal consequences of the heat stroke.

However, very often the heat exhaustion and the heat stroke are misdiagnosed in their early stage, which may result in a coma, even at a few hours before the planned hospital discharge.

2.4.2. Differential diagnosis

The diagnosis should be differentiated with:

- pulmonary embolism,
- acute cardiological conditions,
- anaphylactic shock, and
- heat exhaustion.

2.4.3. Symptoms

Heat stroke may be manifested by the following symptoms:

- disturbed consciousness,
- body temperature raised to 42.2-43.3°C,
- dry, hot, and red skin,
- fast, irregular, and weak pulse, tachycardia,
- paroxysmal excessive sweating,
- asthenia, headache, vertigo, and vision disturbances,
- nausea and vomiting,
- stupor,
- muscle weakness,
- oliguria.

2.4.4. Immediate care

The patient should be:

- placed in horizontal position, with his lower limbs above the level of the trunk,
- undressed and placed in a cool and shaded room,
- cooled as fast as possible to achieve body temperature of 38.0°C within 30 minutes by:
  - bathing in cool water,
  - wrapping in wet, cool sheets or blankets,
  - sprinkling the body with cold water in the form of aerosol,
  - lavaging the stomach or colon with cool saline,
  - directing the air from an electric fan onto the patient's skin – thus increasing the process of transferring the heat from water evaporating from skin surface to air.

When cooling the body of the patient, the temperature should be continuously monitored with electronic thermometer placed in the rectum, in order to avoid extreme cooling and hypothermia.

If this is required by patient's general condition, he/she should be transferred to Intensive Care Unit to undergo appropriate adjunctive treatment.

3. Discussion

Heat exhaustion and stroke are life-threatening conditions requiring immediate care and fast introduction of treatment. Body overheating caused by physical effort (heat cramps, heat exhaustion, and heat stroke) is a serious problem during military actions.

A rapid diagnosis of these conditions and immediate cooling of the patient's body are the basic management. Critical cases must be quickly cooled to a temperature of 38°C (in rectum). Their intensive treatment and medical supervision are required.

A heat stroke is typically accompanied by multiorgan disorders. Overheating of milder degree may be managed with hydration, removal from hot environment, and placing the patient in a cool room.

During resuscitation, a 5% glucose solution or saline in glucose should be infused intravenously in order to stabilise the patient's general condition.

To prevent overheating in individuals from the risk group, the following should be introduced:

- their appropriate hydration, that is drinking of fluids in the amount appropriate to the body mass (volume of at least 2000-2500 ml daily),
- staying in cool rooms and
- adapting to the environment.

The drinks should contain mineral salts. Elderly persons should avoid staying in hot environment which should reduce the risk of overheating in hot weather.

Blue-collar workers, sportsmen, and soldiers should be gradually adapted to the hot environment, as well as have more fluids to drink at their disposal. Their clothes should be light and they

should be provided with a possibility to rest in cool rooms frequently.

The following preventive measures should be introduced: drinking more fluids before, during and after physical effort, gradually increasing the time of work spent in hot environment and avoiding physical effort in the hottest part of the day.

Weather forecasts presented in mass media in summer should warn about the forthcoming heatwaves and the health services should inform how to prepare for such hot days and encourage the residents to:

- avoid staying in suntraps,
- stay in cool or air-conditioned rooms,
- avoid attending to important business in the afternoon hours and
- avoid exhausting effort.

In order to reduce the morbidity and fatality rate caused by heatwaves, all residents should be informed about the health-related benefits of installation of electric fans at their homes or – depending on financial capabilities – air conditioners, and use them always when the room temperature starts to be uncomfortable.

4. Conclusions

1) Pathological conditions caused by high temperature, such as: heat cramps, sunstroke, heat exhaustion, or heat stroke are frequent in individuals working or staying in adverse environmental conditions – in hot environment – and cause many deaths every year.
2) The risk factors include: age, general health state, chronic diseases, excessive physical effort, high temperature of the environment.
3) Most of the fatal cases are recorded after first 2-3 days of intense heat. Individuals at risks of overheating include: sportsmen, soldiers, and people working in the open air or in rooms without proper ventilation.
4) Body overheating related to physical effort (heat cramps, heat exhaustion, and heat stroke) are an important problem during military actions.
5) The pathological conditions being a result of body overheating usually concern: elderly people, individuals with thermoregulatory abnormalities, with schizophrenia, people taking different medicines – including sedatives, hypnotics - and especially those abusing drugs and alcohol.
6) Factors increasing sensitivity to heat are as follows: cardiovascular diseases, diabetes, chronic diseases, multiple sclerosis, abusing drugs and alcohol.
7) These groups of individuals are especially exposed to risk of overheating and should take precautions in summer months.
8) Body overheating is manifested by many symptoms: from asthenia, vertigo and fatigue (in case of heat exhaustion), through syncope, loss of consciousness, neurological complications, stupor, and coma, to multiorgan complications, convulsions, or even death.

Acknowledgements:

Original article previously published in the Polish language in *Wojskowa Farmacja i Medycyna*.

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Emergency Medicine

Epidemiology of syncope in emergency medicine practice

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Received: 2011.01.12 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Introduction: Syncope poses a serious clinical and diagnostic problem in pre-hospital care. Preliminary diagnostics should encompass detailed history taking, measurement of blood pressure and a standard ECG. **Purpose:** The purpose of this study was to analyze interventions of Emergency Medical Service Teams due to syncope. **Material and Method:** The study was conducted with a retrospective analysis of medical documentation consisting of the departure order cards from the Otwock Emergency Medical Services in a period from 01 Jan 2009 to 31 Dec 2009. **Results:** The study involved 501 patients from the Otwock district presenting with out-of-hospital syncope. **Conclusions:** Syncopal episodes pose a serious problem for Emergency Medical Service. They affect women (62.08%) more frequently than men (37.92%). Mean age of the affected men and women is 61.41 years. They occur most often in people aged 70-90 years. The most common etiology of syncope is neurogenic (reflex). They usually take place in the afternoon and during summer.

Key words: loss of consciousness, syncope, emergency medical services, epidemiology.

Introduction

Syncope poses a serious clinical and diagnostic problem. Together with transient loss of consciousness, it is responsible for 3% of all ambulatory visits and 6% of all hospitalizations [1,2,3]. It is a common reason for summoning Emergency Medical Services (EMS). Therapy initiated by the EMS in patient's home should be continued at hospital as, according to Ahnfeld, EMS should be "an extended arm of the Hospital."

European Society of Cardiology (ESC) defines syncope as a transient loss of consciousness due to transient global cerebral hypoperfusion characterized by rapid onset, short duration, spontaneous and complete recovery. The definition of syncope presented above narrows down the previous, wider definition of syncope, by including the cause of unconsciousness through introduction of the term "transient global cerebral hypoperfusion" [1,4,5].
Since 2001, ESC has been successively publishing guidelines on the diagnostics and management of syncope. The most recent guidelines were presented in 2009. According to those guidelines, syncope should be differentiated from other conditions associated with partial or total loss of consciousness due to causes other than cerebral hypoperfusion as well as syncope-like incidents without

impaired cerebral perfusion. In fact, we can distinguish syncope and pseudo-syncope from a true or apparent loss of consciousness by finding whether loss of consciousness occurred and whether features such as: transient character of the episode, rapid onset, short duration of symptoms and spontaneous recovery were present. Generally, episodes of transient loss of consciousness may be divided into traumatic and non-traumatic [6] (Fig. 1).

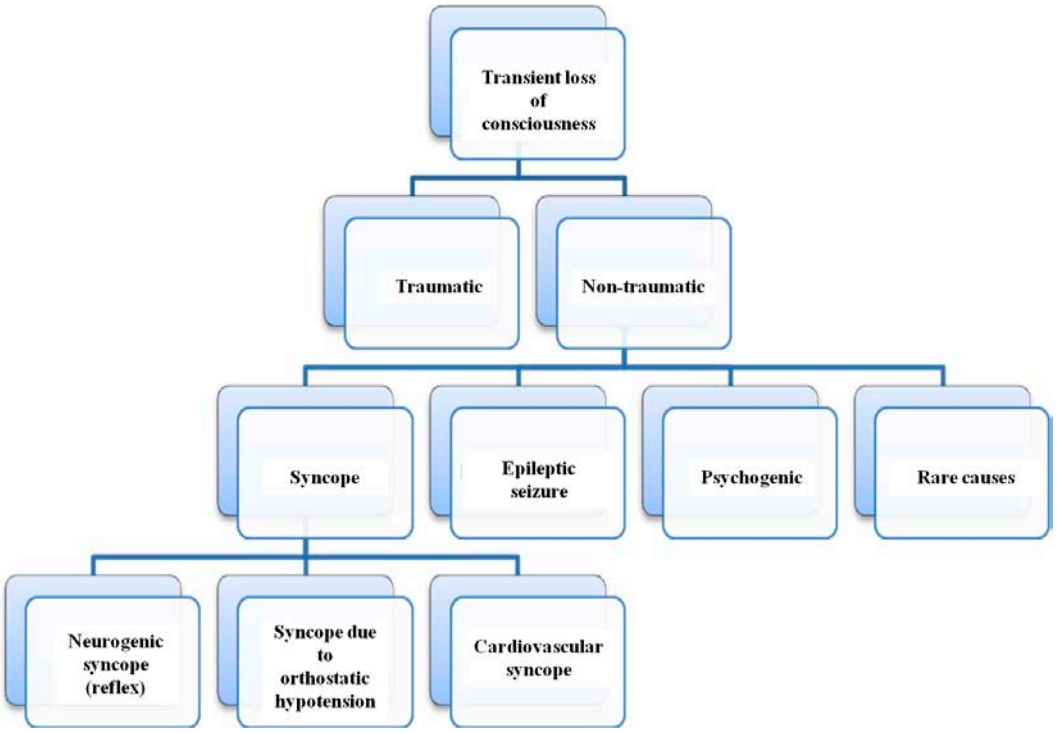

Figure 1: Causes of transient loss of consciousness according to the ESC 2009

Conditions incorrectly diagnosed as syncope may be divided into disorders with partial or total loss of consciousness and disorders without impairment of consciousness [7,8]. In the first group we may include: metabolic disorders (including hypoxia, hypoglycemia, hyperventilation with hypocapnia), epilepsy, intoxication and vertebrobasilar transient ischemic attacks (TIA) [9]. The following states belong to the second group of conditions misdiagnosed as syncope: falls, drop attacks, cataplexy, TIA of carotid origin and functional disorders (psychogenic pseudosyncope) [4,10–12].

Preliminary diagnostics carried out by either a general practitioner, personnel of Emergency Medical Service Teams or an Emergency Department doctor should include taking a detailed history of the circumstances and frequency of syncopal incidents, sudden deaths in the family, physical examination, blood pressure measurements in a horizontal and standing position (a decrease in systolic blood pressure by ≥20mmHg or to the value of ≤ 90mmHg on assuming an erect posture regardless of the presence of symptoms is called orthostatic hypotension), and standard ECG (evaluation of heart rate, atrioventricular and interventricular conduction disturbances, signs of heart muscle hypertrophy, arrhythmias, ST-T segment changes) [13–15]. An abnormal ECG recording at rest constitutes an independent predictor of cardiogenic syncope [13,16,17]. The following electrocardiographic anomalies may be the causes of syncope:

- sinus bradykardia < 40/min or recurrent sinoatrial blocks,
- sinus arrest lasting > s,
- II degree atrioventricular block (Mobitz type II or III),
- supraventricular or ventricular tachycardia,
- intermittent left and right bundle branch block,
- acute ischemia with or without ST segment elevation,
- pre-excitation syndrome,
- cardiac stimulator malfunction with pauses,

- long QT,
- Brugada syndrome,
- T-wave inversion in right-sided precordial leads and an epsilon wave suggestive of arrhythmogenic right ventricular dysplasia,
- interventricular conduction abnormalities (QRS≥0.12s).

While some incidents of syncope can be accompanied by a prodromal period encompassing: lightheadedness, nausea, "cold sweat", weakness or blurred vision, syncopal episodes due to arrhythmias or conduction abnormalities appear suddenly [9,18,19].

Purpose of the study

Analysis of prevalence of syncopal events in the practice of Medical Emergency Service in Otwock with particular focus on the relationship between age, sex of the patient, time of the day and a season and occurrence of syncope.

Material and methods

The data was collected based on the departure order cards of the Emergency Medical Services operating in Otwock district during 2009.
The data acquired from medical documentation were collected in a questionnaire. The following predicting factors were analyzed: age, sex, time of a day and a season when symptoms appeared and signs.
All data were gathered in a Microsoft Access database and some calculations were performed using a Microsoft Excel sheet of the Microsoft® Office 2007 suite.
Statistica 10 program (StatSoft®, Tulsa, USA) was used for statistical analysis. Distribution of nominal scale variables upon examining the differences with regard to the operational type of the emergency medical team, type of the dispatched team and type of organ damage was illustrated using line graphs, bar, circular and radar charts.

Normal distribution of variables was tested using the statistical significance p-value for Shapiro-Wilk test. In case of normal distribution, mean differences were examined using paired Student's t-test. In the remaining cases, we used a non-parametric Wilcoxon test and the acquired results were expressed and presented in graphs as medians.

Examination of the relationships between frequency of occurrence of the tested variables in analyzed sections was conducted using chi-squared test for independence with the accepted level of significance p=0.05. For contingency tables, the strength of association between variables was additionally evaluated with Cramer's V coefficient.

Results

The analysis of 6936 interventions by the Emergency Medical Services that took place during 2009 allowed for selection of 501 cases, in which the diagnosis of syncope was stated (code R55 according to ICD 10).
While analyzing the group of 501 medical interventions due to syncope, we found that they were carried out notably more often by the Basic "P" Teams – 401 interventions (80.04%), than the Specialist "S" Teams – 100 interventions (19.96%), and the differences were statistically significant with regard to the type of the dispatched team ($p = 0.0000$).

Interventions involving women predominated among all incidents of syncope – 311 cases (62.08%). Emergency Medical Services intervened in 190 cases involving men (37.92%). This result is also statistically significant ($p < 0.001$).
Ages of patients in the study group varied from 4 to 99 years. Mean age in the whole group was 61.41 years with standard deviation of 22.26 years. Mean age among women (62.61 years) was slightly higher than mean age among men (59.67 years; Fig. 2).

The most numerous group consisted of people aged 80-89years – 113 cases (22.55%), followed by the group of 70-79-year-olds – 97 cases (19.36%). The lowest number of cases was noted in the age group 1-9 years. There were only 2 such cases, which comprised 0.4% of all interventions due to syncope ($p = 0.0000$; Fig. 3). A detailed age and sex distribution of the study group is presented in Table 1.
Distribution of the study group according to the hour of syncopal episode revealed a relationship between syncope occurrence and time of day. The peak of medical interventions falls between 5:00 and 5:59 p.m. – 49 cases (10%), and subsequently 4:00 and 4:59 p.m. – 45 cases (9%). There were no cases noted between 5:00 and 6:59 a.m. ($p < 0.0001$). Additionally, in order to depict a

Table 1: The frequency of occurrence of syncope with regard to the month

	Male		Female		Total	
Month	**N**	**%**	**N**	**%**	**N**	**%**
January	28	5.59	22	4.39	50	9.98
February	6	1.20	22	4.39	28	5.59
March	15	2.99	25	4.99	40	7.98
April	15	2.99	22	4.39	37	7.39
May	17	3.39	20	3.99	37	7.39
June	23	4.59	42	8.38	65	12.97
July	22	4.39	21	4.19	43	8.58
August	11	2.20	30	5.99	41	8.18
September	14	2.79	17	3.39	31	6.19
October	9	1.80	38	7.58	47	9.38
November	19	3.79	19	3.79	38	7.58
December	28	5.59	22	4.39	50	9.98
P value	***0.0000***		***0.0000***		***0.0000***	

diurnal cycle of syncope occurrence we divided the day into four periods. According to the applied method, there was an apparent increase in frequency of syncope in the afternoon with a significant drop during nighttime (p=0.0000). Comparison between men and women with regard to the frequency of syncopal episodes in a diurnal cycle did not reveal a statistically significant difference (p = 0.1598). Frequency of syncope with regard to the hour is presented in Figure 4 and with regard to the time of day in Figure 5.

In order to determine whether there is a relationship between occurrence of syncope and time of year, the group was divided into 12 months. Distribution of syncopal episodes with regard to the month and patient sex is presented in Table 1. The most cases of syncope were noted in June – 65 cases (12.97%). During remaining months, the number of syncopal episodes remained on a similar level. We also grouped months into seasons for illustration of seasonal changes in syncope incidence. The statistical analysis revealed statistical differences in the frequency of syncope in the whole study group, both with regard to the month (p=0.0000) as well as the season (p=0.0000; Fig. 6).

The study group was also analyzed with respect to syncope occurrence in a weekly cycle. The largest number of cases was noted on Monday (n=84; 17%), followed by Friday (n=78; 16%). On the other hand, the lowest number of cases was noted on Sunday (n=62; 12%; p=0.0000). Distribution of syncopal episodes with regard to the day of the week is presented in detail in Table 2.

Table 2: The frequency of occurrence of syncope with regard to the month

	Male		Female		Total	
Day of week	**N**	**%**	**N**	**%**	**N**	**%**
Monday	31	17	53	17	84	17
Tuesday	23	12	41	13	64	13
Wednesday	31	17	46	15	77	15
Thursday	15	8	54	17	69	14
Friday	32	17	46	15	78	16
Saturday	31	17	36	11	67	13
Sunday	23	12	39	12	62	12
P value	***0.0000***		***0.0000***		***0.0000***	

We determined, on the basis of the data acquired from the departure order cards of the EMS, that the most common etiology of syncope was neurogenic (reflex) – 219 cases (43.71%), followed by cardiovascular reasons – 145 cases (28.98%) and episodes due to orthostatic hypotension – 91 cases (18.16%). In 46 cases, the most probable cause of syncope was not determined (9.18%; p < 0.001).

Discussion

Syncope and transient loss of consciousness are the causes of 3% of all ambulatory visits and 6% of all hospitalizations [1,2,3]. Therefore, they pose a serious clinical and diagnostic problem. The most common type of syncope is reflex syncope (vasovagal) resulting from dysfunction of sympathetic nervous system, which is responsible among other things for regulation of blood pressure and heart rate [4]. The second most frequent reason for syncopal episodes is cardiogenic. This thesis is supported by our own studies showing that reflex syncope comprised 43.71% of all cases and syncope due to cardiovascular disease

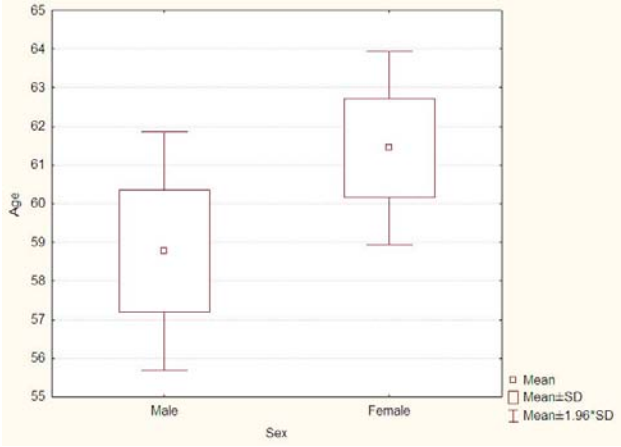

Figure 2: The box plot for average ages of male and female patients

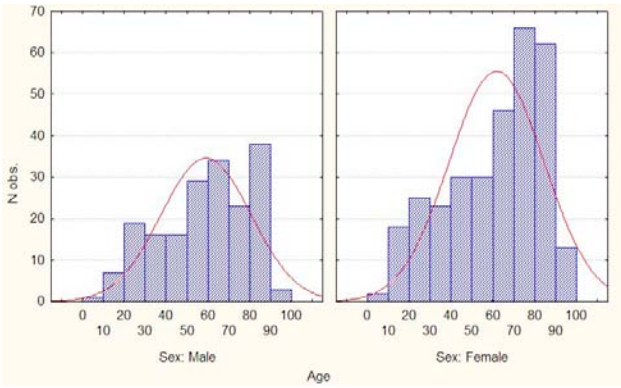

Figure 3: The counts of the investigated group on the basis of age.

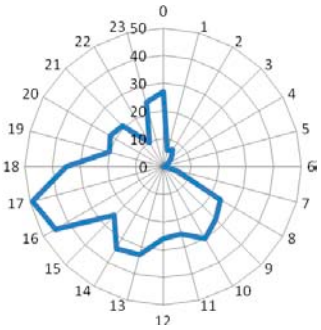

Figure 4: The frequency of syncope cases in the diurnal cycle.

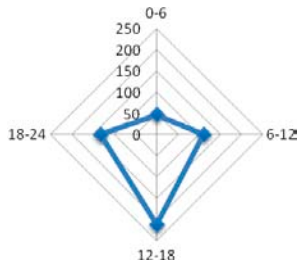

Figure 5: The counts of the investigated group on the basis of age.

29.88%. In the study by Bianchi these results were respectively 21% and 19% [4]. Petel, on the other hand, received the following results: 47% vs 18% [20], Shiyovivh 26.6% [21] vs 17.3%, and Vanbrabant – 58.5% vs 11.1% [22].

Women predominated in our material, comprising 62% of all cases. This prevalence of females in a population of patients treated for syncope is also reflected in the research of other authors: Chen – 53% [23], Vanbrabant – 55% [22], Mitro – 62% [24], DiMario – 63.8% [25], Gajek – 72.5% [26], Cooke – 75% [27]. However, Patel and Furukawa demonstrated higher prevalence of males – 75% [20] and 57% [28], respectively.

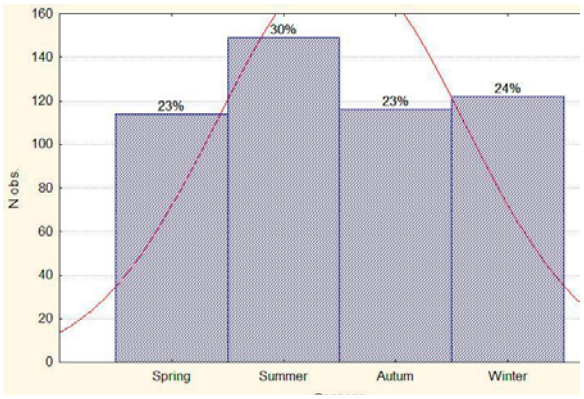

Figure 6: The frequency of syncope on the basis of the day of season.

In case of syncope, proper diagnostics is the key element. If there is a fall, syncope may be mistaken for the end result, and not the cause. Incidence of undiagnosed episodes of syncope raises rapidly in patients above the age of 70, who often suffer from syncope just a moment before the fall.

Mean patient age varies in both national and international studies. Our results revealed mean age of 61.41 years in the study group. Similar results were acquired by Chen – 62 years [23], Furukawa – 64 years [28] and Mitro – 65 years [24]. Higher means were presented in studies by Asensio-Laufente – 77.6 years [29], Cooke – 75 years [27], and Maung – 76.9 years [30]. Lower mean patient ages appeared in the analyses by Vanbrabant – 57 years [22], Patel – 57.4 years [20] and Gajek – 36.6 years [26].

Analysis of our research material revealed an increase in the frequency of syncope during evening hours, on Mondays and during the summer

season. Complete analyses have not been yet conducted on the seasonal incidence of syncope.

Conclusions

- Syncope poses a serious medical problem for the Emergency Medical Teams.
- Syncopal episodes are more common in women (62.08%) than men (37.92%).
- Mean age of men and women with syncope is similar – 61.41 years. It most often affects people aged 70-90 years.
- The most common etiology of syncope is neurogenic (reflex).
- Syncopal episodes occur most often in the afternoon and during summer.

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Emergency Medicine

Indications for treatment of hospitalized patients with blood volume replacement fluids in the perioperative period

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Received: 2011.11.20 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

The goal of this paper is to present indications for intravenous fluid therapy in patients subjected to surgical procedures, principles of selection and application of blood volume replacement products, associated complications as well as to identify indications for therapeutic use of blood derivatives.

Key words: fluid therapy, blood substitute.

The aim of therapeutic administration of blood volume replacement products is to replenish the lost blood and body fluids, to fill the vascular bed in order to prevent the consequences of tissue ischemia, provide proper organ perfusion, preserve excretory function of the kidneys, maintain electrolyte balance for sustaining proper blood pressure as well as intra- and zextracellular pH.

1. Systemic water distribution

Principles and indications for application of blood volume replacement products require understanding of the mechanisms of fluid distribution in human organism, which is divided into separate fluid compartments. We distinguish two basic body fluid compartments divided by a semipermeable membrane:

- intracellular space,
- extracellular (interstitial) space.

In a human body, depending on age and sex, water comprises from 80% of total body mass in a neonate to 45% in a 60-year-old woman. Intracellular water constitutes 60% of body mass (in a 35-year old, 70-kg male it corresponds to about 42 L of fluid). As oncotic pressure exerted on the cellular membrane from the inside is equaled by the oncotic pressure of the extracellular space and water diffusion from the inside to the outside of a cell is very limited even in extreme situations, we may concede that by application of blood replacement fluids we will be mainly influencing the volume and quality of fluid that fills the extracellular space.

Physiologically, water filling the extracellular space of a properly hydrated person comprises 20% of body mass (for a 35-year old, 70-kg male it constitutes about 14 L of extracellular fluid) and is distributed between intrerstitial and intravascular spaces in a 4:1 ratio.

Relatively undisrupted flow of water between interstitial and intravascular spaces together with slow diffusion of osmotically active fluids through an intact vascular endothelium are the theoretical bases for the choice of blood substitutes.

2. Types of blood replacement fluids

Preparations administered intravenously in order to expand the volume of circulating blood may be divided into:

- isotonic crystalloid solutions,
- hypertonic solutions,
- blood substitutes.

Crystalloid solutions
The following solutions belong to the group of isotonic crystalloids:

- 0.9% NaCl solution,
- Ringer's solution,
- Multi-electrolyte fluid.

Osmolalities of these fluids are between 300 and 310 mOsm/l, which corresponds to the osmolality of plasma. Differences in ionic compositions of above mentioned fluids allow for optimizing supplementation of specific electrolytes depending on the needs of an individual patient (with the exception of potassium and bivalent ions, which are present in those solutions in insufficient amounts and their deficiencies must be supplemented with solutions in higher concentrations).

Due to their easy application, wide therapeutic safety window and low costs, isotonic crystalloid solutions are fundamental for management of blood loss without symptoms of hypovolemic shock and they are used as adjuvants to colloid therapy of shock patients. In case of massive bleeding, crystalloid use as sole means of replacement of lost fluid volume is insufficient as they are distributed to the entire interstitial space.

Therefore, only 20% of administered fluids contribute to filling of the vascular bed. Every one liter of administered fluid replaces only 200ml of lost blood volume. The remaining portion of fluid diffuses to the interstitial space, which may lead to peripheral swelling or even pulmonary edema. Hemodynamic effect of crystalloids is short-lasting.

Hypertonic solutions

Administration of a small volume of hypertonic solution to a patient with hypovolemia leads to osmotic movement of water from interstitial space into the lumen of a vessel and an increase of circulating blood volume exceeding the volume of the administered solution.

Blood replacement solutions
Blood replacement solutions may be divided into plasma volume replacement fluids, i.e. colloid solutions that increase the volume of circulating blood, or so-called true blood substitute products with oxygen-carrying capacity.

Colloid fluids
The basic feature of active colloid solutions is a polymer molecule with high molecular mass and reduced ability to pass from the vascular bed into the extravascular space. While remaining in a vessel, it binds water molecules and increases circulating blood volume. Hemodynamic effect of colloid solutions persists much longer than in case of crystalloids (HES 450/0.7 half-life is 48 h).

The following fluids belong to the colloid group:

- dextran,
- hydroxyethyl starch,
- gelatin solutions,
- albumins.

Colloid fluids, despite many advantages such as smaller infusion volume, long-lasting hemodynamic effect, less pronounced tendency for causing peripheral edema, are used less often than crystalloids due to the possibility of inducing pulmonary edema, especially in the presence of vascular endothelial damage (also in the course of ARDS). They also elevate the risk of coagulopathy and anaphylactic reaction and their costs greatly exceed the costs of treatment with crystalloids.

True blood substitute fluids
True blood substitutes should simultaneously act as plasma volume replacement and oxygen carriers. Currently two types of blood substitution products are in an experimental phase of development:

- hemoglobin-based oxygen carriers (HBOC) devoid of cellular matrix,
- perfluorocarbon-based compounds.

Regrettably, despite many years of research the results are still unsatisfactory. The only fluid available for use is Fluosol DA. It serves as an oxygen-dissolving medium and since oxygen solubility depends on pressure, the patient must stay in a hyperbaric chamber in order to increase the effectiveness of "artificial blood."

3. Indications for administration of blood replacement fluids

Indications for administration of colloid solutions:

- acute hypovolemia regardless of the cause (hypovolemic, traumatic or toxic shock, burns),
- prevention of shock,
- prophylaxis of thromboembolic complications in immobilized patients with elevated risk of vascular thrombosis (dextran-70),
- treatment of an early phase of deep vein and arterial thrombosis (dextran-70),
- vascular procedures,
- acute intravascular hemolysis, especially in the course of paroxysmal nocturnal hemoglobinuria,
- disorders of microcirculation – late phase of shock, organ transplantation, extracorporeal circulation, acute coronary syndromes – myocardial infarction (dextran-40).

Indications for albumin administration:

- following allogenic organ transplantation (kidney and/or liver),
- plasmapheresis, repeated paracentesis > 5l,
- hypoalbuminemia < 15-20 g/l (lower limit of tissue edema) in specific disorders of the gastrointestinal tract, liver, pancreas, kidneys,
- correction of intravascular volume in overloaded patients or those with intolerance of other colloids.

Indications for use of true blood substitute products:

- shortage of blood supply of an appropriate type for transfusion,
- acute autoimmune hemolytic anemia diagnosed before surgery,
- patients refusing blood transfusion due to religious reasons.

Fluid replacement therapy in shock patients

Regardless of the cause of shock (trauma, gastrointestinal bleeding, rupturing aneurysm, septic shock, anaphylactic shock, etc.) fluid treatment is the fundamental method of sustaining proper tissue perfusion required for restoration of organ functions after removal of the causative factor. One should set specific goals during administration of fluid therapy in a patient in shock (an adult):

- attaining central venous pressure of >10-15mmHg,
- attaining pulmonary capillary wedge pressure of 10-12mmHg,
- cardiac index >3 l/min/m2,
- serum lactic acid level < 4mmol/l,
- base deficit -3 > BE > 3 mmol/l.

The first step toward attaining these goals should be rapid intavenous infusion (6 ml/kg BM/min) of crystalloid solutions (2000 ml). If patient's condition improves, crystalloid administration should be continued until above mentioned goals are accomplished. In case of failure, one should start administration of colloid fluids until clinical effects are apparent. If patient's condition is not improving despite appropriate blood volume, one should suspect a reduction in blood oxygen-carrying capacity caused by dilution with blood replacement fluids and begin transfusion of packed red blood cells. Whole blood should be used if patient has symptoms of coagulopathy.

Indications for transfusion of packed red blood cells

Packed red blood cells should not be used for expanding circulating blood volume, but only if there is a need for increasing blood oxygen-carrying capacity. The following are clinical symptoms of disrupted tissue oxygenation in a patient with proper volume of circulating blood:

- brain or heart ischemia,
- lactic acidosis >4 mmol/l,
- decreased oxygen consumption VO2 < 100 ml/min/m^2,
- oxygen extraction increased > 0.5, with normal cardiac output.

While making a decision regarding blood transfusion one should take into consideration:

- hemoglobin concentration,
- existing intravascular volume,
- anticipated blood loss,
- extent of surgery,
- comorbidities.

Summary

Understanding water-electrolyte balance physiology, familiarity with existing types of blood volume replacement fluids as well as indications and principles of fluid replacement therapy allow for an effective, safe and cost-effective prophylaxis of intravascular volume disturbances in patients exposed to the risk of fluid loss during surgical procedures and treatment of shock. Proper consideration of indications for blood volume replacement fluids can protect the patient against dangers associated with transfusions of blood derivatives. Despite the development of modern fluid therapy, blood and blood-derived products remain the ideal and often irreplaceable substitutes of patient's own blood.

Acknowledgements:

Original article previously published in the Polish language in *Wojskowa Farmacja i Medycyna*.

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History medicine

Medical service in the Vilnius Region of the Home Army

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Received: 2012.01.11 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Situation of Polish community in the prewar Vilnius province of the II Republic of Poland during World War II was particularly dramatic. Occupational authorities changed five times and inflicted brutal terror on Poles, particularly on Polish elite. Many of its representatives were murdered and doctors were also found among the victims.

In order to protect themselves as well as Polish character of this region, the Poles organized combat divisions of the Home Army (Armia Krajowa), which fought in all territories belonging to the Vilnius region. Injured soldiers were provided medical aid during combat, as there was a well-organized, adequately equipped and effective medical care system functioning within the Home Army. In this article, the process of formation of this system, its key forms and working methods were described. Selected profiles of doctors were also introduced.

Key words: World War II, Home Army, Vilnius region, underground health care.

Attack of the Red Army on Poland in 1939 resulted in breaking of the Vilnius Provence into two parts. Its south-east regions were overtaken by the soviet authority and included in the Byelorussian Soviet Socialist Republic. On the other hand, the north-west part, including Vilnius, was attached to Lithuania on the grounds of Lithuanian-Soviet agreement signed in October of the same year [1, 2].

The fact that the main part of Vilnius region fell under Lithuanian occupation, which was relatively non-invasive influenced the development of Polish underground in this territory during World War II. Vilnius became the center of independence operations on the north-east borders of the II Republic of Poland. A large-scale phenomenon appeared of bottom-up formation of local organizations and conspirational groups, as well as legal societies for charity care. The latter were formed due to the necessity of providing aid to the thousands of refugees and casualties of September 1939 warfare, as well as to the military internees held by the Soviets in Lithuania. There were about 30 thousand war refugees in Vilnius at the end of 1939. For the majority of them, the only source of livelihood was aid of the Lithuanian Red Cross (LRC), which overtook the Polish Red Cross (PRC) points in this town. However, LRC activity was not sufficient.

There were eight prisoner of war (POW) camps in Lithuania containing 12 thousand soldiers and non-commissioned officers (NCO), as well as 2,5 thousand police officers. These camps

were provisional and prisoners suffered from the cold and hunger. Polish community in the Vilnius region tried to provide aid to the fellow countrymen in the POW camps and organize care for the refugees. There were several charity institutions appointed for this purpose. Every one of them established, among other things, outpatient clinics and points providing medical aid to the victims. Therefore, they also recruited doctors and nurses, gathered drugs and medical supplies. It should be emphasized that medical personnel served gladly in those facilities. Many doctors co-created these charity organizations. The largest were: Community Self Aid Society (Towarzystwo Samopomocy Obywatelskiej) led by a Jesuit, Kazimierz Kucharski (dr Stanislaw Markiewicz was responsible for medical care), War Refugee Aid Committee (Komitet Pomocy Uchodźcom Wojennym) established by dr Maria Petrusewicz and the War Victims Assistance Committee (Komitet Pomocy Ofiarom Wojny) managed by Prof. Kazimierz Pelczar, a world-famous oncologist and an admirable social activist. His international connections allowed for an influx of donations to Polish charity organizations in Vilnius from International Red Cross and American charities such as the Commission for Polish Relief and American Jewish Joint Distribution Committee [3, 4].

Another factor influencing the specific character of conspirational work in this region at the beginning of World War II was that the Ministerial Committee for the Home Affairs and the Main Headquarters of the Union for Armed Struggle in Paris (Komitet Ministrów do Spraw Kraju i Komenda Główna Związku Walki Zbrojnej w Paryżu) offered Vilnius region under Lithuanian occupation special treatment. They took steps to gain Lithuanian support for their cause. Therefore, they ordered their activists in Vilnius to hold back their efforts toward building an underground military organization and to focus on charity. This included formation of a system of medical care engaging more and more nurses, dentists, and pharmacists. This is how the future underground health care began forming up in there [5].

Creation of underground health care

When the Soviet Union annexed Lithuania in June 1940, the Polish Government in Exile residing in France allowed for development of organizational cells of the Union for Armed Struggle in Vilnius region. In February 1942, it assumed a name of Home Army (HA), which encompassed the entirety of military efforts undertaken by the Poles under occupation during World War II. This organization was the largest conspirational army in Europe at that time. It covered the entire area that had belonged to Poland before the war. HA operated in provinces of pre-war Commonwealth of Poland. Vilnius Region of HA was one of the most dynamically functioning among all districts at the eastern borders [6, 7].

In the second half of 1940 commanding officers developed all cells of command and auxiliary services into a complete headquarters of the Vilnius region. A priest, Kazimierz Kucharski aka. "Simon," became its member as a chief of the medical branch [8, 9].

Polish community in Vilnius responded to the return of Soviets with great anxiety. It came to a realization that a "rest" period when Vilnius was the only place in divided, occupied Poland where life took a normal course giving hope for enduring war under relatively peaceful and safe conditions despite the nuisance of Lithuanian rule had ended. The omnipotence of NKVD was particularly feared and its activity evoked awe and sense of insecurity among Poles with a threat of sudden arrest and deportation. One of the first decisions of the Soviet authorities was disbandment of Polish charity organizations. However, most of their workers continued their activities underground, in secret from the Soviets. Medical personnel was among them [10, 11].

The main goal of NKVD was destruction of Polish underground. An extensive network of confidents and spies, mainly non-Poles, was constructed in order to achieve it. Various forms of terror were inflicted upon Polish population. Until June 1941 there were three mass deportations, which decimated the most productive and valuable parts of society. Seeds of Polish conspiracy were annihilated in this manner. There were many regional commanding officers among the deportees. The chief of medical service of the Vilnius region, Kazimierz Kucharski, was arrested on 25th May 1941. After brutal interrogations involving many

acts of maltreatment he was sent deep into the Soviet Union [3, 9].

Restitution of HA branches in Vilnius region did not take place until autumn 1941, under German occupation. Lieutenant colonel Aleksander Krzyzanowski became the commandant of this district. Command of the medical services was also appointed within the regional headquarters. Major Adam Galinski, the former director of Social Insurance Company in Vilnius, took the authority over it and doctors: Stefan Borkowski, Wiktor Dunin-Horkawicz and Stanislaw Markiewicz became his deputies. The Regional Medical Headquarters continued to exist in this structure until reorganization in spring 1943. Then, dr W. Dunin-Horkawicz became the chief of the HA medical services of the Vilnius region [12, 13].

Vilnius Region Command Headquarters followed the instructions and orders of the Main Headquarters in Warsaw that dictated preparation of forces and resources for an uprising as well as conducting ongoing struggle. The district commandant had a wide range of autonomy in execution of these tasks. He organized the subordinate structures according to human resources and conditions arising from the politics of the occupational government as well as ethnic relations [14].

During years 194 – 943 the HA soldiers were preparing for an uprising that was supposed to overtake the regions under General Government (GG). The HA of the Vilnius region was not to assume any insurgent fights due to its general weakness. It was expected to conduct diversion and sabotage on communication routes and hubs in order to stop the influx of German forces from the Eastern Front to GG. Therefore, several dozen of diversionary and partisan centers were formed in this area. While preparing for these actions, HA soldiers from Vilnius region conducted mainly diversionary-partisan operations. Few soldiers were injured in their course. They were treated by "doctors of trust," who worked in hospitals and outpatient clinics in various locations around the Vilnius region and were in agreement with the commanders of combat groups as to the rules for providing medical assistance in necessity. It must be emphasized that they were working in particularly dangerous conditions. They were constantly under control. They worked mainly in small towns where all members of the community knew each other and there was a great risk that they would identify strangers around doctors' offices and report them to the authorities [15].

Vilnius community consisted of various nationalities, mainly Poles, but also Lithuanians, Byelorussians, Jews and Russians. German and Lithuanian police took advantage of this situation by antagonizing them against each other. The events that took place in Sventsiany were the proof of that. In May 1942 a group of Soviet partisans attacked a German car near a town of Sventsiany, killing three people. Poles were indicated as the attackers. Lithuanian police in cooperation with the Germans murdered 400 men, women and children who inhabited it. One hundred and fifty Poles kept in the Vilnius prison were executed [2, 12].

Doctors had to be very careful in their cooperation with HA under those circumstances. Members of the Regional Medical Service Headquarters were aware of that as they were slowly but systematically forming medical aid cells in their area. Above all, they were establishing a network of underground medical service in districts that previously belonged to Polish counties and recruited doctors from hospitals and ambulatory clinics. Recruitment of directors and heads of clinics in county hospitals was most desirable. At that time the majority of personnel in those hospitals began their cooperation with HA medical services [15].

Situation was somewhat different in Vilnius. The majority of its inhabitants were anonymous to each other and it was much easier to organize military resistance and medical aid for HA soldiers in this town. Therefore, this was the place where the first main organizational structures were formed. It resulted in an unfortunate division of the district areas into two parts: the city of Vilnius (under codename "Mansion") and the rest of the province (under codename "Field") composed of four Regional Inspectorates (several districts comprised an inspectorate) and a sub-district of Kaunas county. Negative consequences of this division, especially in the area of medical aid, revealed later. It was functioning

remarkably well in Vilnius itself, but situation in surrounding areas was not so good [8, 12].

Conspiration work in Vilnius hospitals

Vilnius hospitals constituted a center for medical aid for the whole region. During Nazi occupation they were directed by the Germans and Lithuanians, but patriotic Polish personnel dominated among their workers. There were teams in every hospital whose members belonged to the medical branch of the HA. Dr Stanislaw Markiewicz was the chief of medical service in Vilnius. All Vilnius hospitals fell under his command and each had an appointed conspirational commandant [8].

Dr Feliks Oleński was appointed the conspirational commandant of St. Jacob's Hospital. Dr Józefa Dowgiałło-Muszyńska, dr Antoni Tołłoczko and dr Leon Achmatowicz worked on the surgical ward. There were covert patient beds in this hospital prepared for HA soldiers injured in combat. One of the surgeons was constantly on duty and traveled with a special surgical kit to distant places on every call of the organization in order to attend to the wounded.

The conspirational commandant of the Railway Hospital was dr Jan Janowicz. Surgeons who were working there: dr Józef Piotrowski and dr Michal Juszczyński took care of HA soldiers both in the hospital and in the field [9].

Neurological Hospital in Zwierzyniec was also involved in conspirational activities. Dr Janina Hurynowicz became the commandant of this hospital. Also dr Zofia Bojarczyk-Czyżewska and dr Zygmunt Kanigowski belonged to the HA structures. Numerous injured and compromised soldiers of the underground resistance found shelter there. Patients, instructed by the doctors, imitated signs of illness with such skill that even experienced German and Lithuanian board doctors were not able to expose the fraud. The hospital relocated men from Vilnius to Warsaw multiple times under the pretext of performing brain surgeries (brain tumors), as at that time only the neurosurgical center in Warsaw could perform such procedures. The legislative branch of HA supplied the "patient" as well as his escort with proper documents. It was one of the most reliable paths of communication with the main HA Headquarters in Warsaw [16].

The conspirational commandant of the Hospital for Infectious Diseases in Zwierzyniec was dr Zofia Wasilewska-Świdowa, who worked with the following doctors: Michał Raubo, Romuald Orłowski, Aleksander Rutkowski, Michal Gojdź and Witold Umiastowski. Hospital consisted of several separate pavilions (or rather barracks) surrounded by a thick bush, which made it easier to transfer wounded and ill HA soldiers into its buildings. It was also well-furnished with medical equipment and other supplies by the regional HA logistic service, as the Germans did not inspect this hospital for the fear of infectious diseases [15].

In the Surgical Clinic in Antokol, under the command of Prof. Kornel Michejda, experienced surgeons: Władyslaw Żemojtel, Antoni Szczerbo and Helena Maciejewska taught future doctors of HA squads. Dr Tadeusz Winiszewski and the following medical students: Zbigniew Szacki, Janusz Michejda and Jan Szwykowski (who was later sent to the Novogrod district for support) gained battlefield surgery skills in this hospital. Polish doctors were also employed in some of the clinics belonging to the hospital in Antokol, which was later transformed into a German Military Hospital no. 901. Hospital's commandant, dr Reichelt from Vienna, set up a chapel on its grounds, which was open to general public. It made the work of HA doctors easier, as it enabled them to move HA soldiers into and out of the hospital and transport out the equipment, medicines and medical supplies essential for the partisans. Almost every day, a horse carriage carrying prof. Michejda to and from work would leave hospital premises loaded with supplies for HA. Wehrmacht soldiers encountered on the way would salute a German N.C.O, who was driving the carriage. Professor would raise his hat [9].

Dr Zdzisław Kieturakis was the conspirational commandant of the Red Cross Hospital on 3 Boguslawska St. His surgical aids were: Józef Tymiński and Antoni Naumik. Numerous times they were called to the wounded partisans brought from the battlefields around Vilnius region to medical aid points created

in private houses on the outskirts of Vilnius. They also often traveled to the resting places of partisan units scattered over the area of all inspectorates [8].

There were covert hospital beds maintained in an Ophthalmology Clinic on 16 Tyzenhauz St., which were meant for wounded resistance soldiers. The chief of regional medical service, dr Wiktor Dunin-Horkawicz, worked there with other doctors sworn into the HA: Stanisław Markiewicz and Józef Kucharski (the conspirational commandant of this hospital). Councils and briefings of doctors from the HA Headquarters of Medical Service in the Vilnius region were conducted there. Organizational schemes of the medical service and operational directives for diversionary actions, the general uprising as well as the 1944 campaign (codename "Tempest") were established during those meetings [9].

Councils, meetings and medical training were also conducted in doctors' homes and private offices such as the private laboratory of dr Helena Dunin-Horkawicz on 12 Portowa St., the office of dr Wiktor Kopeć on Kalwaryjska St., or the home of Assistant Prof. Janina Hurynowicz on 16 Tomasz Zan St. [15].

Conspirational medical points and partisan hospitals

Not only in the hospitals the Vilnius doctors provided assistance to the HA soldiers. They also organized covert medical aid points on city premises where injured combatants were attended to and rehabilitated. It was so, because the wounded could not always be hospitalized in civilian facilities presented above. Original weekly medical reports as well as the records of HA soldiers treated in those conspirational medical service points organized in all seven precincts of Vilnius in 1944 may be found in the Central Archive of the Ministry of Internal Affairs in Warsaw. They contain a lot of data that show the extent of medical aid offered in those places. It proves that the wounded were brought there from the entire Vilnius region. They also present the statistics associated with number of hospital beds prepared for them and the number of patients who stayed there. It appears that there were 50 beds in standby. It should be emphasized that the number of beds always exceeded the number of patients, which means that the care of medical personnel surpassed the actual needs in that matter [17].

Medical service of HA in the Vilnius region had a numerous personnel. Almost all doctors and nurses working in the Vilnius district belonged there. Most of them conducted secret courses that trained paramedics for partisan units. Many members of medical personnel were taught by the faculty of Medicine from Stefan Batory University (SBU) in Vilnius. On 15th December 1939 Lithuanian authorities shut down this Europe- and world-famous Polish school depriving young people of the opportunity to study. All scientists and employees were deprived of work and means for making a living. Many of them were forced to undertake physical work in deforestation or digging drainage ditches. Secret teachings were organized in many departments despite difficult conditions. That included medicine. Dr Michal Reicher, the former prorector of the SBU, became the chief of secret medical department. After he fled from Vilnius he was replaced by dr Stanislaw Legeżynski [18,19].

Many young doctor and students of secret teachings were allocated to hospital surgical wards, where they underwent intensive training in battlefield surgery necessary for aiding the wounded in combat. They later assumed responsible positions in medical service of HA units. Overall, over 100 doctors, about 150 members of the middle-level medical personnel (nurses, laboratory workers, field surgeons) and over 300 trained paramedics belonged to the HA in the Vilnius region. About 30% of them were ordered to join the HA squads in the forests. Over a dozen of doctors and medical students were sent to the Novogrod region medical service, which was lacking personnel. Some historians, who were previously HA soldiers in the Vilnius region, emphasize that medical service of this region was the most numerous and best-organized among all other auxiliary services [20, 21, 22, 23].

Terror imposed by the Gestapo and oppression of Polish citizens in the Vilnius region resulted in many fatalities, including doctors. Among others, prof. Kazimierz Pelczar and

prof. Mieczysław Gutkowski were executed by the Germans. Prof. Bronisław Wróblewski died of a heart attack while Gestapo was searching through his home. Prof. Marian Hłasko, prof. Stefan Kempisty, prof. Walenty Romanowicz and dr Szczepan Ławcewicz died in prison [24].

A plague of bandits was a great nuisance to the inhabitants of rural areas. Combat groups were formed for defense. Another factor fostering the development of military resistance was the fact that in 1943 the occupational government intensified its efforts to capture men for slave labor in Germany. In order to avoid detainment men escaped to the forests. Therefore, there were spontaneous inclinations toward forming a resistance movement. The commandant of the regional HA took advantage of these inclinations and, as a result, many partisan combat groups were formed. They acquired weapons and military supplies in combat [13,25].

The most dynamic development of partisan groups in the Vilnius region took place in spring 1944. Over twenty field units were formed during six months. Units consisting of more than 100 people capable of carrying out independent tactical tasks were called partisan brigades. Thirteen units received that designation. There was a medical service unit in every brigade as an inherent organizational element. In eight brigades these units were commanded by doctors and in five cases they were led by medical students in their last years of studies. They all underwent training in battlefield surgery conducted by prof. Kornel Michejda. They were young people with no previous military training. They gained the experience of military doctors in partisan groups. Only in the 3rd Vilnius Brigade (under the command of "Szczerbiec") second lieutenant dr Lech Iwanowski, who completed four years of studies at the Medical Cadet School before the war and received professional military and medical training, served as doctor. Moreover, he also participated in the September campaign in 1939 as a deputy commandant of a sanitary train [26].

As they began their service, brigade doctors had nothing but enthusiasm. They had to achieve everything with their own efforts, especially at the beginning. For that purpose, they established contacts with doctors and pharmacists from nearby villages and towns, who gladly helped by providing them with basic medical equipment, medicines and dressings. They were also taking care over the ill and the wounded that required treatment away from the unit [15].

There were partisan infirmaries functioning within the brigades attended to by doctors and auxiliary personnel such as nurses and paramedics. They were also included in the units. These infirmaries were organized in peasant homes. It should be emphasized that brigades were constantly moving. As a rule, they only stayed in one place for one or two nights, so it was not possible to create a stationary facility. Such lifestyle was very burdensome. Constant efforts to find a place for night's rest were very troublesome. People most often slept in overcrowded rooms of peasant homes. It was often the case that, on arrival, they could not find a place to sleep because of people ill with typhoid fever inhabiting the homes. In such cases plans for night's rest would complicate. Under such circumstances, hygiene was not the most important thing. They often washed in the morning with cold water from the wells. In exceptional cases they washed in "banyas" popular in the Vilnius region as there was usually no time for it. They did not change their undergarments very often. Therefore, it is not surprising that many partisans suffered from scabies and lice infestation was common [27,28].

From the accounts of many soldiers it ensues that after several months in the brigade they suffered from a severe health crisis. Abscesses and ulcers formed in various places, especially on the legs and buttocks. Gastrointestinal disturbances appeared. Some, for a long time, could not rid of cough and rhinitis following an upper respiratory tract infection. All these conditions were treated in the brigades with scarce resources of the medical personnel [23, 29].

Its members also participated in combat training. They taught first aid to the partisans with the use of personal dressing that belonged to every man's equipment. They explained the importance of mutual aid in case of injury on a battlefield. They were also training many ways of transporting the wounded to the medical aid

point. These skills were new to them as most soldiers were 18 – 20 years old and had not previously undergone any military training. Good preparation for this task was very important as in 1944 the number of battles carried out by the soldiers of the HA in the Vilnius region was rising from month to month. There were 65 battles in the first three months and 110 combat operations in the next quarter. Particular intensification of warfare fell in the period from March until May of that year. Many Vilnius HA soldiers call this time a "spring epic." During this year large regions were freed from enemy occupation [30,31].

Gaining control over the territory enabled organization of medical aid in the field. There was a possibility of forming partisan field hospitals in specific Regional Inspectorates of the Vilnius region of HA. Moreover, the Headquarters of Field Units were established in April 1944. At that time, inspectorates were reorganized into partisan groups in preparation for the "Tempest" campaign. The most severe combat took place in the region of Inspectorate "A" encompassing the Vilnius-Trakai district. German and Lithuanian garrisons withdrew from this area in spring. Partisan hospitals were organized in liberated towns and villages. The largest such hospital was created in the village of Onżadowo. It was established by the mentioned second lieutenant Lech Iwanowski, a doctor serving in the 3rd Brigade under command of "Szczerbiec." This hospital consisted of three chambers, an operating room, a surgical dressing room, kitchen and storage rooms. It was relatively well-outfitted with equipment and medicines. A lot of this medical equipment was captured from destroyed Lithuanian units and German police posts. Some of this equipment was supplied by the logistics unit of Inspectorate "A" [32].

The second partisan hospital was organized and operated by a doctor from the 7th Vilnius Brigade, Dr Wiktor Korzeniowski. Brigades belonging to this Inspectorate formed the 1. Partisan Unit. Dr Stefan Cierpiński assumed the duties of the medical unit commander [33].

The second Partisan Unit was formed from the Inspectorate "North," which was created by joining Inspectorates "B" and "C". It encompassed the following districts: brasławski, święciański, głębocki and postawski. Dr Tadeusz Ginko became the chief of its medical service. He established cooperation with "doctors of trust" of partisan units. Doctors most devoted to the resistance movement in this area were: dr Marian Hajel of Woroniany, dr Stefan Opalski of Łyntupy, dr Marian Sylwanowicz of Kiemliszki, dr Jerzy Rogowski from a hospital in Święciny and dr Jerzy Gołoński from a hospital in Świr [33].

Conspirational medical service points were organized in the field – in colonies, mansions, settlements – in order to tend to the wounded and the ill. For safety reasons there was a rule not to place more than two ill or injured soldiers in the same house. "Doctors of trust" would visit and care for them. Together with dr Ginko they would collect medical equipment, bandages and medicines. Formations of the 2. Unit carried out a successful combat operation in Daugiliszki Nowe where they acquired a large supply of medicines and dressings greatly needed before the "Tempest" operation from a local pharmacy and Lithuanian magazines [34].

In Punżany, the medical chief of the 2. Unit organized the first field partisan hospital in this area. Hospital was supplied by the local doctors and pharmacists. Some of the necessary equipment was acquired from the Headquarters of the Medical Service of HA in the Vilnius region. The second partisan hospital in the operational area of the 2. Unit was established by a local estate co-owner – member of HA – Czesław Popławski. Regional Headquarters of the Medical Services appointed dr Wiesław Rasiewicz as the hospital commandant.

Four districts of the south-east Vilnius region: mołodeczański, wilejski, wołożyński and oszmiański comprised Inspectorate "F". The last of the mentioned districts played a leading role. Brigades from this region were called "oszmiański." Doctors from a district hospital in Oszmiana were chiefs of the medical services in this Inspectorate. All doctors as well as the middle-level auxiliary personnel who worked there belonged to the HA. The doctors were: Jan Brzozowski, Michał Holak, Piotr Wysocki, Bohdan Tallat-Kiełpisz. The first one of them served as a doctor in the 3. Partisan

Unit. Two partisan hospitals were formed there. One of them was established in a forest lodge near Wojnaryszki Wielkie by corporal Andrzej Sochański, who underwent medical training before the war as a scout. As injured soldiers started arriving to the hospital, dr Stanisław Żebrowski overtook the command. The second hospital was located in the village of Antoniszki. It was located in the wooded area and occupied two spacious houses on the village borders. It included a well-equipped operating room, a library and a radio. Dr Jan Brzozowski was the commandant of this hospital. Partisan field hospitals not only gave the opportunity to treat wounded and sick soldiers. They also served as training bases for the medical services of the Vilnius HA region [35].

Medical care during operation "Gate of Dawn" („Ostra Brama")

As it was mentioned above, HA soldiers were preparing for the fundamental task of general, armed uprising at the end of World War II. The tactical and operational foundations for this struggle were worked out in autumn 1943 and were given a codename "the Tempest". These operations were to assume the form of harassing rear guards of the German forces withdrawing from the Eastern front as well as diversionary operations conducted throughout the whole area. They were initiated in 1944 in Volhynia. This concept was modified with regard to the Vilnius region (it was decided to take over Vilnius instead of large areas). On June 12, 1944 Vilnius region commandant, lt. col. Aleksander Krzyżanowski aka. "Wolf", during a briefing in Warsaw received orders for combat – operation received a codename "Gate of Dawn" . He was supposed to carry it out using his own units concentrated in the Vilnius neighborhood together with subordinate Home Army units from Novogrod district and capture the city few days before arrival of Soviet army. He was assigned the command over joint forces of both districts. His headquarter was established in the town of Dziewieniszki freed from German occupation by the partisans [13, 36].

Operation „Gate of Dawn" was to be carried out by the forces of garrison "Vilnius" fighting within the city as well as partisan units attacking firmly fortified German positions from the outside. To differentiate them from the units and conspirational groups in Vilnius they were called "units in the field". The medical chief of these units was dr Michał Reicher. It was anticipated that during this warfare the number of casualties requiring medical aid will raise significantly. Steps were taken to make sure that it would be the best possible [35].

One of the most important decisions during that time was organization, apart from the medical units already existing in the brigades, so called forward medical teams designated to provide professional medical help to soldiers in the first line of fire. Field partisan hospitals constituted support for those teams. They consisted of one or a few doctors, nurses and paramedics. They were prepared to establish a field surgical hospital under any conditions. Before the "Gate of Dawn" operation, each partisan unit was assigned one forward medical team carrying a corresponding number. A forward medical team of the District Command, a so called "K" Team, was also established. [35]

According to the regulations developed by the Chief Medical Service of the District Command, many steps were taken in order to ensure adequate supply of medical equipment to partisan units. There were attempts to create field repositories for them. It must be added that medical equipment, medication and dressing materials were gathered for several years. In addition, a lot was seized from the enemy. The majority constituted gifts of patriotic people: doctors, pharmacists and other citizens. In many civilian hospitals, covert cells of medical service would produce personal bandages. Vilnius craftsmen manufactured in their workshops sterilization cans, syringes and other tools without asking for payment [8,9].

Matters of hygiene propagation among soldiers and prevention of infectious diseases were also considered in the course of preparations for the battle of Vilnius. Doctors from medical service headquarters developed popular, concise guidelines on those subjects. These guidelines were copied and distributed among unit commanders in a form of small brochures with a recommendation to dispense it among soldiers together with appropriate instructions. Even earlier the Offices of Information and Propaganda in those districts, both directed by doctors – mjr dr Jerzy Dobrzański in Vilnius district

and dr Stanisław Wawrzyńczyk in Novogrod district, – periodically published popular information on hygiene and prophylaxis of infectious diseases. This kind of activity was very useful, as partisan units were often forced to stay in areas of epidemiological and sanitary hardships [12].

Infectious diseases most commonly occurring among civilians inhabiting these regions were: typhoid, typhus and dysentery. As the population of partisan units constantly rotated, there was a significant danger of spreading the disease among them. As medical services did not have a sufficient amount of serum at their disposal to vaccinate all soldiers, precautions were taken in the form of quarantines for the newcomers. Moreover, in order to prevent spreading of infectious diseases among soldiers, the quartermasters ordered all community leaders to immediately report all cases of infectious diseases in a civilian population to the commandants of partisan units stationed in their areas [15].

It is also worth mentioning that, due to the anticipated necessity of blood transfusions, there were plans to conduct blood group testing among soldiers. A qualified "K" Team initiated such testing, but could not be continued due to the movements of units in the course of the planned campaign [35].

Despite careful preparations for the operation "Gate of Dawn," several unfavorable assumptions were taken and many of its details were not considered, which in the end had a negative influence on its course. Among other things, it stipulated a frontal attack of the HA units on the city in a manner similar to a regular army, which it was not. Enemy forces and their location were not properly identified. The Regional Commandant and his headquarters were not aware that German generalship designated a special task for its units in Vilnius. As it considered this city as one of the most important connection hubs for defense position covers, its forces were strengthened and soldiers ordered to remain in their positions at all costs. German forces occupying Vilnius at the beginning of July 1944, under the command of gen. Rainer Stahel, consisted of 17 500 soldiers. They had a significant advantage in terms of military equipment as they possessed 270 cannons and 60 tanks at their disposal. Several combat aircraft squads were stationed in Porubanek. On the other hand, HA used about 4 of 18 thousand soldiers it had under arms in both districts. It constituted only 21% of their own forces. An order given on the 3rd of July speeding up the operation by a whole day contributed to this to a large extent. As a result, battalions from Novogrod did not manage to arrive on time. It is hard to explain why a number of units stationing near the city did not receive orders on time and were not used in combat [37, 38].

Attack of the Home Army units on Vilnius began during the night of 6th on 7th of July. Despite fierce German defense, Polish offense was initially successful. However, in the morning it was stopped at the bunkers under fire from artillery, mortars and aircraft gunfire. The intent to seize the city by surprise turned out to be impossible. Prospects of repeated offense during daytime were unfavorable and only exposed the attackers to the risk of further losses. This is why lt. col. "Wolf" decided to withdraw all units away from the city Vilnius. Only the 3. Brigade continued fighting during the day together with a Soviet unit. Units of the Vilnius garrison got involved in the combat at that time and participated in fierce battle for the next seven days together with the Red Army. They captured many important public and economic objects. HA efforts were crowned by hanging a white-and-red flag on the Castle Hill on July 13, when the Germans withdrew from the city. However, it was quickly taken down by Soviet soldiers [39, 40].

During the operation "Gate of Dawn" medical aid was provided to the wounded by medical patrols, surgical sanitary points, forward medical teams as well as the city and field hospitals. Medical patrols were present in all squadrons. They were given with a task of providing first aid and evacuating the injured to surgical sanitary points. A patrol consisted of a medical NCO and two paramedics. Every patrol was equipped with a stretcher, a sanitary bag and compression bandages. The bag contained over a dozen of bandages and splints for limb immobilization [29].

Surgical sanitary points were served by: a doctor, a medical NOC, paramedics. They were equipped with surgical tools, anesthetics, analgesics and dressing materials. The extent of aid

provided to the wounded was usually limited to bandaging the wound, application of anti-tetanus serum, analgesics and cardiac medicines. Less complex surgical procedures were also performed from time to time. Lightly wounded soldiers were then transferred to prepared conspirational quarters and severely wounded patients were evacuated to the field hospitals in Onżadowo, Szwajcary, and Elżbietowo or to civilian hospitals in Vilnius [15].

Surgical sanitary points were organized not only by the units attacking the city of Vilnius from the outside, but also by the combat units formed within the city. For example, one of such points was organized in the downtown precinct by a doctor belonging to the Vilnius "Kedyw" (Diversion Command of the Home Army Headquarters), Igor Klatzo. This point was located on the combat positions on 4 Żeligowski St. Similar points existed on Jagiellońska St., Wielka Pohulanka and in the basement of a convent next to St. Catherine's church, where dr Józef Lenartowicz performed treated the wounded.

The entire first-line medical service performed its duties selflessly. Doctors were working constantly. Paramedics and porters carried away the wounded from the battlefield under gunfire. It is estimated that during the battle of Vilnius, in all lines of combat, medical patrols and surgical sanitary points provided emergency medical help to about 300 injured HA soldiers saving their health and sometimes also their lives [9].

Forward medical teams played the greatest role in providing medical aid to the injured in the course of Vilnius battle. It should be emphasized that they adapted very well to the dynamic situation on the battlefield. They were organized in partisan hospital bases, established field hospitals during successive rest stops, where the wounded brought from the battlefield were operated on and treated. Moreover, forward medical teams were created by all command posts of individual units, where the injured were attended to before sending them to the respective field hospitals [35].

The forward medical team of the 1. Unit moved together with its squad since the beginning of July. Three days before a battle, it established a field hospital in the village of Czarne, where the casualties were brought from the battlefield. Doctors from the forward medical team performed necessary surgeries under German aircraft fire. On the 9th of June, the forward team moved together with its patients to the Kuny estate, and after the following four days, to the village of Elżbietowo. It provided assistance to about 100 wounded HA soldiers [35].

At the beginning of July forward medical team of the 2. Partisan Unit provided medical aid to the soldiers in numerous encounter combats that took place during their march toward Vilnius. Because of that, this unit did not participate in the night battle on July 6/7. Arriving late, this unit had to fight many battles with Wehrmacht forces withdrawing from Vilnius. The most deadly battle occurred in the region of Nowosiółki-Krawczuny on July 13th. It encountered a German combat unit of 3 thousand men under the command of gen. Stahel. German losses in the course of this battle amounted to 1000 people (dead, wounded, detained or missing). Polish losses, on the other hand, consisted of 79 deaths. Immediately after it began, the medical chief of the unit (and a forward team) and doctors from individual brigades organized surgical sanitary points. Medical patrols collected the wounded from the battlefield and carried them to those points. Not only injured Poles were tended to, but also German soldiers. Polish medical service showed great humanitarianism under those circumstances. About 150 wounded soldiers were sent away to local hospitals after their wounds had been attended to.

This forward team was relatively well-supplied with medical equipment, medicines and dressings. Several columns with sanitary equipment were seized during victorious battles with the enemy. Substantial stores of vaccination sera greatly needed by all medical teams were also acquired.

Forward medical team of the 3. Unit was created at the beginning of June 1944 on the grounds of a partisan hospital in Antoniszki by dr Tadeusz Wiszniewski. When partisan units were ordered to regroup to the Vilnius region on the 2nd of July, dr Wiszniewski left Antoniszki, together with the nurses and the paramedics belonging to his team. On July 6th, the team arrived in Szwajcary, in the Kulesza estate,

over a dozen kilometers away from Vilnius. Soldiers injured in the battles of Vilnius started arriving shortly. The total number of wounded and casualties who passed through this point was about 180 persons.

The forward medical team of the Regional Command, the so-called „K" team organized and commanded by dr Władyslaw Żemojtel, fulfilled the medical needs of the units protecting the Command. It was also supposed to dispatch medical teams to the units requiring sudden or augmented medical interventions. Therefore, it was more numerous than a regular team. It was relatively well-equipped. Supplies were replenished along the way by purchasing medicines and dressings in pharmacies. Dr Antoni Karwowski donated a folding metal surgical table, an autoclave, medicines, bandages and linen to the team. During the battle of Vilnius this team changed their position several times. It provided help to tens of injured HA soldiers [9, 35].

In theoretical assumptions made while planning the "Gate of Dawn" operation, Vilnius civilian hospitals were to be the basis of medical care for HA units. It was anticipated that some of the city precincts would be seized on the first strike. As we have already mentioned above, they were well-prepared for that task as their personnel already got involved in underground activities and provided aid to the partisans from the beginning of the occupation. These hospitals could not be utilized in full due to the failure of combat operations. However, there was an urgent need for a provisional hospital that would provide care for severely wounded soldiers. [37]

On the first day of the battle, Polish forces took control over Pavilnys – a settlement located on the eastern peripheries of the city. A large field hospital was organized there in the local school and preschool. It was equipped due to the efforts of local resident council. Residents of this settlement, led by the parson Lucjan Pereświat-Sołtan and dr Halina Łobzowa, spared no efforts to provide the wounded soldiers with excellent care and nutrition. It mainly served soldiers from the 1. Unit ("Szczerbiec" and "Tur's" brigades). Doctoral staff came from the "K" Team and Vilnius hospitals. The hospital functioned for a relatively long time – until August 1944. Over 200 soldiers were hospitalized and attended to in this facility [41].

It must be said that establishing an exact number of fatalities as well as wounded and sick soldiers who passed through the surgical sanitary points, forward medical teams and partisan hospitals during the battle of Vilnius, the greatest battle fought by the Home Army with the Nazi occupants on the lands of the II Republic of Poland aside from the Warsaw Uprising, is an incredibly difficult task. Patient records were not always strictly kept and even if it were, most of these records are missing [42].

According to the reports of the medical chief of the Field Units, prof. Michal Reicher, losses of the Vilnius region HA during a week-long struggle amounted to over 500 deaths. This number includes fatalities both within the city and in all operational sections. There were 650 wounded soldiers. A large proportion of fatalities to the number of wounded could be explained by exceptionally difficult conditions for providing effective medical aid in the city fiercely defended by the enemy as well as the fact that Germans often killed the wounded. It must be considered that a number of soldiers, scattered and devoid of medical care, died on the battlefield or in the vicinity. Moreover, a number of the wounded took care of them, especially within of the city, and escaped identification. Most injuries sustained by the HA soldiers were gunshot wounds inflicted by handguns or machine weapons, 50% of which comprised wounds to the extremities, mainly soft tissues [35].

One should also indicate that establishing the exact losses sustained by the partisan units of the Vilnius HA region before the operation "Gate of Dawn" is incredibly difficult. Due to the conspirational conditions there was no evidence of wounded and sick partisans. Many injured HA soldiers were treated in civilian hospitals as "accident victims", etc.

Polish losses sustained during over a dozen of larger battles and tens of encounters were relatively small. Partisan groups employed tactics of surprise attacks. Enemy advantage in terms of weaponry and firepower were balanced by good

training, selflessness and good knowledge of the terrain. Unit commanders conducted combat operations in such a manner that would minimize their losses. According to the estimated calculations, about 200 soldiers were killed and 400 were wounded on the part of Poland during the period of augmented attacks on enemy posts and garrisons, that is from autumn 1943 until July 1944. Most of the injured returned to their units after treatment. It was a great merit of medical services in the Vilnius region. It was one of the best-developed auxiliary services in this area. Almost all Polish doctors, field surgeons, nurses and paramedics participated in it. The majority of them made a soldier's oath to the Home Army. Their selfless work, courage and sacrifice constitute one of the brightest chapters in the history of Polish struggle for independence during World War II. In those incredibly hard times medical personnel of the Vilnius region fulfilled their humane, civil and professional duty. Tens of distinctions granted to doctors and medical personnel of the HA are some of the proofs of their virtues.

However, political situation that had developed in the Vilnius region at that time resulted in dramatic persecution and repressions toward HA soldiers instead of the expected satisfaction from their achievements, awards from the government and society's gratitude. Following a joint liberation of Vilnius by the soldiers of the HA and the Red Army, the Commandant of the Vilnius HA region came to an agreement with the commanding officers of the 3. Byelorussian Front that his brigades would be transformed into regular army corps and continue combat on the front. The Soviets, however, after tolerating the HA units for several days, decided to abolish them. On the 17th of July lt. col. "Wolf" in the company of his deputies went to the headquarters of the 3. Front in order to talk over matters regarding creation of the corps. They were arrested there. Tens of HA officers were arrested in Bogusze on the same day. The next day, Soviet tanks and units encircled HA brigades in Vilnius region. After disarming, 8 thousand Polish soldiers were deported to Kaługa. There were many members of Vilnius HA medical service personnel among them. [43]

Since August 1944 NKVD units increased their actions against the remaining HA groups. Although Vilnius HA region became disbanded on the 18th of February 1945, its soldiers were persecuted and suffered repressions from the Soviets for many more years [44].

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Emergency Medicine

The epidemiology of intracranial injuries in children

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Received: 2011.10.12 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

Introduction: This article constitutes an assessment of epidemiological and clinical aspects of intracranial injuries in children. **Material and Method:** The investigation was conducted among all children aged up to 18 years admitted to the Regional Specialist Hospital in Lodz in 2011 due to an intracranial injury. Factors taken into consideration were: sex and age of the patient, time and mechanism of injury, neurostatus according to GCS, as well as mortality as a result of intracranial injury. **Results:** The study group included 214 patients (144 boys and 70 girls). The average age in the group was 11. The average duration of hospitalization was 3.89 days. All of the patients underwent head tomography which showed brain concussion in 212 cases. The remaining two cases were: traumatic cerebral oedema and traumatic subarachnoid haemorrhage. **Conclusions:** Boys aged 17 and 18 were the ones who suffered from intracranial injuries the most frequently. The majority of patients with intracranial injury obtained 15 points in the Glasgow Coma Scale. The most frequent intracranial injury was brain concussion.

Key words: trauma, child, emergency, brain.

Introduction

Children with craniocerebral traumas are the dominant group among paediatric patients hospitalized because of injuries [1-3]. The course is different from that in case of adults, which is why in this group, unexpected, life-threatening complications are the most likely to occur. [2-4].

A general condition of the vast majority of admitted patients is good, with minor head traumas [5,6,7-10]. "Minor" does not mean "insignificant" or "trivial". Sara A. Schutzman, MD, believes that attempts to decrease the mortality rate due to head injuries in children should not focus exclusively on the treatment of the most serious and quite serious injuries, but also on the prevention of dangerous complications of the minor injuries [11-12]. One of the most frequent types is intracranial injury, including brain concussions [13]. Considering the fact that there are hardly any epidemiological data referring to intracranial injuries in children, the authors decided to undertakethis issue.

Aim of the study

The purpose of the paper was to assess the epidemiological and clinical aspects of intracranial injuries in children.

Material and Method

In this paper, the cases of children admitted to the Regional Specialist Hospital in Lodz because of intracranial injuries were retrospectively analyzed.

The analysis took into account factors such as the age of the patients, their sex, time (of day and year) and mechanism of injury, and patient's neurostatus.

The analysis covered the year 2010 and was based on medical documentation. It was conducted in accordance with regulations on the protection of personal data, which were meticulously attended to.

In the analysis, the following tests were used: Student's t-test, Wilcoxon rank-sum test, chi-squared test, and chi-squared test for contingency tables. Cramer's V coefficient was also utilized.
The significance level for all the tests was $\alpha=0.05$.

Results

A group of 214 paediatric patients treated for intracranial injuries was selected. A large majority of the group were boys (n=144; 67%). Girls constituted 33% of the study group (n=70; p<0.001). Sex distribution of the group is shown in Figure 1.

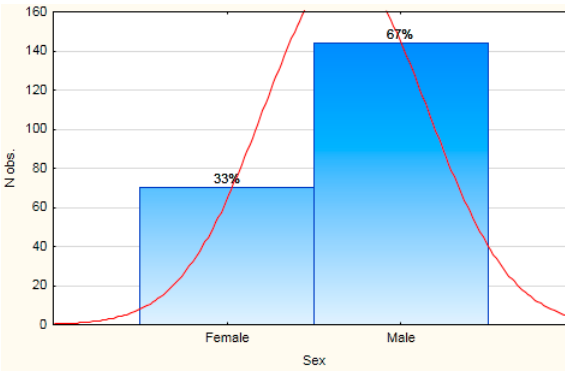

Figure 1: Sex distribution in the study group.

The average age of the group was 11.26±4.96. No statistically significant difference in the average age of girls and boys was observed (p=0.6474; Fig.2).
The most dominant group with intracranial injury were people aged 16 and 17 years (n=30; 14% for each of the groups), followed by those aged 12 years (n=19; 9%). Children under 1 year of age were the least numerous group (n=2; 1%). The analysis

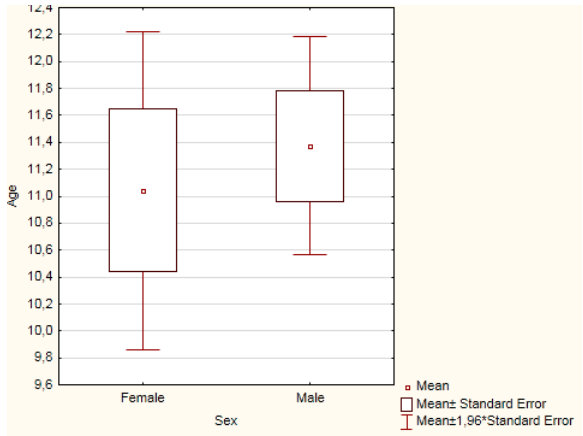

Figure 2: Box plot of patients' age in the study group.

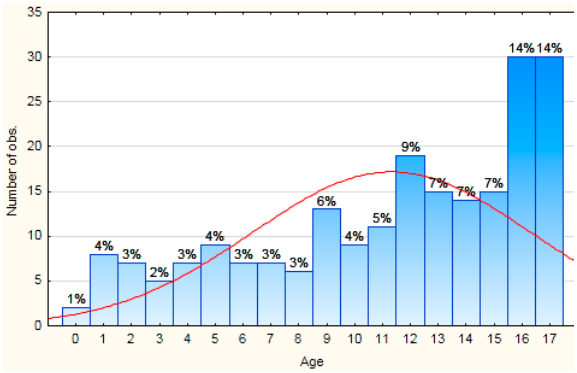

Figure 3: Age distribution in the study group

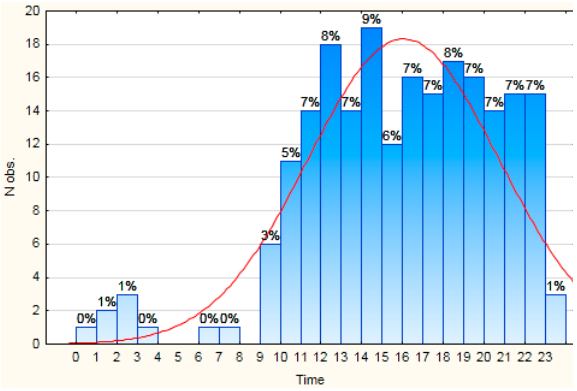

Figure 4: Distribution of the cases of intracranial injuries depending on the hour

revealed a statistical difference in the age of paediatric patients with intracranial injuries (p<0.001; Fig.3).

The analysis was conducted with a focus on the frequency of intracranial injuries in the diurnal cycle. Medical assistance to intracranial injuries was usually sought at around 2 p.m. (n=19%; 9%), followed by midday (n=18; 8%) and 6 p.m. (n=17; 8%). Cases of intracranial injuries were much less frequent at nights and in the early mornings. No cases were observed between 4 and 5.59 a.m. or between 8 and 8.59 a.m. (p<0.001; Fig.4).

The analysis on the basis of a division into four separate periods (midnight – 5:59 a.m., 6:00–11.59 a.m., midday–5:59 p.m., 6–11:59 p.m.) indicated that most of the intracranial injuries among patients under study were inflicted in the afternoon (midday – 5:59 p.m.). As many as 94 cases of intracranial injuries were observed during that period, which amounted to 44% of the study group. In the period from 6 to 11:59 p.m., 80 cases were observed (37%), whereas in the morning period (6-11:59 a.m.) 33 cases occurred (15%). In the period between midnight and 5:59 a.m. the lowest number of cases was observed (n=7; 3%). The distribution of intracranial injuries over the diurnal cycle is shown in Figure 5.

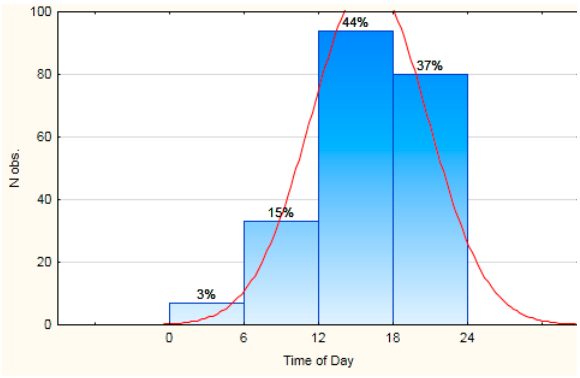

Figure 5: Distribution of the cases of intracranial injuries depending on the time of day

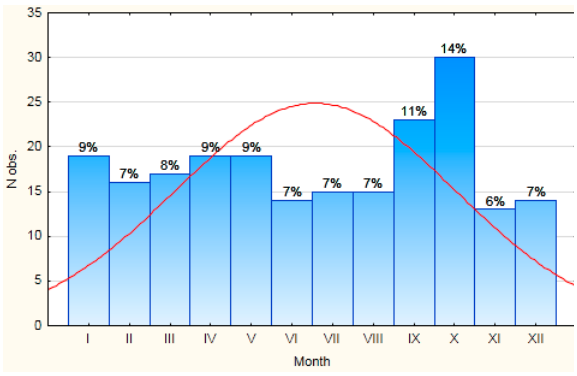

Figure 6: Distribution of the cases of intracranial injuries depending on the month

The analysis was conducted with the focus on the month of admission to hospital. It revealed that the intracranial injuries were most frequent in October (n=30; 14%), followed by September (n=23; 11%), whereas the lowest number of cases was observed in November (n=13; 6%; Fig.6).

The analysis on the basis of months divided into seasons revealed a statistically significant difference in the number of cases of intracranial injuries in the study group ($p<0.001$). The patients sustained intracerebral injuries most frequently in autumn (31%), followed by spring (26%), whereas the cases were least frequent in summer (21%; Fig.7).

Taking into consideration the frequency of intracerebral injuries in the course of the week, most of them were inflicted on Sunday (n=39; 18%), followed by Monday (n=36; 17%), whereas the lowest frequency was observed on Saturday (n=16; 7%). The Shapiro-Wilk test showed a statistically significant difference in the occurrence of intracerebral injuries depending on the day of the week ($p<0.001$; Fig.8).

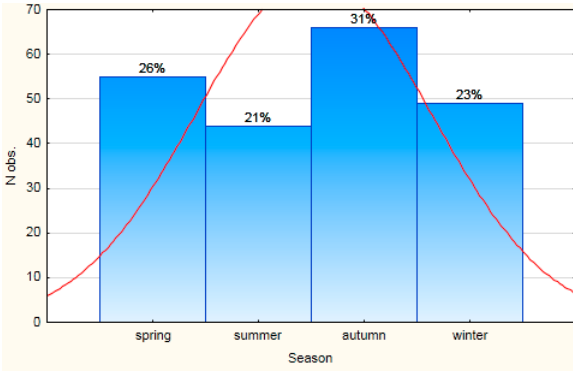

Figure 7: Distribution of cases of intracranial injuries depending on the season of the year.

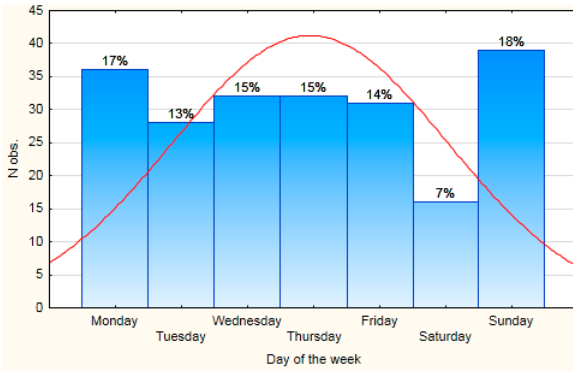

Figure 8: Distribution of cases of intracranial injuries depending on the day of the week.

The survival rate until hospital discharge amounted to 100% in the study group. The average hospitalization time was 3.89±2.44 days, whereas the longest hospitalization period was 24 days ($p<0.01$; Fig.9).

The most frequent cause of intracranial injury was falling down on a level surface, which accounted for 42% of the investigated injuries. This cause was followed by collision-free bicycle accidents (n=22;

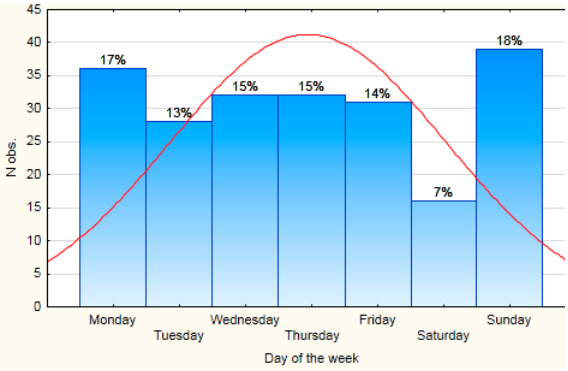

Figure 9: The duration of hospitalization in the study group.

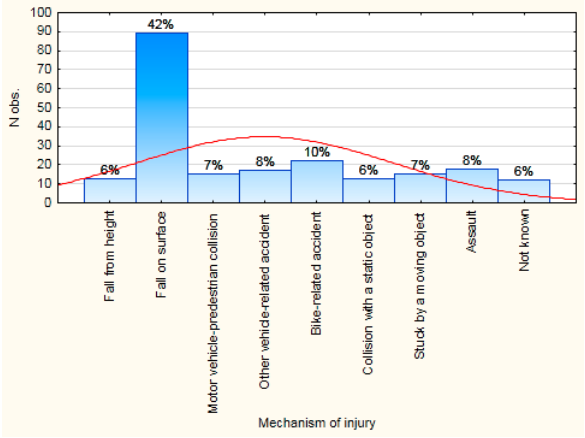

Figure 10: Mechanism of injury in the study group.

10%) and beatings (n=18; 8%). "Being hit by a car" was the cause of 15 cases of intracranial injuries, whereas other road traffic accidents accounted for 8% of them (n=17; p<0.001). The distribution of the injury mechanism is shown in Figure 10.

During medical examinations, patients with head injuries were also assessed neurologically, with the Glasgow Coma Scale. As many as 89% of patients (n=191) were rated 15 points according to GCS; 18 of them were rated 14 points. Two patients were rated 12 points and another two 11. Only one person was rated 13 GCS points.

All patients underwent a CT of the head. Brain concussion was diagnosed in 212 cases; the remaining two diagnoses were traumatic cerebral oedema and traumatic subarachnoid haemorrhage.

Discussion

Over the last two decades, a decline in the number of head injuries has been observed both in Western Europe and in the United States [9-10, 14]. This results from preventive measures being widely applied in those countries – there is a downside trend in the number of road traffic accidents as well as in the number of injuries themselves [14]. Unfortunately, this is not the case in Poland. There is a steady increase in the number of patients treated for head injuries. Predominant causes of injuries remain the same. However, as stated by many authors in the last decade, more and more of those injuries are caused by road traffic accidents and acts of violence [4,15].

Our research showed a great deal of similarity to the results presented in the literature. Among patients of the Regional Specialist Hospital in Lodz there were 214 paediatric cases with intracranial injuries. Boys were the dominant subgroup (n=144; 67%); girls accounted for 33% of the whole population (70 cases). Male dominance in the groups of patients with intracranial injuries was also indicated by other authors (Tarantino – 56% [8], Atabaki – 64.1% [5], Isik – 65% [16], Kleiven – 67.7% [17], Gassner – 68% [13], Cadotte – 69.6% [3], Brown – 83% [18]).

The average age of patients suffering from intracranial injuries in the study group was 11.26 years and was much higher for boys than for girls. The age connected with the highest number of head injuries was 17 and 18 years (14% of each group), whereas the second peak was 12 years of age (9%). The lowest number of those injuries was observed in the group under 1 year of age (1%). These results seem to indicate that patients suffer from intracranial injuries most frequently after they become qualified to drive vehicles. A lower average age of patients suffering from intracranial injuries was observed by Atabaki (8.9 years of age) [5].

The analysis of the material showed some statistically significant differences in the occurrence of head injuries depending on the month (p<0.001). An increase of the intracranial injury cases in autumn months and a decrease in summer months was observed. Similar trends can be observed in the distribution based on seasons (p<0.001). However, research conducted by Duus indicated otherwise – he observed an increase in head injury cases in spring and summer months [18].

The peak number of head injuries can be observed in the afternoon (2 and 6 p.m.), which may result

from an increased activity of people, connected with their return home from the place they stay at during the day. Different authors claim that the most frequent cause of serious head injuries is road traffic accidents, regardless of the patient's age. Seat belts and airbags used in an appropriate way as well as improved road infrastructure and reduction of speed can decrease the risk of fatal and serious head injuries by about 45-55% [4].

The cause of 42% of head injuries was "falling down on a level surface"; road traffic accidents accounted for 15% (including "being hit by a vehicle", which accounted for 7% of all cases). Intracranial injuries were inflicted as a result of violence in 8% of the investigated cases. These results are not discrepant from those presented by other authors (Ingebrigtsen – 62%, 21%, 7% [19], Agrawal – 65%, 25.6%, 9.4% [1]). The dominance of road traffic accidents among the causes of intracranial injuries was indicated by Cadotte (60.3%) [3]. Falling down was observed to be the most frequent cause of intracranial injuries also by Alexoiu [20], Brown (53%) [21], DiScala (58.4%) [22] and Isik (70%) [16]. Road traffic accidents were mentioned as the most frequent cause of head injuries by Lopez (56% of cases) [23].

Conclusions

- Intracranial injuries are most frequent among boys of 17 and 18 years of age.
- Most of the patients suffering from intracranial injuries receive 15 points in the Glasgow Coma Scale.
- The most frequent intracerebral injury is brain concussion.

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History medicine

Healthcare System of the ZWZ-AK (Union for Armed Struggle, Home Army) in the Stanisławowski Region

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Received: 2011.11.12 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Summary:

The article discusses the formation and activity of the Polish Underground Organisations' healthcare system in Stanisławowski province which was one of the most difficult regions for the Polish community during the WWII. They experienced not only terror and repression of Soviet and German occupation authorities, but also hostile attitude of Ukrainian nationalists.

Key words: second world war, Soviet occupation, German occupation, Polish underground organisations, healthcare system.

"The Marshal's leading notion is to continue the War with the Germans using units present in the country and to use as many units not yet engaged in the battle, or even those already engaged, but located nearby the Romania-Hungary border, by ordering them to travel across Romania and Hungary to France and to join the Alliance forces, so that he could continue the war and fight together with the Allies side by side. (…) The land units which had previously received an order to swim down the rivers to the area preceding the Romanian bridges, are now trying to find the shortest route to Romania or Hungary. The same applies to the unengaged military units. The air force is concentrating by air or optionally by land" [16].

These words were written down by Lieutenant Colonel Józef Jaklicz, II Deputy Chief of the General Staff of the Polish Armed Forces, during a speech by Marshal Edward Śmigły-Rydz in the morning of 17 September 1939 during a briefing with the officers of the General Staff, after receiving information about the invasion of the Red Army on Poland. The briefing took place in Kołomyja, where the General Staff of the Polish Army was located at that moment. At the night between 17 and 18 September, the Polish President, Government and General Staff of the Polish Army moved from the territory of Stanisławowski province to Romania [8].

The fact that Stanisławowski province, also called "Pokucie", was a borderland, it gained special importance during the Second World War. Romania was the only neighbouring country which the Polish government was allied with. Thus, tens of thousands of Polish soldiers could travel across its territory when heading west. The Romanian routes were also used by couriers of the Polish Government-in-exile to reach its branches in the occupied country and in backward direction – from Poland to the west. Due to that fact, the countries being at war with Poland increased the number of soldiers guarding the border with Romania. They used all possible means to counteract the formation of the Polish Armed Forces on the west and the activity of the armed underground on the territory of Poland. They also

carefully checked the territory of the Stanisławowski province. The Poles living there were subject to terror and extermination. The local Ukrainian community was encouraged to participate in the War against Poles. Thus, a great number of Poles lost their lives. Many had to flee to save their lives [3].

By the end of 1939, over 100 thousand Polish soldiers had crossed that region to reach Hungary and Romania. Many of them were breaking through in an extremely difficult conditions, i.e. after the Soviet military had taken control of the region. They also experienced huge hostility from the Ukrainians who constituted a majority in the region [15, 20].

In Kołomyja, the Ukrainians took over the authority as early as on 18 September. Their main goal was to act against the units of the Polish Army which were still stationing there. On that day, the Ukrainian authorities took about 10 thousand Polish soldiers and 600 officers prisoner and handed them over to the Soviets later on. Even more, they took over the centre of the town and blocked the road leading to the Kut city, which the General Staff had travelled when heading to Romania [4].

In that situation it became crucial to organise help for Polish soldiers crossing the territory of the Stanisławowski province . It was a difficult task as few Poles inhabited that region. Among the three pre-war provinces of Eastern Małopolska region, Stanisławowski was the one with the lowest percentage of Poles. During the National Census in the Second Polish Republic in 1931, only 22.4% of the region's inhabitants claimed to use Polish language, whereas 68.9% - Ukrainian. When one takes religion as an indicator of nationality: 16.6% claimed to be of Roman Catholic belief and 72.9% Greek Catholic, so the dominance of Ukrainians was even more visible. They inhabited mainly villages. Poles were more numerous only in a small number of villages in that province. In towns and cities, however, the Jews constituted the majority, comprising 40-45% of inhabitants. Poles were the second largest ethnic group in cities (about 35%), the third were Ukrainians – between 18 and 28% [11].

Under the Soviet Occupation

The unfavourable for Poles ethnic situation in the Stanisławowski province made it difficult to organise an underground resistance against the Soviets, who annexed it in 1939. They also had to struggle with the Ukrainian nationalists. Before the War, they formed a military and political organization called the Organization of Ukrainian Nationalists (OUN), with one of the main goals being to remove the Poles living in the region of Eastern Małopolska along with the culture they had been creating for centuries – mostly material – like the cities of Kołomyja, Stryj and Stanisławów (now Ivano-Frankivsk in Ukraine) [8].

The OUN was established in 1929, yet quite quickly, between 1930 and 1934, it was already responsible for an organized wave of terror on the territory of Poland. It murdered Polish politicians, assaulted Polish national institutions, burnt properties. It grew especially in those regions of Galicia (Eastern Europe), where the Ukrainians outnumbered Poles the most. Stanisławowski province was one of that regions.

The factor which made the situation even more dire for the Poles, was the fact that at the beginning of September 1939 many young Poles were conscripted to serve in the army and left the area. Some of them became part of the 11th Infantry Division of the Karpaty Army, which was being formed at that moment. Later on they were hunted down and repressed by the Soviet occupation authorities and also by numerous and well organized groups of Ukrainian nationalists. Members of the OUN had been murdering Poles living in that region and soldiers of the Polish Army since the first day of War. Many of them had undergone prior combat and sabotage training in the Third Reich, where they learnt how to fight Polish military units behind the front lines. In the first days of September 1939 they were transported to the territory of Stanisławowski province and began fighting the Poles, while the German forces were moving in the same direction at the same time.

The first attacks on Polish military units were carried out on 10 September. The following day, the OUN called its members to disorganise the backs of Polish units by sabotage. Anti-Polish operations by the Ukrainians gained momentum after 17 September 1939. On that day, many soldiers and officers of the Polish Army tried to reach Hungary and Romania through mountain trails on the territory of the Stanisławowski province. However, they were often caught by the Soviet soldiers and the Ukrainians collaborating with them. One

of the caught ones was Gen. Władysław Anders, shot on 28 September by Ukrainian inhabitants of the Jesionka Stasiowo near Turka and was handed over to the NKVD [1].

Hostile attitude of the Ukrainians towards the Polish soldiers made the latter avoid coming back to their hometowns after the September campaign had finished. It applied also to physicians. Those who had been conscripted to serve in the 11th Infantry Division of the Karpaty Army reached Hungary and then France. Among them were: major MD Tadeusz Daszkiewicz, captain MD Piotr Frączak and captain MD Leon Bazała [5].

The main transport routes of Polish soldiers to Hungary led through Stanisławów and Nadwórna and also through Stryj and Dolina. To Romania the route led through Kołomyja. In the face of danger, the Poles living in those cities started organising their own groups – kept secret from the Soviet authorities – which helped Polish refugees in all possible ways. First of all they helped them walk the local mountain trails safely to the southeast border of the Second Polish Republic. In this incredibly difficult terrain they organized refuges and provided them with medications, food and – in late autumn and winter – warm clothes. Hundreds of people were in such groups, doing enormous and vital work. Their role has not been fully appreciated so far.

It should be pointed out that the compact military units which walked through there in the middle of September 1939, were in need of only a modest support which they received. In a memoir of a dweller of Stanisławów we can find the following sentence:

"*We began to offer the soldiers bread and whatever there was at home. The Ursuline Sisters set up a whole buffet with coffee and tea. No soldier wanted to accept food. Drinks – yes.*
– We are not hungry! We have our own provisions! Keep the food for yourselves, you will need it soon." [13].

The above words show the involvement of all the social circles in helping Polish soldiers and their great generosity. It should be stressed that in the Polish society, especially in the Eastern Borderlands, there was a tradition of taking great care of one's own soldiers. It started as a result of fights lasting for centuries in that region.

Creation of the Union for Armed Struggle (ZWZ) Healthcare System

At the end of 1939, on the territory of Stanisławowski province, structures of a nationwide underground organisation – Union for Armed Struggle – started to form. They were started by emissaries from Lviv, where it had already been up and running. They contacted mainly members of groups giving help to soldiers heading west because they were the ones who had already declared readiness to become part of the underground and they accepted the inherent martyrdom [22].

It was then when the first structures of the ZWZ medical service started shaping along with its staff. The genesis of this service was also associated with spontaneously formed groups providing help. It was vital to provide first aid to the refugees travelling through that region. A long walk in a demanding terrain often resulted in injuries.

Therefore, the organisers of the help groups made efforts to include trusted doctors in them. It was best if the initiator of the group was a doctor himself. One of them was MD Stefan Hoszowski from Stanisławów. He played a significant role in preparing the youth of his city to participation in the War and subsequent occupation. He fully devoted himself to helping Polish soldiers and was arrested and repressed for doing so. It seems that he is the one to whom we should ascribe the role of the organiser of the first healthcare system structures of ZWZ in the Stanisławów district. He was one of the youngest doctors in that region and he was perfect for that position. Before the War he engaged himself a lot in social activity, mainly as an instructor and educator of the youth to whom he became a role model in terms of patriotic devotion. This all made it easier for him to organise agile youth groups helping soldiers travelling westward between autumn 1939 and Spring 1941.

He was born in 1906 r and received his doctor's diploma in 1935. Soon after he started work in Stanisławów. [17] His social and professional profile was vividly depicted by Tadeusz Olszański, who had known and remembered him well. In his memoirs he wrote: "Doctor Stefan Hoszowski came to Stanisławów in the mid 30s. He was like godsent, I mean from the big world. He had studied medicine in Bologna and Padua. He spoke many languages. He was handsome and incredibly helpful.

He had offers to work in Warsaw and Poznań, but he chose Eastern Borderlands because he was born there. He was socially engaged – he was the doctor of a boy scout regiment in Stanisławów and the "Rewera" sport club [14].

When the War broke out, he was conscripted to serve in the Polish Military medical service as he was an officer in reserve. Soon after coming home he engaged in underground activity together with his brother Roman – a graduate of the Technical University of Lviv (Politechnika Lwowska) – who was working in the Forestry on the territory of the Stanisławowski province. Their villa in Jaremcze became one of the refugee and courier shipping points to Hungary. There they received all the help they needed. The help was provided by the villa's hosts and senior boy scouts from Stanisławów, but also priests and the youth living nearby Jaremcze. Their secret meetings were held in churches [14].

They continued their activity until Spring of 1941, which proves that group members, but most of all its leaders, had great organisation skills. That is when the local Ukrainians become aware of their underground activity and reported them to the Soviet authorities. The Hoszowscy brothers were put in NKVD prison in Stanisławów, where they were brutally beaten with batons, to such an extent that Stefan did not recognise his own brother on the prison yard – he was so covered in blood, swelled and hard to recognise. Roman probably took all the blame on himself. He was sentenced to 15 years in a forced labour camp (Gulag) and sent to Workuta. In Stefan's case, a pivotal role played the money collected by his family and finding somebody who accepted the bribe and allowed him to be released from prison [14].

MD Józef Franciszek Łagan was also a member of the underground organisation providing help to refugees in Stanisławów. He was born in the city in 1914, but studied medicine at Poznan University of Medical Sciences. After receiving his doctor title he returned to Stanisławów. He worked in the Social Insurance Company and the local hospital. He participated in the September campaign of 1939. After returning home, together with his brother Jan, he took up underground activity. They both engaged themselves mainly in providing medical help to soldiers travelling through that area and supplying shipping points in medical devices and medications. They were arrested by the NKVD on 19 March 1940 in their parents' apartment. During interrogations in the Stanisławowski prison they were tortured and beaten. The repressions were so horrible that Jan Mieczysław Łagan died in consequence. MD Józef Łagan was sentenced to death and transported to a correctional camp in Krasnoyarsk Krai (Syberia), where due to harsh living and working conditions he died in 1941. He was only 27 then. The same year, their whole family was deported from Stanisławów also to Krasnoyarsk Krai [6].

Ruthless repressions of the NKVD and a system of informers in Stanisławów developed by its officers made it impossible for underground activity to develop in that region. The early structures of ZWZ were formed only in Kołomyja. In the beginning of 1940 a Command of the ZWZ in the region of Kołomyja was set up, which aim was to expand the underground activity on the whole territory of Kołomyja poviat (second level of local government administration in Poland). The head of the healthcare system in that Command was MD Mieczysław Szajna, who worked in that city. He was born in 1905 and received his diploma in 1929. [17] In March 1940 he was arrested by the NKVD together with all the other members of the regional Command. [13] However, he managed to survive the repressions [17].

In May 1940, in the region of Kołomyja, Lieutenant Colonel Władysław Smereczyński – who came from Lviv – started his underground activity. His job was to organise and command the ZWZ in the Stanisławów region. In different cities in that region, contact points were set up where he could safely stay and meet with local underground members. One of such places was in the apartment of MD Kazimierz Robaczewski in Worochta (Vorochta) [14].

He did not manage, though, to organise permanent structures of ZWZ in the Stanisławów region. He did not even set up his own Command. He did not appoint anyone to head the healthcare system in the region either. Together with a handful of co-operators he formed only rudimentary structures in some bigger cities.

The Soviet authorities that took over the region in September 1939, made great efforts to prevent forming of the Polish underground. They regarded the intellectuals as the initiators. They tried to

eliminate those perceived as particularly dangerous using various methods. First of all, they strived to exterminate Polish Army officers, both professional and in reserve, including doctors. In Autumn 1939, many of them were interned and in Spring 1940 murdered in Katyń, Charków and Miednoje (Mednoye). Among the murdered doctors of the region were: Andrzej Pelczar (director of the hospital in Stryj, murdered in Charków), Mieczysław Adalbert Dąbrowski (in Charków), Franciszek Krzysztof Zieliński (in Charków), Szymon Schimel (in Katyń), Salomon Weinbach (in Katyń) [2].

A form of a mass elimination of the Polish intellectuals, including healthcare staff, were four mass deportations to Siberia and Kazakhstan. In Stanisławowski province, more than 20 thousand Poles were deported [12].

It is hard to estimate the number of doctors and other healthcare staff among them. It seems there were many of them. It was when the number of staff of Polish origin substantially decreased in medical facilities across the Stanisławowski province. One of them was Captain MD Aleksander Jakub Wasilewski, the head of the Health Centre in Kołomyja. He graduated from the University of Tartu, faculty of medicine and received his diploma in 1916. When the First World War broke out, he was conscripted to the Russian army. When the revolution in Russia started, he participated in the formation of Gen. Lucjan Żeligowski's divisions. After returning to country in 1918, he served in the Polish Army. He was the chief doctor in the 14th lancer regiment (14 Pułk Ułanów Jazłowieckich). He received the War Order of Virtuti Militari for his outstanding engagement in the battle. He was demobilized at the end of 1921. In later years he engaged in social activity apart from being a doctor. He worked in the Reserve Officers Association, Folk School Association and in the Polish Social Service. In 1939 he participated in the WWII. A year later he was deported to Kazakhstan. When General Władysław Anders was organizing the Polish Army in the Soviet Union, he joined its ranks. As its officer and a doctor, he died in undisclosed circumstances at the end of 1944 in Loreto, Italy [6].

In 1940 a pharmacist – PhD Stefan Stenzel – was deported from Kołomyja to Kazakhstan together with his family. He was an owner of a pharmacy in the town and also the "Mariacka" pharmacy in Lviv located on the Mariacki square where he also had a factory producing chemicals and cosmetics. When after two years in Kazakhstan he heard about the formation of General Ander's army, he joined it. He became the head of the Central Medical Supply. Unfortunately, as a result of extreme emaciation he contracted typhus after a few days and died. He was buried on the military graveyard in Yangiyo'l (Jangijul – Uzbekistan) [6].

The deportations had significantly weakened the Polish community in the Pokucie region. Moreover, they strengthened the potential of an already incredibly strong Ukrainian population. It made the underground activity of the Polish community even more difficult. Also mutual aid, rescue and sanitary activities were hampered. Among the Poles deported from the region by the Soviet authorities there were many women who had been trained before the War to serve as medical assistants and support for the medical staff in war times. Their disappearance caused the medical sections in facilities of the Polish underground to be sparse and of little effectiveness.

Another form of repressions of Polish intellectuals – including doctors – used by the Soviet authorities were those experienced by MD Stanisław Tomaszek. He was born in Lviv in 1890 and studied medicine there. Yet when the First World War broke out, he was conscripted to the Austrian army. In 1915 he was taken prisoner by the Russians. Two years later he joined the Siberian Division (Polish 5th Siberian Rifle Division) and in its ranks he fought the bolsheviks (Soviets). After the Division was defeated he was taken prisoner by the bolsheviks, but he managed to escape. He settled in Krasnojarsk but returned to Poland in 1922. He received his Doctor of Medicine diploma in 1925. After three years he moved to Stanisławów, where he started work as a doctor of the Railways. He also engaged in social activities, e.g. he was a member of the Folk School Association. He also founded the Polish Lesser Nobility Association (Towarzystwo Szlachty Zagrodowej) which promoted Polish traditions among the countryside dwellers. It was probably the reason why he was arrested by the NKVD as early as in October 1939. At the beginning he was imprisoned in Stanisławów, but later transported to Russia, where he was in many different prisons. He died on 30 November 1940 in a prison nearby Stalingrad [6].
An exemplification of the tragedy of Polish doctors in the region was the fate of MD Stanisław

Kaliniewicz. Before the War he headed the Public Hospital in Kołomyja. After the occupation of the city began in 1939 he moved to Tarnów, where he started a job in the Municipal Hospital as the head of the surgical ward. In the middle of 1940 he was approved by the Germans to fill the position of the head of the hospital. When in 1943 he went for holiday to Kołomyja, he was murdered by the Ukrainian nationalists [10].

The medical staff was also among the thousands of Poles held in prisons located across the Stanisławowski province. After the German-Soviet war broke out on 22 June 1941 they were simply murdered. The NKVD officers usually killed them in their prison cells by throwing a bundle of grenades inside. Only in the prison in Stanisławów over 2500 Poles were murdered [14].

Sometimes doctors died as a result of coincidence. We can read about such an event in memoirs of one of the city's dwellers: "On the day the Soviets were leaving Stanisławów, doctor [Stanisław – Z. J.] Hamerski came to the outpatient clinic and walked into his office. On that day the cleaner was tidying the office. She was dusting everything very carefully and while doing so she took the Stalin's and Lenin's portraits off the wall - portraits which were obligatory in every public place. She simply wanted to clean them. In that very moment the NKVD officers rushed into the office. Seeing that the portraits were taken off the wall, they shot doctor Hamerski on the spot" [13].

In anti-Polish operations, the Soviet authorities were supported by the Ukrainians and Jews with communist views among whom there were also members of medical staff. For instance, in Kołomyja during the encroaching of the Soviet military, a "Workers and Farmers Red Guard" was formed, which was organized by a dentist – Maksymilian Alweil. Later on he organized healthcare in those regions on Soviet terms [12].

The Ukrainian nationalists did not halt their anti-Polish campaign. The Soviet authorities were striving to remove the Poles from the Eastern Małopolska region and the activists of the Ukrainian nationalist organisations had exactly the same goal. Some of them, driven by a desire to remove the Poles, took up various jobs in the Soviet administrative and police institutions. Only the activists at the forefront of the Organisation of Ukrainian Nationalist (OUN) were actually repressed by the Soviets – also by means of deportation. Some of them left the area and moved to the General Government to avoid repressions [12].

The Soviet authorities repressed mainly those Polish doctors who held high positions in the healthcare system. After their removal, they filled those positions with doctors of Jewish origin and doctors brought from the Ukrainian Soviet Socialist Republic. They started doing so after they noticed a tradition in that region whereby doctors played important roles in political and social life. That tradition took root and developed thanks to MD Gustaw Karol Dobrucki from Stanisławów and MD Tadeusz Targowski from Stryja. Both of them, by their commitment to social and political life, gained the trust of the community of the province and became its leaders. A proof of that was their election to the parliament of the Second Polish Republic in 1922.

Gustaw Dobrucki was born in 1873 in Miazuń, a small village in the Dolina poviat, located in the Stanisławowski province. He graduated from secondary school in 1890 in Stanisławów where he received his diploma (=GCSE). Later on, he studied medicine at the Jagiellonian University. After receiving a Doctor of Medicine diploma he settled in Stanisławów and took a job in the Public hospital. Apart from work he was very politically and socially active. He was the President of the National-Democratic Party and the editor-in-chief of the "Rewera" weekly. Between 1912 and 1914 he was also the Chairman of the "Strzelec" hunting association in the city.

In the First World War he served in the Austrian army, initially fighting on the Italian front. At the end of the War he returned to the region of Karpaty and joined the Supreme National Committee. After the breakdown of the Austria-Hungary he participated in political and military efforts to keep the Eastern Małopolska region within the Polish borders. In Stanisławów he set up a Civic Committee, which organized Polish administrative authorities in the city. At the beginning of 1919 he was imprisoned by the Ukrainians. After the Polish military units entered the city in May 1919, he became the starost (village headman) of the Stanisławowski poviat. He carried out the function until 1927. During that period he was also the President of a Polish-American War Orphans Committee.

In 1920 he became the head of the Public Hospital in Stanisławów. He stepped down in 1922, when he became a Polish senator of the PSL "Piast" political party. In January 1927 he became the Minister of Religious Beliefs and Public Enlightenment in Józef Piłsudski's government. He carried out his function until the end of June 1928. He moved to Warsaw the same year. He died in 1943 and was buried in the Powązki graveyard in Warsaw [19].

Social and political work was the basis of an equally impressive political career of MD Tadeusz Targowski. He was born in 1886 in Sambir . He studied medicine in Vienna where he received his Doctor of Medicine diploma in 1912. During his studies he was responsible for the organisation of the Sokol movement. In 1905 he became a member of the PSL "Piast" political party. During the Polish-Soviet War he headed the military hospital in Stryj. In 1922 he became a member of the parliament of the PSL "Piast" political party [9].

Their political and social commitment was an example for other doctors working in the Stanisławowski province during the existence of the Second Polish Republic and the occupation. However, the Soviet authorities had significantly limited the participation of Polish doctors in social events by means of terror and repressions.

Under the German occupation

Extermination, terror and persecutions, also of the medical staff in the Pokucie region, were even more severe during the German occupation.

At the end of June 1941 after the Soviets had been forced out, the Hungarian army entered the region. They were German allays but with a positive attitude towards the Polish community. Their short-lived reign was a period of respite for the Poles. It should be underlined that thanks to the Hungarian soldiers, the Poles avoided repressions prepared for them by the Ukrainian nationalist. Hungarians' attitude to the Polish and Jewish people was correct. Knowing what fate was awaiting the Jews under the German occupation, they facilitated their escape to their own country. One of the co-organisers was MD Tadeusz Olszański, who collaborated with members of the ZWZ. He had a good relationship with the Hungarians because his wife was one. His son in his account of the events claimed that a few thousand people, mainly Jews among whom had been many doctors, had crossed the Polish-Hungarian border in July 1941 [13].

The situation of Poles in that region changed on 7 August 1941 when the German took over the administration of the Stanisławowski province. Together with the Ukrainian nationalists they ruthlessly terrorized the Poles. Many times the German security police, accompanied by the Ukrainians, had arrested young men and women who were then transported to Germany as slave workers.

There were also exterminations. As early as in August 1941 at the command of Hans Krüger – the chief of Gestapo (German security police) in Stanisławów – mass arrests of Poles in the city were carried out. The lists of names had been prepared by the Ukrainian nationalists. They covered over 800 people from Stanisławów and surrounding areas. Among those were over 300 members of Polish intellectuals, mainly teachers. There were also seven doctors with their families in that group: Leonard Dąbrowski, Jan Gutt, Adam Hickiewicz, Józef Kochaj, Ludwik Morvay, Erazm Niemczewski, Andrzej Raczyński, and also Mrs Krzywicka, a wife of a doctor who had not been at home on that day. They were all murdered in the so called Black Forest (Czarny Las) near Uhryniv (near Ivano-Frankivsk) [12].
Another wave of arrests and murders swept the city before 11 November 1941. Also this time mainly the intellectuals suffered.

Home Army's (Armia Krajowa – AK) healthcare system

In order to organise the Poles living there to fight against the occupants, the Central Command of ZWZ in Warsaw sent there a few of its own officers. In December 1941 Captain Rudolf Majewski came to Stanisławów as the one appointed the chief of local Command. In January 1942 Lieutenant Colonel Jan Rogowski also came to Stanisławów and became the chief of ZWZ – later renamed to Home Army (HA) – in the Stanisławów region. The underground started slowly forming in very difficult conditions. The Polish community was sparse, about 160 thousands, of whom 16 thousand were capable of serving in the army. In consequence of Soviet repressions, the number shrank to about 85 thousand. The cruelty and extensiveness of the repressions paralyzed the remaining Poles. Due to

that, a large share of them were not keen on engaging in underground activity.

The most active was the youth. In an organizational report sent to the ZWZ Central Command on 6 May 1942 by the HA regional Command in Lviv (which covered the Stanisławowski region), we read: "The chances of filling the vacancies is bleak because there is a lack of professional officers. Reserve officers have been conscripted into the German military and are not keen on participating in underground activity. The civilians are passive and intimidated. We can count on professional non-commissioned officers in 75% of cases. There are about 120 – 150 of them in every bigger city of the region, such as Kołomyja and Stanisławów, and smaller groups in a few other locations. Moreover, we can count on 90% of the youth from schools. Women are also keen on helping".

No wonder that in September 1942 there were only about 3 thousand Home Army soldiers in that region. In the organisational structure of the local Command from that period we do not find a position of the head of healthcare. It was still being formed back then. However, as a part of the First Division, a Women Military Service (WSK, Wojskowa Służba Kobiet, Wojskowa Służba Kobiet) was established, which had one facility. Probably in its ranks was a medical clerk, because in later reports from this local Command it was clear that the best developed section of the WSK was the medical service.

A lack of a doctor in the local Command of that region did not mean that the healthcare was completely ignored there. Situations like these were characteristic for all HA regions in their beginnings. It was enough to have only occasional contacts with doctors working at hospitals and outpatient clinics. In case of a need to give medical help to sick soldiers of the HA, more radical steps were taken, usually open and legal, as such cases were a rarity. There were no fights yet then so there were no wounded. In memoirs of one of the dwellers of Stanisławów it says that his father, MD Tadeusz Olszański, collaborated with the HA as early as in 1942.

Doctors cooperating with the HA were surely more numerous. Generally, the Polish community in the Pokucie region dramatically lacked doctors. A characteristic feature of pre-war doctors in that region was that most of them were Jewish. The proportion grew even higher during the Soviet occupation reaching 70% of the overall number of doctors. However, the Germans locked them in a ghetto in Stanisławów at the beginning of the occupation and murdered them subsequently.

The Ukrainian population, hostile to Poles and dominant in terms of number, helped the German authorities invigilate the structures of HA. As a result there were constant arrests of the Polish underground members. The biggest wave was at the turn of 1942 and 1943. About two hundred soldiers from different levels of the organisation were seized. A few of them were from the local Command of the region, and among them: the chief – Lieutenant Colonel Rogowski, chief of staff – Captain Majewski and quartermaster – Mieczysław Schimma, who was in charge of the healthcare. A few times more people left the region because they had thought they were at risk of being arrested. Many of them escaped to Hungary. Among them were doctors previously collaborating with the HA. The arrests and flees stymied the organisational and numerical growth of HA in that region. Until the end of the German occupation, no efficiently working Commands, combat units or secondary structures – including healthcare – were formed.

In February 1943 in Lviv, a Restoring Unit of the HA in the Stanisławowski region was set up, with captain Władysław as the chief. By the end of the year, basic organisational units were set up. The chief of healthcare in the region was "Dr Puma" (name unknown). He collected medications and wound dressings. Apart from other equipment, he had 3 sets of surgical tools (small surgery kits) and 2000 wound dressings. He developed a procedure on how to organize and run a district hospital with 250 beds and four field hospitals with 20 beds each. He made efforts to equip them with medications and devices, furniture, working clothes, kitchen and dining utensils, and so on. He also trained the female medical orderlies (there were almost 200 by the beginning of June 1944). They participated in the fights of self-defence units, organized in Polish villages to protect them from the attacks of the Ukrainian Insurgent Army (UPA, Ukraińska Powstańcza Armia).

The Stanisławowski region of the HA was established and operated in extremely difficult conditions. It was one of the weakest regions in the occupied Poland during the WWII. It also had poorly organized medical services. Its soldiers were unable to carry out major combat and sabotage operations. However, they played a significant role in self-defence operations, which saved the lives of thousands of Poles living in the Pokucie region who were in danger of attacks by the UPA.

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History of Medicine & Pharmacy

Obituary - Colonel Retired, Professor Tadeusz MOSINIAK (1927 – 2011), MD, PhD

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Received: 2012.01.12 • **Accepted:** 2012.03.01 • **Published:** 2012.03.27

Colonel Retired, Professor Tadeusz MOSINIAK, MD, PhD (1927-2011)

In great grief and sorrow we say goodbye to the colonel ret. Professor Tadeusz MOSINIAK, MD, PhD. He was born on October 8, 1927 in Łódź. Until the outbreak of World War II, he attended a private school of Social Society of a Polish Male Gymnasium in Łódź (Prywatna Szkoła Towarzystwa Społecznego Polskiego Gimnazjum Męskiego w Łodzi). After the end of the war, he graduated from high school and after receiving his school diploma in 1948 he joined the Faculty of Pharmacy at the University of Lodz, from which he graduated in 1952 with a Master's degree in pharmacy. In 1952, he was appointed to a training for healthcare officers at the Military Centre of Medical Training in Łódź, after the completion of which he was directed to serve in the Military Unit in Wroclaw, and then in Poznań again. In 1954 - after training at the Higher School of Infantry in Rembertów - he was selected for a specialist Higher Academic Course at the Kirov Military Medical Academy in the then Leningrad. After returning home in 1956 he was appointed to the position of the deputy director for science at the Military Centre of Medical Training in Łódź. In 1958, at his own request, he resigned from his high administrative position and transferred to the division of teaching and scientific work, taking the position of a senior assistant in the developing Military Medical Academy that he co-organized.

In 1964 he defended his thesis and received his PhD in pharmacy at the Faculty of Pharmacy of the Medical University of Lodz. In the same year, he became an assistant professor at the Military Medical Academy. In 1969, he was appointed as the Head of the Faculty of Pharmacy at the Institute of Military Medicine, Military Medical Academy, and the Commandant of the University entrusted him with the function of the Dean of the School of Pharmacy and Laboratory Medicine. In 1975 he received a post-doctoral degree in medical sciences at the Faculty of Medicine of the Military Medical Academy. In 1978 he was appointed to the position of the Deputy Commander for Research at the Institute of Military Medicine, Military Medical Academy, and in 1984 he became the Commander of the same Institute. On 11 July 1985, he received the title of a professor. The professor supervised 5 postdoctoral degree conferral procedures. Under his supervision, 12 dissertations were prepared and defended at the Faculty of Medicine of the Military Medical Academy, as well as many master's theses at the Faculty of Pharmacy, Medical University of Lodz. For many years he was the Chairman of the National Examination Committee at the Ministry of National Defence granting 1st and 2nd degree specializations in the field of military medicine. Under many years of his supervision, 51 officers-pharmacists obtained the 1st degree of specialization, and 66 – the 2nd degree of specialization in the field of Organization and Tactics of the Health Care and Medical Supply. Since 1958 he ran lectures, classes and seminars on organization of medical supplies and sanitary materials, for students of the Faculty of Medicine, School of Dentistry, School of

Pharmacy at the Military Medical Academy, as well as students of the Training Centre of Health Service Reserve of the Military Medical Academy, and for many years - from 1959 to 1975 - he gave lectures and classes for students of the Faculty of Medicine, Pharmacy and Dentistry at the Medical University of Lodz. He filled successively all the positions of an academic teacher, from assistant to the head of the Faculty and the Commander of the Institute. For his achievements in science and teaching and educational work, the President of the Military Medical Academy awarded him in 1977 the prestigious title of the Leading Academic Teacher.

Retired colonel Professor T. Mosiniak, MD, PhD was an active member of the Polish Pharmaceutical Association. With the consent of

the Board of this Association, he established the only Military Pharmacy Section in the country, at the Department of Łódź, of which he was the chairman. For many years he was a member of the board of directors of the Łódź Department of the Polish Pharmaceutical Association. With many years of devoted work for the Association, the Department in Łódź awarded him with a diploma for the 30th anniversary. He was also a member of the Board of Directors and the vice-president of Łódź Division of Maria Skłodowska-Curie Polish Radiation Research Society.

Retired colonel Professor Tadeusz Mosiniak, MD, PhD held responsible positions such as: member of the Editorial Collegium at Biuletyn Wojskowej Akademii Medycznej, a member of the Scientific Council, Editorial Board and Honorary Editor of the quarterly Wojskowa Farmacja i Medycyna, a member of the Council of the Faculty of Medicine, Military Medical Academy, the Deputy Chairman of the Committee on Inventions and Innovation at the Military Medical Academy, a member of the board of the Faculty of Pharmacy, Medical University of Lodz. He also held the honourable position of the chairman of the Scientific Council of the Institute for Organization of Health Care of Soldiers at the Military Medical Academy, a member of the Committee of the Practical Application of the Council of Fundamental Medical Sciences, Faculty VI of the Polish Academy of Sciences, member of the Senate Committee for the development of scientific personnel of the Military Medical Academy and a many-year member of the Polish Red Cross.

For all the research and teaching and educational work he was awarded: the Officer's Cross and Knight's Cross of the Order of the Rebirth of Poland, the Gold Cross of Merit, the medal of the National Education Commission, the gold, silver and bronze medal of "Merit for National Defence", the gold, silver and bronze medal "Armed Forces in the Service of the Fatherland", the medal "for exemplary work in health care", the gold, silver and bronze medal of Military Medical Academy, The Red Cross Medal of Honour of III and II class, the silver medal "Dedicated Member of the League of National Defence", "Badge of Honour of the City of Łódź", the silver medal "Youth for Progress", the medal "In recognition of the contribution to enhancing the defence readiness of health and social care", the Diploma, Medal and Title "Military rationalizer", Commemorative Medal of the

Medical University of Lodz, "for many years of teaching students of Faculties of Medicine, Dentistry and Pharmacy".

Retired colonel Professor Tadeusz Mosiniak, MD, PhD was repeatedly awarded numerous awards and diplomas of recognition, among others by: the Minister of National Defence, the Chief Inspector of Technology of the Polish Armed Forces, the Quartermaster General of the Polish Armed Forces, the Minister of Health and Social Welfare, the Minister of Science and Higher Education, the President of the Medical University of Lodz, the Commander of the Military Medical Academy and the Commander of the Navy.

Retired colonel Professor Tadeusz Mosiniak, MD, PhD worked and participated actively until the last moments of his life in teaching and research at the Department of Epidemiology and Public Health, Medical University of Lodz, lecturing, reviewing doctoral and master's dissertations - sadly he did not manage to read the last review. The professor always offered us good advice and it was always possible to count on his help and great knowledge not only scientific or didactic, but also life-related. The professor was buried on 22 December 2012 at the cemetery in Łódź, with military honours, led away with a flag by the Guard of Honour of the 25th Air Cavalry Brigade of the Polish Army.

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Military Pharmacy and Medicine (MF&M) is an international, peer-reviewed scientific journal that publish original articles based on own research, as well as review articles and case reports in the field of pharmacy and military medicine, and modern solutions in the field of military and civilian healthcare based on the latest national and international achievements.

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Editors may agree to exceed the number of pages in case of: summaries of habilitation dissertation and the habilitation dissertation on degree of doctor of pharmaceutical and medical sciences.

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Koffler D, Reidenberg MM. Antibodies to nuclear antigens in patients treated with procainamide or acetylprocainamide [published erratum appears in N Engl J Med 1979;302:322-5]. N Engl J Med 1979; 301: 1382-5.
Article in electronic form:
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Erratum

In the issue No 1 (vol. IV, 2011) on the page 11 **should be**

Aerosolotherapy in respiratory system diseases

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