STUDIES IN PHYSICAL CULTURE AND TOURISM
Vol. 17, No. 1, 2010

REVIEW ARTICLE

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PREVENTION OF LIMB DEEP VEIN THROMBOSIS (DVT) IN TOURISTS DURING LONG DISTANCE COACH TRIPS

Key words: coach trips, deep vein thrombosis, preventive measures.

ABSTRACT

Based on the offers of travel agencies in Poland and foreign publications the Authors define trends in coach tourism development. A seated position maintained for a longer period of time, as during long-distance journeys by coach, results in blood flow slowing. A long travel by modern coach entails both potential health hazards and possible prophylactic measures that could be taken by tourists to prevent the development of deep vein thrombosis. DVT prophylaxis consists in physical prevention of "help yourself" kind – almost totally dependent on the passenger and pharmacotherapy. Preventive "help yourself" measures include frequent changes of the body position and forced muscle activity. Based on the presented data on the risk of DVT development in tourists during long distance journeys by coach we may conclude that the probability of preventing Travel Related DVT ("economy class syndrome") is relatively high.

INTRODUCTION

Long distance trips are becoming increasingly popular in Poland not only due to the improvement of living standards of the Polish population, but also with the desire to sightsee distant places and to visit the friends and relatives living abroad. The vast majority of Poles still travel by organized means of transport. Despite the widespread use of air transport, coach remains a basic component of transport infrastructure. This entails the necessity of knowing the general and medical aspects of using this means of transport.

According to coach categorization, there are four categories of buses marked with stars. They have different onboard standards (refrigerator, toilet, air conditioning, audio equipment, facilities for the disabled), but mainly differ in the space between seats (Table 1).

Table 1. Space between seats depending on coach class[1]

Space between seats (minimum)	Coach category
68 cm	1 star
72 cm	2 stars (excursion coach)
77 cm	3 stars (tourist coach)
83 cm	4 stars (long distance coach)

[1] Bosiacki S., Śniadek J. (ed.), Metodyka i technika obsługi ruchu turystycznego (Methodology and techniques of tourist service). AWF Poznań, 2004.

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The transport facilities in long-range transport include:

- excursion coaches – vehicles adjusted to longer trips, enabling transport of people in a seated position over short distances (without special adjustments);
- tourist coaches – vehicles adjusted to long distance travels with numerous facilities (reclining seats, footrests, larger hand luggage compartments). The arrangement of seats on such coaches can be improved and the space adjusted to the transport of people over longer distances (above 500 km);
- long distance buses – vehicles for longer trips, meeting passengers' requirements over longer distances.

Such facilities (separated passenger area, small galley area, toilet, mini-bar and a sleeping place for the drivers) enable long-distance travels without the necessity of using general infrastructure [10].

Certainly, the above described scheme is a general scheme, not applicable for all possible types of coaches. However, it enables to determine, which groups of passengers are at the highest risk of developing thrombosis in lower limb veins [11, 17].

COACH TRAVEL SPECIFICITY

It should be stressed that, depending on the travel schedule, it is possible to determine a potential hazard of developing deep vein thrombosis. As for systematic scheduled trips, the route is planned and optimized. This enables scheduled stops and performance of some necessary activities during the journey. In the case of isolated journeys, when the driver does not know the route, the passengers are forced to assume a position that cannot be changed due to the conditions of this transport modality for too long a time.

According to the data concerning various transport modalities, it should be admitted that long distance travels and vehicles not directly dedicated to passenger needs (microbuses, vans, excursion coaches) carry the highest risk for the development of deep vein thrombosis [12, 15, 19].

In Poland, a number of carriers in their efforts towards a radical modification of their bus fleet, focus their attention on small buses or utility vehicles adjusted to passenger transport. Thanks to this they can save the costs of vehicle maintenance and adjust the offered seats to actual needs – the so-called load factor (the ratio of revenue passenger miles to available seat miles, frequently used in air transport) – providing information on the effectiveness of using a given vehicle model for passenger transport. Such an attitude however, results in the passengers crammed between seats, unable to move freely in smaller vehicles which are not designed for special purposes. This leads to a limited potential of changing the body posture, which can be manifested as deep vein thrombosis [8, 16].

TRENDS IN THE DEVELOPMENT OF LONG-DISTANCE TRAVELS

Based on the offers of travel agencies in Poland, we can strictly define the trends in coach tourism development. Coach tourism will most likely be focused on the routes enabling comfortable passenger transport within the existing transport infrastructure. Coach tourism utilizes the existing transport infrastructure. Using single transport modalities enables a suitable adjustment of the offer to our actual needs. We should expect that current trends will be in conformity with the defined pathway of the development of organized tours. As for domestic travels, coach transport will be always regarded a substitute for railway transport [9].

As for long-distance travels in Europe, a coach still remains an important substitute for air transport. Tourists with lower incomes, who cannot afford their own transport or airline tickets, will always travel by coach. Due to the specific conditions in Poland, this is also one of the few modes of transport providing an opportunity to travel from the eastern part (main international airports are located in the central and western parts of Poland, and the railway lines between the eastern part and the remaining parts of Poland are limited).

Moreover, there are multiple social groups in Poland, which due to their economic status (students, young married couples, elderly peoples) search for the opportunities of cheap transport. While the two former groups are at a low risk of the economy class syndrome, the latter is at the substantial risk of developing complications during journeys. This is related to age and the tendency to

develop conditions that may contribute to deep vein thrombosis in the lower limbs.

Undoubtedly, it should be emphasized that it is necessary to be prepared for coach journeys as for traveling by other means of transport. Systematic packing things for the journey is essential, as well as taking the proper amount of beverages and adequate clothes (compression socks or stockings) and medicines.

EXEMPLARY COACH ROUTES

Among the most frequent coach routes, we should mention:

– routes in Poland – tourist excursions, passenger transport at long distances above 4 hours;
– long distance routes in Europe – coach excursions (Mediterranean, sightseeing tours), passenger transport (Eastern Europe, Scandinavia).

It should be emphasised that the tendency to limit individual car transport due to environmental pollution will make a vast majority of tourists use coach transport as a substitute for car transport. This will probably result in a different role of the coach as transport modality, yet it will not affect changing its construction.

The significantly improving road infrastructure, the tendency to reduce vacation time and expectations connected with the arrangement of guided tours will certainly support the development of coach transport. Such an attitude requires implementation of the above mentioned recommendations to prevent the symptoms of deep vein thrombosis that may occur during long distance tourist trips.

AN EXEMPLARY LONG-DISTANCE COACH EXCURSION: TREASURES OF ITALY

This exemplary itinerary of Treasures of Italy excursion allows us to assess the extent of a potential risk for the development of deep vein thrombosis in the lower limbs. The itinerary is based on the data obtained from the Ecotravel Travel Agency (www.eccotravel.pl). The above trip was chosen due to its marked popularity, route length (about 3000 km), season (summer, high temperatures) and the diverse age and sex of tourists.

Treasures of Italy – Venice, Ravenna, Assisi, Monte Cassino, Pompeii, Rome, Vatican, Florence.
Tour schedule:

Day 1 – Departure from Krakow at 2 p.m. Transit through the Czech Republic and Austria.

Day 2 – Arrival in Venice in afternoon hours (about 1100 km, 24 hour driving). A cruise from the parking lot to St Mark's Square. Free time. Return to the parking lot. Departure to the hotel near Ravenna (about 150 km, about 2 hour driving). Accommodation at the hotel.

Day 3 – Breakfast in the hotel. Sightseeing tour of Ravenna. Driving to Assisi (approximately 200 km and 2.5 hour driving). A sightseeing tour. Driving to the hotel near Rome (about 220 km, and 3 hour driving). Accommodation at the hotel.

Day 4 – Breakfast in the hotel. Driving to Monte Cassino (about 140 km and 2 hour driving). Driving to Pompeii (about 120 km, about 2 hour driving). Sightseeing the ruins and archaeological excavations of the partially buried Roman town-city. Transport to the hotel near Rome (about 240 km, and 3.5 hour driving). Accommodation at the hotel.

Day 5 – Early breakfast. Arrival in the Vatican. Participation in the Pope's general audience (depending on whether the Pope is in Rome or not – waiting time and audience in standing position approx. 3 hrs). Sightseeing of the Vatican and Rome by night. Return to the hotel. Accommodation at the hotel.

Day 6 – Breakfast. A trip to the Vatican. Return to Rome. Return to the hotel. Accommodation at the hotel.

Day 7 – Breakfast. A trip to Florence (about 275 km, 4 hour driving). Sightseeing Florence. Departure in the evening, travel to Poland, Florence – Krakow (about 1350 km, 26 hour driving).

Day 8 – Transit through Austria and Czech Republic. Return to Krakow about 8 p.m.

Notes concerning transport:

– meeting of the participants 15 minutes prior to the departure,
– on antenna routes there might be changes in travel schedules,
– seats on a coach are distributed according to the sequence of declarations to participate in the excursion,

– on every route there are comfortable coaches, equipped with air conditioning, mini-bar with hot beverages (paid to the driver),
– passengers may get to antenna routes by micro-buses,
– the tour leader decides where to stop every 3-4 hours, break time – 20-30 minutes.

The above description of a weekly travel by modern coach organized in summer to southern European countries indicates both potential health hazards and possible prophylactic measures that could be taken by tourists to prevent the development of deep vein thrombosis.

PREVALENCE OF LIMB DEEP VEIN THROMBOSIS

Deep vein thrombosis (DVT) and venous thromboembolism (VTE) are connected with substantial health hazard due to their prevalence and potential life-threatening complications. The most dangerous consequence of this disease is pulmonary artery embolism, and the most frequent one is venous insufficiency, manifested as postthrombotic syndrome. The causes of the formation of dangerous venous embolism were for the first time identified and presented in 1858 by a German pathologist, Rudolf Virchow (1821-1902). They include changes in the venous wall, slowing of the blood flow and hypercoagulability (the so-called Virchow triad) [7]. Air Travel Related DVT was first described by an American surgeon, John Homans (1877-1954). In 1931, at the age of 54 after a 14-hour flight from Boston to Venezuela, he diagnosed himself with acute DVT based on the pain in the calf, intensified after an active and passive dorsiflexion of the foot (Homans's syndrome) [3, 4]. As the latest studies more and more often reveal the prevalence of DVT, also when travelling by car, coach or train, presently the confusing and not very precise name "economy class sydrome" is being replaced by Travel-Related DVT [18]. In 2006, the death of a "healthy individual" following a long coach travel was reported [17].

A seated position and dehydration maintained for longer time, as during long-distance journeys by coach, result in blood flow slowing. When the opportunities for moving are limited, the lower extremities are dropped down, often crossed, the knees bent, and the blood circulation is arrested for many hours (hemostasis). This causes anoxia of the venous epithelium, impairment of the internal fibrinolytic activity and the dynamic equilibrium between coagulation/fibrinolysis, being disturbed and resulting in hypercoagulability. Healthy volunteers were found to possess increased levels of thrombin-antithrombin complex (TAT), prothrombin fragments (F1 and F2) and D-dimers. These levels turned out to be even higher in persons with factor V Leiden mutation and those using oral contraceptives [15].

A prolonged immobility, even in an optimally comfortable seat in a coach or car, results in pressure exerted on the posterior areas of the thighs, the popliteal fossa and the posterior crural areas. This adversely affects blood outflow from the lower extremities. This substantial limitation of space for a passenger, characteristic for the "economy class" (during air or coach travel) due to the greater number of seats and cramped space between them, was frequently the reason for DVT development. Therefore, this condition was called economy class syndrome [2]. So far, travel-related DVT has been reported in 1,560 studies worldwide [1]. In the case of air travels, there is a documented proportional correlation between the distance covered (flight duration) and the prevalence of DVT (up to 5,000 km 0.01/million passengers, above 5,000 km 1.5/million, and above 10,000 km 4.8/million passengers, as related to flights 1 x per 4,600 flights.) [18, 20]. 12 out of 200 volunteers experienced asymptomatic DVT (revealed by USG Doppler examination) after a long distance flight. Kwarecki, the co-author of the paper: "Venous thrombosis – an urgent problem of transport medicine" reported his not entirely scientific, yet "unitary and subjective finding" after his long distance travel to Paris. He wrote "…the majority of passengers developed noticeable swelling of feet and lower crural regions, accompanied by pain in the feet and calves" [11].

DVT prophylaxis consists in physical prevention of "help yourself" kind – almost totally dependent on the passenger and pharmacotherapy. Preventive "help yourself" measures include frequent changing of body posture and forced muscle activity. It is necessary to perform lower extremity movements, rotational movements of the feet, extension and flexion of the feet (activation of muscular pump), lower limb lifting and isometric exercises. It is also recommended to wear proper

clothes whilst traveling. The clothes should be loose (likewise the underwear and footwear). Passengers should often move around – stand up and walk on board (at least a few steps). Tall passengers should occupy aisle seats leaving those near the windows to shorter persons. Like during air travel, while travelling by coach, adequate hydration is necessary. Drinking non-alcoholic and non-carbonated beverages is recommended, as carbonated beverages increase the still existing tendency to flatulence, causing compression of the inner organs and arresting blood outflow from the lower body. Even minor dehydration results in blood anhydraemia and hypercoagulability The course of DVT is frequently asymptomatic. Its most frequent noticeable symptoms include "heaviness" of the lower legs, swelling of the legs (talocrural joint), pain, painfulness and elevated temperature in the crural area. In that case, the findings of multiple studies in aviation medicine should be utilized when planning long-distance coach travels.

Hugo Partch, an outstanding specialist in the diagnosis and treatment of DVT (former president of the International Union of Phlebology) divided the passengers at risk of DVT during air travels > 6 hours[2] into the three groups:

I – low risk – healthy individuals < 40 years;

II – average risk, obesity > 40 years, chronic venous insufficiency, varicose veins, pregnancy and puerperium, hormonal contraception, hormonal replacement therapy, circulatory insufficiency;

III – high risk – history of DVT, cancerous disease, recent history of surgical procedures (particularly within the lower extremities, e.g. of hip or knee joints), immobilization in plaster cast, hematologic syndromes associated with hypercoagulability, haemophilia.

Long-distance airline and coach travels have a lot in common. The most important risk factor is maintaining a seated position with the knee joints bent for a prolonged period of time in a cramped space between seats.

Although inside a coach there is no exposure to the decreased partial pressure (as on a plane – in arterial blood and pulmonary vesicles) or to the decreased air humidity and quick changes of the climate (e.g. to subtropical), the travels, however, are definitely longer (sometimes even several times longer), and due to this fact, the phenomenon of "mental exhaustion" is frequently observed. Therefore it seems reasonable to accept without any objections the subdivision presented by Partch, adding an extra risk factor for the development of DVT, namely the body height above 185 cm in males and above 175 cm in females.

The most frequent risk factors for DVT include such conditions as varicose veins and obesity, and long term pharmacotherapy – hormonal replacement therapy and contraception. Additional risk factors include the age above 40 years and the aforementioned body height for both sexes. Based on this assumption, we may conclude that under such static conditions as travelling by coach, almost all the passengers are at average risk for developing DVT.

Compressive socks (very rarely stockings are needed) with graded compression capacity play a significant role (diminishing the risk by about 50%) in DVT prevention and comfort improvement during long distance journeys [5, 6].

They should possibly most accurately correspond to the leg contours and increase compression of about 8 mmHg under the knee, 14 mmHg in mid-crural area and 18 mmHg in the talocrural joint area. Adequately selected knee length socks (sizes and compression) 1-2 weeks is definitely recommended prior to the journey; buying uniformed size socks immediately prior to the journey is not advised. In order to reduce swelling, pain and heaviness of the legs, the tourists may use medications from the group of flavonoids (e.g. diosmin).

Since 1937 heparin has been used as the basic and most effective means of pharmacological prophylaxis of DVT Since the mid-1980s, using low molecular weight heparin (LMWH) in prophylaxis and treatment of DVT has contributed to a widespread use of this safe and easy method [5]. A single, subcutaneous injection of LMWH (prescribed by a physician) by the patients themselves, once a day provide a very good protection. Convenience and simplicity of usage (disposable ampoule-syringes with adequate doses of LMWH), high biological availability of this form of heparin and virtually rare cases of complications and low costs resulted in a widespread use and very good results of this form of treatment. As for the second risk group mentioned earlier, using LMWH

[2] WRIGHT – World Health Organisation Research Into Global Hazard of Travel, while working out the international project of multicenter prospective studies on the correlation between travelling, DVT and pulmonary arterial embolism, has established the risky time of "transport" immobility > 4 hours [2].

is recommended, and in the case of the third risk group – necessary.

Summing up, based on the presented data on the risk of DVT development in tourists during long distance journeys by coach we may conclude that the probability of preventing the Travel-Related DVT (economy class syndrome) is relative high – even among healthy passengers. Therefore, a proper informative and health-promoting policy of travel agencies, family doctors, lecturers at medical and tourist departments and mass media is crucial. Healthy persons (without latent risk factors) are at low risk of DVT, especially its asymptomatic form, during flights of shorter duration than 3 hours. Conversely, risk factors (even the "silent" ones, such as factor V Leiden mutation) may carry even thrice as high risk of DVT, especially on flights longer than 6-8 hours [7, 13, 15]. People at average and high risk factors of DVT should systematically adhere to physicians' recommendations concerning the lifestyle, working conditions, clothes, physical activity, using compression therapy and low-molecular-weight-heparin (LMWH) as prevention means.

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