The suggestion that venous thromboembolism (VTE) is associated with air travel has for several decades been the subject of both “media hype” and extensive debate in the medical literature. As emotion and anecdote is often a feature in this debate, it is therefore necessary to separate evidence from anecdote. “Travelers’ thrombosis” is a more appropriate term because the evidence suggests that any form of travel involving immobility lasting more than 4 h can predispose to thrombosis. There is no unique factor in the air travel cabin environment that has been shown to have any effect on the coagulation cascade. Prevention of thrombosis in any form of travel, including air travel, requires being aware of the issue and making an adequate risk assessment together with appropriate prophylactic measures.

Keywords: travelers’ thrombosis, air travel, evidence, immobility, passenger health, risk assessment, prophylaxis.

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Travelers’ Thrombosis

Symington and Stack (28) described eight cases of VTE following travel. Three had traveled by car, three by aircraft, one by rail, and one by rail and ship travel combined. Just as Homans (13) had reported, they found the condition was not unique to air travel. In 1988, Cruickshank (7) coined the unfortunate phrase, “economy class syndrome” when he described six case reports of VTE. As is now quite clear, this term is a misnomer and it is unfortunate and unhelpful that it is still found in some media reports on the subject. The Aerospace Medical Association’s Air Transport Medicine Committee (2) stated that the phrase “economy class syndrome” is seriously misleading and the term “travelers’ thrombosis” should be used. This view was also supported by the UK House of Lords Select Committee on Science and Technology (14).

The evidence for the association of travel and VTE has been studied in a number of publications. Kraaijenhagen (18) studied 788 patients with a diagnosis of possible deep venous thrombosis. The data in this paper showed that the odds ratio for air travel was 1.0 (95% CI: 0.3–3.0). This is the only publication which failed to show any association.

In a case control study of 160 individuals, Ferrari (8) found a history of air travel in those who presented with VTE in 24.5% of cases as against 7.5% in those who did not present with VTE (P < 0.0001). The odds ratio for venous thromboembolism was 3.98 (95% CI: 1.9–8.4). In this study 28 individuals had traveled by car, 9 by air, and 2 by train and the duration of travel was 5.4 ± 2.1 h.


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Despite this convincing evidence that VTE can occur in any form of transport when associated with prolonged immobility, it has still been suggested that the coagulation cascade may be activated by the aircraft cabin environment and enhance the risk in this particular mode of transport. Bendz (4) showed that in volunteers who were exposed to hypobaric hypoxia, a transient activation of coagulation up to eightfold occurred. However, in this study there was no control group and this finding, therefore, needs to be treated with a degree of suspicion, as measurements were made in the same individual before and after exposure to hypobaric hypoxia. This situation was later clarified by Toff et al. (29), who showed that there was no activation of coagulation in a controlled decompression chamber study simulating the standard cabin environment. In this study a single blind cross-over technique was used.

Scurr (25) raised further doubts, suggesting that in those passengers flying for more than 8 h, there was a 10% prevalence of what was described as “thrombosis.” However, this “diagnosis” was merely a positive ultrasound scan, with a negative D-dimer (a sensitive indicator of fibrinolysis associated with DVT). As the scan was not confirmed using a “gold standard” technique and the numbers in the study were small, the statistical significance of these findings is in doubt. However, it is interesting to note that of those passengers who wore compression stockings, none had a positive scan. The “10% prevalence” is considerably higher than the figures from the general population (23). In 2001 the UK Civil Aviation Authority performed a study which showed that the incidence of VTE in the pilot community was 0.2 per thousand per year, which is considerably less than the general population. Even allowing for the healthy worker effect, there is no evidence from these data that suggest there is any activation of coagulation in this occupational group (17).

Robust data on the incidence of VTE and travel has been published by The World Health Organization Research into the Global Hazards of Travel (WRIGHT Project) (31). The first report from this research was in 2006 by Cannegieter et al. in the Multiple Environmental and Genetic Assessment (MEGA) Study (5), which showed that the risk of venous thrombosis was moderately increased for all modes of travel whether by air, car, bus, or train. This study listed the following well-recognized risk factors for the development of VTE:

- Immobility
- Recent surgery
- Recent trauma
- Abnormalities of blood clotting
- Previous or family history of DVT
- Malignancy
- Pregnancy
- Estrogen: OC or HRT
- Increasing age over 40 years
- Chronic heart disease
- Obesity
- Chronic venous insufficiency

The study also confirmed that these risk factors, such as excessive body weight, blood clotting abnormalities, and oral contraceptives, are significant factors in the general population and are not particularly associated with the aviation environment.

The final report from the WRIGHT Project phase one study, performed in a cohort of healthy individuals, showed that the absolute risk of VTE in flights greater than 4 h was 1 in 6000. Kuipers (19), in a separate publication in a cohort study of 8755 traveling employees, found that the exposed incident rate ratio was 3.2 (1.8–5.6) and that the absolute risk of DVT was 1 in 4656 flights. Higher rates were also seen in specific risk groups, e.g., oral contraceptive use and those who were overweight or extremely tall.

**Prophylaxis**

The evidence for a moderate increase (three to four times) in thrombosis associated with travel on flights of 4 h or greater (9) poses the question of what preventative strategy should be adopted to minimize the risk. Upgrading to a business class seat, which could be the intuitive approach, is not supported by evidence. The BEST Study (16) showed that there was no difference between the incidence of VTE between business and economy class.

What is required is an individual risk assessment to ascertain whether a specific predisposition to thrombosis exists. As previously described and further confirmed in the LONFLIT Study (9), in 75% of passengers traveling by air immobilization is a significant factor. It is therefore most important to encourage mobility,
particularly in those who already have other risk factors. If the risk is perceived to be particularly high, then the use of properly fitted antiembolism stockings or formal anticoagulation with low molecular weight heparin (LMWH) or warfarin needs to be considered. The benefit of using prophylactic anticoagulation treatment was studied by Cesarone et al. (6), who studied three groups using high-dose Enoxaparin (1 mg · kg$^{-1}$) 2–4 h prior to travel lasting between 7 and 8 h and compared this with aspirin one dose daily for 3 d starting 12 h before travel vs. control. The results of this study showed that there were 0 of 82, 3 of 84, and 4 of 83 asymptomatic DVT in the 3 groups, respectively. No symptomatic DVT or pulmonary embolism events occurred in any of the groups. However, this study had only a very small sample size and, as follow-up ended after the individuals left the airport, the significance of these findings is limited. Also, aspirin has not been shown in any scientific study to have any significant beneficial effect on the venous side of the circulation. The American College of Chest Physicians evidence-based practice guidelines (12) for the prophylaxis of VTE are shown in Fig. 1 together with the grades of evidence for their use. This subject was reviewed by the UK House of Lords Science and Technology Committee in 2007 (15).

Whenever a robust risk assessment is necessary in airline passengers, particularly those at high risk, both the passenger and their advising physician should be fully cognizant of the issues involved. In order to enhance the comfort and pleasure of air travel, several airlines (29) now produce in-flight magazines and safety videos on their websites, with good health information on several aspects of air travel, and this includes travelers’ thrombosis. In some countries such as the UK organizations like the Aviation Health Unit of the UK CAA (1) also make information available. However, a recent study by Scurr (26) reviewing the websites of approximately 100 airlines found that only about 25% were warning of the risks of travelers’ thrombosis, so there is room for considerable improvement. The Aerospace Medical Association’s Air Transport Medicine Committee encourages any initiatives which enhance awareness and better understanding of this potential health issue in travelers. This paper is a contribution to that debate and the committee is committed to encouraging all airlines to consider their own position on this important subject and to comply with the recommendations made in this paper.

In conclusion, there is an increased risk of thrombosis with prolonged travel by train, bus, plane, or car. The approximate three to fourfold increase in relative risk requires attention with respect to provision of advice to travelers. Targeting individuals with increased risk and applying appropriate prophylaxis means the majority of individuals may fly without any undue risk.

Long-Distance Travel

For travellers who are taking flights > 8 hours, we recommend the following general measures:

- Avoidance of constrictive clothing around the lower extremities or waist;
- Maintenance of adequate hydration;
- Frequent calf muscle contraction (Grade 1C).

For long-distance travellers with additional risk factors for VTE, we recommend the general measures listed above. If active thromboprophylaxis is considered because of a perceived high risk of VTE, we suggest the use of properly fitted below-knee GCS, providing 15 to 30 mm Hg of pressure at the ankle (Grade 2C) or a single prophylactic dose of LMWH, injected prior to departure (Grade 2C).

For long-distance travellers, we recommend against the use of aspirin for VTE prevention (Grade 1B).

![Fig. 1. Recommendations for DVT prevention (12).](image)