Literature Review of Deep Vein Thrombosis in Air Travellers

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Citation

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Abstract

Objective: The objective of this review article is to find out the risk of deep vein thrombosis on long-haul flights.

Method:A systematic review of the literature was undertaken. Studies on passengers of long haul flights were selected according to specific criteria and they were analysed to generate summative data.

Results: Seventeen studies published in last the 30 years were analysed encompassing 8969 passengers travelling on long haul flights. Mean flight duration was 7.1 hours. 13.79% of the passengers were on either therapeutic or prophylactic therapy for deep vein thrombosis (DVT). The study group included all types of passengers regardless of age, sex and risk stratification. Amongst randomised control trials, 0.16% of the passengers in the stockings group and 3.64% of the passengers in the control group developed DVT (OR 23.37, 95%CI 0.56-0.96, df = 1, p = 0.027) indicating a significant risk reduction in the stockings group. In case control studies, 12.68% of the passengers in the case group and 7.1% of the passengers in the control group developed DVT (OR 1.88, 95%CI 1.45-2.45, df = 1, p = 0.05) indicating a higher risk of DVT after long-haul flights in the population with previous history of thromboembolism. Summative data suggested an incidence of 3.72% for DVT in the passengers of long-haul flights.

Conclusion: Prolonged air travel is associated with a risk of DVT. The quantification of this risk is variable from 0 to 12 % in different published studies. Passengers with previous episodes of thromboembolism are more prone to develop DVT. Compression stockings may provide an economical and handy prophylactic tool but their role needs further exploration.

INTRODUCTION

The Boston surgeon John Homans[1] made the first report of two patients with DVT following prolonged air travel. In 1977, Symington and Stack introduced the term “economy class syndrome” when they reported 8 patients with DVT occurring shortly after travelling in economy class[2]. It is evident now that traveller's thrombosis is present in both classes (economy and business) and both groups are equally at risk of developing symptomatic or asymptomatic DVT and pulmonary embolism.

Thromboembolism in air travellers, a growing problem of great concern, is still a controversial issue as far as its management and prophylaxis are concerned. Recently, there has been much litigation against airlines by long haul flight travellers. This review article and future studies are important, as the public health concern is significant. The estimated number of air and land passengers are more than 2 billion in the year 2006, it is very vital that the information given to travellers both of their thrombosis risk and of preventative strategies is evidence based, reliable and thorough.

Methods

Relevant studies published between January 1976 and November 2006 were identified through the MEDLINE, EMBASE, CINAHL and COCHRANE LIBRARY databases. The terms “stocking/s”, “sock/s” and “hosiery/hosieries” were used in combination with the medical subject headings “thromboprophylaxis in air travellers”, “thromboembolism in air travel” and “travellers' thrombosis”. Relevant articles referenced in these publications were obtained. Each article was critically reviewed to assess eligibility for inclusion in this study (Table 1).

Figure 1

Table 1

Inclusion criteria
Randomised controlled, non randomised control trials, observational studies, case control studies and comparative studies on air travellers to assess the risk of DVT.
Use of objective diagnostic tests for determination of DVT e.g., venous duplex ultrasonography.
Studies where end point was DVT
Use of blinded interpretation of diagnostic tests. Each positive diagnostic test was evaluated by two different radiologists unaware of reported conclusion of each other.
Use of predefined criteria for abnormal test results. Positive duplex scan was defined if thrombus was seen and/ or vein was not compressible.
Any size of study cohort sample.

Study cohort size was not criteria for inclusion. Randomised controlled trials, non randomised controlled trials, comparative studies, case control studies and observational studies on passengers after long haul flights were included in this review.

RESULTS

Seventeen studies[3,4,5,6,7,8,9,10,11,12,13,14,15,16] published in the last 30 years were analysed encompassing 8969 passengers travelling on long-haul flights. Mean flight duration was 7.1 hours. 13.79% of the passengers were on either therapeutic or prophylactic therapy for DVT. The study group included all types of passengers regardless of age, sex and risk stratification.

Amongst randomised control trials[8,9,10,11,12,13,14,19](table 2 and 3), 2 out of 1237 passengers in the stockings group (0.16%) and 46 of 1261 (3.64%) in the control group developed DVT (OR 23.37, 95%CI 0.56-0.96, df = 1, p = 0.027) indicating a significant risk reduction in the stockings group.

Figure 2

Table 2: Trials used for review

	Trials	Diagnostic test	% DVT
1	Schwarz et al[4]	Venous Duplex	7/964 (0.72%)
2	Jacobson et al[7]	Venous Duplex	0/899 (0%)
3	Scurr et al[8]	Venous Duplex	12/216 (5.5%)
4	Hughes et al[9]	Venous Duplex	9/878 (1.02%)
5	Belcaro et al[10] 2001 LONFLIT 2	Venous Duplex	20/833 (2.40%)
6	Belcaro et al[11] 2002 LONFLIT 4-1a	Venous Duplex	4/358 (1.11%)
7	Belcaro et al[11] 2002 LONFLIT 4-1b	Venous Duplex	3/271 (1.10%)
8	Cesarone et al[12] 2003 LONFLIT 4-2a	Venous Duplex	0/195 (0%)
9	Cesarone et al[12] 2003 LONFLIT 4- 2b	Venous Duplex	0/146 (0%)
10	Cesarone et al[12] 2003 LONFLIT 4- 3a	Venous Duplex	0/144 (0%)
11	Cesarone et al[13] 2003 LONFLIT 4- 3b	Venous Duplex	2/130 (1.53%)
12	Belcaro et al[14] 2003 LONFLIT 5	Venous Duplex	7/205 (3.41%)
13	Ferrari et al[15]	Venous Duplex	51/320 (15.93%)
14	Samama et al[16]	Venous Duplex	93/988 (9.41%)
15	Kraaijenhagen et al[17]	Venous Duplex	52/788 (6.59%)
16	Aryal et al[18]	Venous Duplex	51/568 (8.97%)

Figure 3

Table 3: Characteristics of included studies

	Trials	Flight Duration	Type of passengers	Confounding variables
1	Schwarz et al[4]	≥8 hours	All types of passengers	Not stated
2	Jacobson et al[7]	≥12 hours	Low-medium risk passengers	Stockings
3	Scurr et al[5]	≥8 hours	All types of passengers	Stockings
4	Hughes et al[9]	≥10 hours	Low-medium risk passengers	Anticoagulation
5	Belcaro et al[10] 2001 LONFLIT 2	≥12 hours	High risk passengers	Stockings
6	Belcaro et al[11] 2002 LONFLIT 4-1a	4-8 hours	Low-medium risk passengers	Stockings
7	Belcaro et al[11] 2002 LONFLIT 4-1b	4-8 hours	Low-medium risk passengers	Stockings
8	Cesarone et al[12] 2003 LONFLIT 4-2a	4-8 hours	Low-medium risk passengers	Stockings
9	Cesarone et al[12] 2003 LONFLIT 4- 2b	4-8 hours	Low-medium risk passengers	Stockings
10	Cesarone et al[12] 2003 LONFLIT 4- 3a	4-8 hours	Low-medium risk passengers	Stockings
11	Cesarone et al[12] 2003 LONFLIT 4- 3b	4-8 hours	Low-medium risk passengers	Stockings
12	Belcaro et al[14] 2003 LONFLIT 5	Not stated	High risk passengers	Stockings
13	Ferrari et al[15]	≥4 hours	All types of passengers	Not stated
14	Samama et al[16]	Not stated	All types of passengers	Not stated
15	Kraaijenhagen et al[17]	≥3hours	All types of passengers	Not stated
16	Aryal et al[18]	≥8 hours	All types of passengers	Not stated

The relative risk for DVT was 23.30 indicating that passengers without stockings were 23.30 times more at risk of developing DVT than those with knee length stockings. In case control studies[6,7,15,16,17,18] (table 3), 130 of 1025 (12.68%) in the case group and 117 of 1639 (7.1%) in the control group developed DVT (OR 1.88, 95%CI 1.45-2.45, df = 1, p = 0.05) indicating a higher risk of DVT after long-haul flights in the population with previous history of thromboembolism. The summative data indicated that the incidence of DVT in the passengers of long haul flights was around 3.72%, varying from 0 % to 12%.

DISCUSSION

Despite the early recognition of an association between longer air travel and DVT, it was not until recently that more informative studies have been performed. There are many risk factors which are responsible for DVT in air travellers and most of them are shared between this group and the hospitalised population (table 4).

Figure 4

Table 4

DVT risk factors in air travellers
General Risk Factors
Immobilization (Sitting in narrow space for more than 8 hours)
Dehydration (Poor fluid intake, dry environment, drinking)
Cramped Conditions (Narrow and crowded seats)
Hypoxia (Pre-existing respiratory disorders, normobaric or hypobaric hypoxia)
Specific Risk Factors
Hypercoagulability of any origin
Elderly people
Obesity
Previous history of DVT/PE
Malignant conditions
Recent pelvic/hip surgery
Varicose veins and deep vein insufficiency

Furthermore, air travellers are equally at risk of sequelae of deep venous thrombosis including pulmonary embolism, post-thrombotic syndrome and chronic venous insufficiency associated with leg ulceration. In 1858, Rudolph Virchow famously proposed that the alteration of one of the three characteristics of venous circulation (blood flow, blood composition and the attributes of the functioning vein) might precipitate a thromboembolic event. Endothelial injury (factor I of Virchow`s triad) can be induced by immobilization and hypobaric or normobaric hypoxia. Circulatory stasis (factor II of Virchow`s triad) can be due to immobility during long haul flights. Hypercoagulability (factor III of Virchow`s triad) can be due to dehydration due to poor fluid intake and sitting in dry and hot environment for long time. Air passenger miles will likely double by year 2020. The altered and restrictive environment in an airliner cabin can influence haematological homeostasis in passengers and crew. Flight-related deep venous thromboemboli (DVT) have been associated with at least 577 deaths on 42 of 120 airlines from 1977 to 1984 (25 deaths/million departures)[17], whereas many such cases go unreported. However, there are four major factors that could influence formation of possible flight-induced DVT: sleeping accommodations (via sitting immobilisation); travellers' medical history (via tissue injury); cabin environmental factors (via lower partial pressure of oxygen and lower relative humidity); and the more encompassing

chair-rest deconditioning (C-RD) syndrome. There is ample evidence that recent injury and surgery (especially in deconditioned hospitalised patients) facilitate thrombophlebitis and formation of DVT that may be exacerbated by the immobilisation of prolonged air travel. In the healthy flying population, immobilisation factors associated with prolonged (>5 hours) C-RD such as total body dehydration, hypovolaemia and increased blood viscosity, and reduced venous blood flow (pooling) in the legs may facilitate formation of DVT.

Thrombosis risk is greater following journeys of more than 8 hours and those at greater risk are the travellers with a history of venous thromboembolism, pre-existing hypercoagulation disorders and malignancy. Based on the best evidence available, the risk of symptomatic DVT after flights of more than 12 hours is 0.5%[16]. The quantitative risk of lower limb DVT is 5% per flight for high risk subjects and 1.6% per flight for lower risk subjects following long-haul flights[18].

The regular DVT prevention protocol for travel thrombosis is still controversial. Knee length compression stockings have been used in many trials and were found to be very effective. Class I and Class II knee length graduated compression stockings with ankle pressure of 14-30mm Hg have shown reduction in lower limb DVT in air travellers[18]. Regular exercise plans for 5-10 min every hour, avoiding baggage between seats and drinking water regularly (100-150 ml per hour) for high risk population is recommended in a few trials. Similarly, 400mg aspirin for 3 days or a single dose of low molecular weight heparin (1mg/kg) was also studied. Aspirin was found to be ineffective but low molecular weight heparins certainly reduce the incidence of DVT in air travellers[18].

We suggest that passenger behaviour (movement, avoidance of dehydration and of alcohol) and appropriate pharmacological prophylaxis for high-risk travellers can reduce the likelihood of VTE. Physical prophylaxis (use of compression stockings or in-flight exercise devices) may also be of general benefit to passengers. It is recommended that airlines become more active in educating passengers concerning the dangers of VTE and in promoting passenger actions that can reduce risk. Airlines should also work to avoid cramped seating conditions (seat size and pitch) that contribute to prolonged immobility. Governments and regulatory authorities should mandate the provision of adequate seating conditions and a good cabin environment and should support studies that will define risks and determine the efficacy of protocols to minimize dangers of VTE. Increased long-haul air traffic and an aging population suggest that travel-related VTE may present a growing healthcare threat and highlight a need for additional biomedical research into the causes and potential solutions of this problem.

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