Venous and arterial thrombosis in airline passengers

The causation of deep vein thrombosis (DVT) and subsequent pulmonary embolism (PE) is still unknown despite the huge volume of publications over the past 100 years; indeed, we still quote the triad of causal factors propounded by Virchow in 1856—changes in the blood, changes in flow and changes in the vessel wall[1]. The important role of stasis in the causation of DVT/PE was highlighted in 1940 by accounts of individuals who had tried to escape the bombing of London by going into the Underground and sleeping overnight in deck chairs. Compression of the venous return from the lower limbs by the crossbar of the chair resulted in stasis and subsequent acute pulmonary embolism[2]. A decade later similar observations were made in people sitting in cramped conditions for long journeys by car, bus and aeroplane[3]. Most of these early descriptions recorded incidents in single cases or small numbers of patients. Between 1963 and 1965, in a series of 42 patients who collapsed after a routine flight, 21 had cardiovascular disease and 4 had cerebrovascular disease but none had pulmonary embolism; however, it was noted that one had a fatal cerebral embolism due to deep vein thrombosis, the embolus having passed through a patent foramen ovale[4]. The first collected series of cases of DVT/PE related to travel was recorded in 1977 by Symington and Stack[5]. They looked at 8 patients who developed thromboembolism after travel—3 after long-haul air travel, the others after car, bus or sea journeys. They suggested that such incidents reflected not only cramped seating arrangements but also dehydration associated with alcohol intake in dry atmospheres. An additional 3 proven cases were recorded from Hillingdon Hospital in patients who had become unwell soon after leaving their aircraft at Heathrow[6].

Nowadays, one may well spend up to 14 hours in a plane without the opportunity of taking much exercise. A substantial part of this time will be spent sleeping, in an upright position, with immobility enhanced by alcohol or sleeping tablets. In addition, the 'pitch' (i.e. the space between seats), particularly in economy cabins, is much smaller than in former days when flying was a more exclusive mode of transport. The average pitch in scheduled carriers is now 31–32 inches (79–81 cm). Charter carriers, who are now increasing their long-haul operations, may use the minimum pitch of 28 inches. Immobility may also be enhanced by necessary safety advice to keep seat belts fastened while in the seated position.

Whereas in 1980 about 1.1 million passengers travelled long-haul out of Gatwick Airport, in 1995 the figure was about 4.1 million. In view of this large increase we felt it important to analyse reported cases of DVT/PE for recent years. The incidents may arise during or immediately after a flight, or hours later when the patient is at home far from the airport. Clinical reports should therefore come from hospitals associated with international airports or carefully collected sets of data from doctors with a special interest in DVT/PTE diagnosis and treatment. A 12-year survey of publications linking air travel, DVT and other thrombotic disorders yielded a handful of clinical case reports and anecdotes[12]. In addition, a report on sudden deaths in commercial airline travellers during flight from February 1979 to January 1982 from Heathrow showed 61 deaths in passengers of which 11 were from pulmonary embolism due to DVT. More than three-quarters of the victims were women, and typically there was no relevant previous history. Reviewing the published work in 1992, Milne[13] was unable to conclude that travel of any kind is epidemiologically associated with venous thromboembolism—much less that particular modes of travel present special risks.

Some recent studies are worthy of comment because they offer larger numbers. Eklof and others[14], from Honolulu, describe 44 patients with deep vein thrombosis or pulmonary embolism during or after air flights of 5–17 hours. In this group of patients, 28 of the 44 had DVT only, 5 had PE only and 11 had DVT and PE. 95% of the thrombi had extended above the popliteal vein. The identified risk factors were a history of previous DVT 34%, presence of a related chronic disease or malignancy 25%, hormone therapy 16%, recent lower limb surgery 11% and recent surgery or femoral catheterization 9%. The second large series comes from Ribier *et al.*[15], who report 40 cases of DVT/PE diagnosed over 6 years. A special feature of this study was the young age of individual patients and the fact that there was no previous medical history. A third series comes from Germany[16], including 5 cases after long-distance travel; and a fourth (which again comes from Honolulu) documents 33 patients admitted after long-distance air travel (>4 hours)[17]. Hawaiians are of course at risk because of the geographic remoteness of the islands. The mean age of these 33 patients was 48 years with a range from 19 to 80 and a male/female distribution of 27:6. 16 had DVT, 8 had PE and 9 had both. The risk factors were similar to those already described—previous venous thromboembolism in 5, known malignancy in 6, chronic heart failure in 3, recent leg surgery in 1, paraplegia in 1, anti-cardiolipin antibody in 1, oestrogen therapy in 1 and none obvious in 12. Symptoms started on the flight in 4, on day 1 after the flight in 8 and before day 15 in 27. The median time of symptom onset was day 4.

When we add up the reported cases and remember that about 1.5 billion people fly every year, we might reasonably conclude that DVT/PE in air travellers is very rare. Perhaps some cases are missed or go unreported, but discussion with colleagues in the specialist area of venous thrombosis round the UK yielded general agreement that the predicted 'epidemic' due to the huge numbers of people flying long distance has not materialized. Nonetheless, there is little doubt that certain air travellers are at high risk and should be identified. Important risk factors are advanced age, obesity, immobility, recent surgery, malignancy, heart failure, use of oestrogen containing hormone preparations, and dehydration (particularly associated with alcohol intake and lack of fluids).

Regarding thrombosis at other sites, there are several case reports of peripheral arterial thrombosis[18–20] in association with air travel, and also a series of 15 patients with cerebral venous thrombosis in whom there was a direct link with long-distance air travel alone or with air travel plus diarrhoeal illness[21].

What mechanisms underlie the risks associated with long-haul flights? Although the biochemical and physiological effects of dehydration[22] are well recognized we know little about the causation of DVT/PE under flight conditions. The only prospective scientific investigation reported was by Landgraft and colleagues[23], who looked at clinical and biochemical changes in 12 healthy volunteers during four simulated 12-hour flights day and night. Measurements included plasma viscosity, haematocrit, albumin, fluid balance and lower limb swelling. No impressive changes were seen in the legs of the volunteers although there was fluid retention and some slight increase in oedema. The rheological changes were equivalent to known circadian rhythm changes and none pointed to a predisposition to venous thrombosis. A weakness of this study is that it took no account of changes in air pressure, humidity or psychological stress.

From this review of the newer published work we conclude that, for occasional individuals, long journeys in cramped conditions, by land, sea or air, do carry a risk of DVT/PE. In such individuals with pre-existing risk factors who contemplate a long and cramped journey it would be prudent to look at preventive measures. In particular we suggest: maintenance of mobility and hydration during the flight; for those with multiple risk factors, anti-embolism stockings and/or low-molecular-weight heparin; and, for those with recent surgery or trauma, postponement of the journey.

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