Age and Ageing 2002; **31:** 17–22

REVIEW

Air travel in older people

JAMES A. LOW, DANIEL K. Y. CHAN[1]

Department of Geriatric Medicine, Prince of Wales Hospital, High Street, Randwick 203, NSW Australia
[1]Department of Aged Care and Rehabilitation, Bankstown Hospital, Bankstown, NSW Australia

Address correspondence to: J. A. Low, Department of Geriatric Medicine, Alexandra Hospital, 378 Alexandra Road, Singapore 159964. Fax: (+ 65) 379 3540. Email: jamesalvinlow@yahoo.com

Abstract

Commercial air travel is one of the safest means of transport. However, the environment within the aircraft cabin may have deleterious physiological effects on passengers, especially those with underlying medical problems and those who are old. With growing affluence, cheaper airfares and an ageing population, there will be more older people travelling by air over extended periods and longer distances, with a concomitant rise in the number of medical illnesses in the air. Older people may encounter various problems during a long journey. Certain actions may help to minimize these problems.

Keywords: *disorientation, economy class syndrome, flight, hypoxia*

Introduction

Although air travel is one of the safest forms of transport, the environment within the aircraft cabin may have adverse physiological effects on passengers, especially those with underlying medical problems. The older person may be more susceptible to complications during long-distance flights [1].

We discuss the problems that the older traveller may encounter on long journeys and suggest measures that can be taken to minimize the risks involved.

The cabin: physiological effects

Cabin pressure varies according to altitude. Most commercial planes cruise between 28 000 and 45 000 feet (flight altitude) above sea level, while cabin pressures are maintained between the equivalent of 6000 to 8000 feet (cabin altitude) above sea level. Cabin oxygen starts decreasing at a flight altitude above 22 500 feet [2]. At a cabin pressure of 6000 feet, the alveolar oxygen tension is 71 mmHg while at 8000 feet it is 59 mmHg [3]. Thus, at cruising altitude, cabin oxygenation is almost invariably diminished and may pose a health risk to passengers with anaemia, cardiopulmonary illnesses and other vascular conditions [4].

The low cabin pressure also leads to expansion of gases (in accordance with Boyle's law). This has clinical implications—especially if gas is trapped in body cavities such as the sinuses, middle ear, gut, pleural cavity, eyes, tooth fillings and skull [5]. Difficulty equalizing air pressures within these enclosed areas with the external environment can cause problems such as aerotitis media, barosinusitis, aerodontalgia, nausea, vomiting and pneumothorax [3].

Low humidity (usually below 25%) within the cabin may lead to dryness of exposed membranes (such as the oropharynx and cornea) and possibly to dehydration, especially if compounded by the diuretic effects of alcohol ingestion during the flight. To support this, there can be an increase in mean plasma and urine osmolality as well as specific gravity of the urine [6].

The cramped conditions, prolonged immobility (especially in long-haul flights), constant noise and vibration and intermittent air turbulence may be disconcerting to the older traveller [7] and can cause oedema of the lower limbs (jet flight leg) [8, 9] or deep vein thrombosis ('economy class syndrome') [10] as a result of venous stasis. Pulmonary embolism is now a well-recognized complication of long-haul air travel [11–14]. A less well-known but important complication is the development of acute ischaemia of the lower limbs from prolonged sitting [15].

Psychological aspects of air travel in the older person

Fear of flying is common in elderly people and may lead to hyperventilation and anxiety [5]. Anxiety-provoking situations include flight delays, customs and baggage reclaim, and aeroplane take-off and landing [16]. The demands of preparing for the journey, the trip to the airport and the paperwork are all added stresses to the older traveller. Air-terminal stress refers to the physical and mental stresses that the traveller encounters at the airport [17]. Filling in forms at the airport, checking-in at the correct counter, getting to the correct departure gate and looking for the numbered seat may be an ordeal for the older person with poor eyesight, hearing impairment or other disabilities—especially in a crowded, noisy environment. Consequently, many of the emergencies among air travellers occur within the air terminal [18]. Aerial claustrophobia may be more prevalent in older people who have never or infrequently travelled by air [19].

Delirium has many contributing causes, which include hypoxia, alcohol intoxication and dehydration. There are few data on in-flight delirium. A rare cause was reported in an 83-year-old man who developed pneumoencephalus after attempting to unblock his nose with the Valsalva manoeuvre during a flight from Australia to the United Kingdom [20].

Medical hazards

Hypoxia

Hypoxia during flying is postulated to induce ischaemic conditions, which may in turn present overtly as an acute myocardial infarction or stroke, or may present in more unusual ways, such as a change in cognition [21]. There are concerns about the hazards of flying, even for infants where, although there may not be any overt clinical manifestations, magnetic resonance scans of the brain may show abnormalities [22, 23]. Conceivably, susceptible older people may suffer the deleterious effects of prolonged hypoxia without presenting overtly initially.

Although research into the medical effects of hypoxia is meagre, possible cardiac consequences of in-flight hypoxia include angina, acute myocardial infarction and congestive cardiac failure [24]. Cardiac conditions constitute the most common cause of in-flight deaths [25] while cardiac-related problems rank as one of the commonest causes of in-flight emergencies [18]. Air travel should thus be avoided in those with new-onset or unstable angina, a recent myocardial infarct (within 3 months), poorly controlled congestive cardiac failure, malignant hypertension or severe anaemia (<8 g/dl) [5].

Older travellers with chronic airflow limitation may experience an exacerbation of their illness while in-flight because of the low oxygen and humidity environment [26–28]. It is imperative that such passengers be assessed by a physician before the journey, to see if there is a need for oxygen onboard the flight. The low cabin pressure may also lead to gas expansion and pose a theoretical risk to those with underlying bullous lung disease or unresolved pneumothorax [29].

Economy class syndrome

The term 'economy class syndrome' refers to the development of deep vein thrombosis and pulmonary embolism in passengers travelling long distances in the cramped economy class seats (but is not confined to people in these seats) [10, 30]. Eklof *et al.* identified seven cabin-related risk factors for the development of deep vein thrombosis: low humidity, hypoxia, diuretic effect of alcohol, insufficient fluid intake, smoking, "coach" (i.e. economy seat) position and immobilization [31]. Those with predisposing medical conditions such as venous disease, malignancies, heart failure, nephrotic syndrome and other hypercoagulable disorders, and those with a history of thrombo-embolic illnesses are at a particular risk of developing this complication [30, 32, 33]. Women on hormonal therapy and those who have had recent surgery are also at risk.

Pulmonary embolism can occur on journeys as short as 4 h [34], may present 1–2 weeks after the flight and is not necessarily preceded by a painful calf [10]. In elderly people, it may present atypically and mimic pneumonia, gastrointestinal disease or stroke [35]. Prevention of deep vein thrombosis is the key to avoiding pulmonary embolism. Measures suggested include the use of pressure-graded elastic stockings, periodic muscle-contracting exercises while seated [36], regular walks from the aisle seat (avoiding the window seat if possible) [10], avoidance of smoking and excessive alcohol intake, and adequate (non-alcoholic) fluid intake [37]. For those with predisposing conditions and who are at a high risk for thrombo-embolism, low-molecular-weight heparins, warfarin or low-dose aspirin may be taken prophylactically [38, 39].

Leg oedema ('jet flight leg'), which may mimic deep vein thrombosis, is commoner in women, usually benign, resolves spontaneously and can be prevented by the use of elastic stockings, which should be worn before take-off to be effective [8].

Effects on body gases

The expansion of body gases within the low-pressure environment of the aircraft cabin can cause problems [3, 40]. Expansion of gases within the stomach and duodenum may lead to discomfort, nausea or vomiting. Theoretically, expansion of gases within a diseased hollow viscus (e.g. peptic ulcer or diverticuliti) may result

in perforation, while distension of the gut may lead to splinting of the diaphragm and cause respiratory embarrassment in susceptible individuals [3]. The older traveller who is predisposed to such problems should therefore be advised to avoid gas-producing foods before travel and carbonated drinks during the flight. Those with recent abdominal (gastrointestinal and urological) surgery, gastrointestinal haemorrhage or bowel obstruction should avoid flying altogether for at least 2 weeks after the event. For those with a colostomy, a larger bag should be used or a spare one brought into the cabin [3]. An overlooked symptom is aerodontalgia, where trapped air in defective fillings, apical abscesses and carious teeth expands to cause toothache.

Ear and sinus problems

Cabin pressure changes can also be deleterious to passengers with middle ear and sinus problems. Failure to equalize pressure within the middle ear and the environment can cause otic barotrauma and potentially even tympanic membrane rupture. Otic barotrauma occurs in up to 9% of air travellers and presents as severe ear pain, tinnitus, vertigo or hearing loss [41]. A patent Eustachian tube is of paramount importance in equilibrating middle-ear pressure with the external environment.

Individuals with acute otitis media and other conditions causing a blockage of the Eustachian tube should, therefore, be advised not to fly until the blockage is cleared. Passengers who do develop otic barotrauma, however, should be advised to perform a Valsalva manoeuvre or to swallow repeatedly. Should the pain be excruciating and intractable, the cabin altitude may have to be adjusted by the pilot altering the altitude of the aircraft. Those with acute sinusitis should avoid flying—particularly if a polyp or mucocoele obstructs the ostium of the affected sinus. Similarly, those who have recently had eye or brain surgery or laparascopic procedures should avoid air travel.

Neurological conditions

Neurological conditions that can occur in the plane include seizures (in those with pre-existing neurological conditions) and strokes. Those with pre-existing seizures should be well-controlled on medication before embarking on the journey while those with a recent (within 4 weeks) stroke should try to avoid flying altogether.

Syncope

The most common in-flight medical emergency is syncope from various causes [42–44]. Aircraft passengers, especially elderly travellers, are more prone to syncope because of prolonged sitting, dehydration and alcohol use, which can lead to postural hypotension [2].

Motion sickness

Air turbulence causing a linear vertical motion on the vestibular organ, psychological factors and excessive alcohol consumption can cause motion sickness, which can be distressing and incapacitating. Although this problem is usually benign, in the frail passenger it may potentially cause dehydration, electrolyte imbalance, rib fractures and the Mallory–Weiss syndrome, especially if protracted. Measures that can be used to minimize this problem include flying at night to reduce visual stimulation and sitting in a reclining position, away from the engines and toward the centre of gravity of the aircraft [3]. Prophylactic anti-motion medication can also be used before and during the flight. Anti-histamines are the drug of choice, but they can cause sedation and have anticholinergic side effects.

Infection

There is a theoretical risk of infection within the enclosed environment of the aircraft cabin. The actual risk, however, is extremely low because of the frequent air exchanges (every 3–4 min) and the sterilizing effect of passing recirculated air through the jet engines at extreme temperatures [45]. The risk of infection by organisms carried on large droplets (streptococci, meningococci and some haemorrhagic viruses) is very low because of the air filtration system which removes particles of $<1\ \mu$m in diameter, using high efficiency particulate air filters [46].

Nevertheless, organisms transmitted by tiny droplets of $<10\ \mu$m have the potential to spread between passengers. Such organisms include measles and influenza viruses and tuberculosis. The latter is more likely if the index passenger has a cavitatory lesion in the lungs, coughs frequently and sits within two rows of seats, and if the at-risk passengers are exposed for several hours [47]. To avoid this problem, patients with active tuberculosis should be prevented from boarding the aircraft—a difficult measure to enforce. Perhaps passengers with chronic lung and heart diseases should be given influenza and pneumococcal vaccinations before the flight.

Physical and functional aspects

The frail older traveller may require a longer time to prepare for the journey, deal with formalities at the airport and make his or her way into the aircraft. Thus, it would be prudent to start the journey from home earlier than usual. Most airlines would allow passengers with wheelchairs to board an aircraft provided they are given ample warning.

Medications should be brought onboard in hand luggage and be appropriately adjusted as the person traverses through the different time zones. This is particularly important for diabetic drugs and injections [5].

Some older people may have difficulties reading signs and listening to announcements on the public address system of the terminal and the plane itself. Those with sensory impairments should bring their aids into the aircraft. Hearing aids should be switched off or the volume turned down to avoid damage from aircraft noise, especially during take-off [48].

To prevent urinary incontinence, a seat near the toilets and avoidance of alcohol is advisable. Fluid ingestion should also be balanced to meet but not exceed the loss of water in a low-humidity environment. One may even consider reducing the dose of diuretics, if the person's condition allows.

Although most older people are able to travel on their own, some might feel more at ease if they were accompanied by a younger relative or friend or travelled in a group. Group tours tailored for the older person, appropriate to their level of function and capabilities, are recommended.

Precautions for the older air traveller

While most older people complete their travels uneventfully, a few have serious medical problems in-flight. This may lead to flight disruption, unscheduled landing or flight diversion [18, 25, 49]. It inconveniences other travellers; incurs additional costs and can put the sick passenger in a dangerous situation where the resources available for treatment may be inadequate [42].

In-flight medical emergencies can be reduced or averted with careful pre-flight evaluation. Pre-flight screening should be considered for those with many medical problems who are on multiple medications, those recently discharged from hospital, those with advanced chronic illness (such as heart failure or chronic airflow limitation) and those who are frail [50]. One suggestion is that all passengers over 65 who intend to fly for more than 6 h at a stretch be routinely screened as a precautionary measure [19].

Screening of patients potentially susceptible to the adverse effects of hypoxia might include arterial blood gasses, an electrocardiogram, lung function tests and measurement of serum haemoglobin concentration. The more sophisticated hypoxia–altitude simulation test is occasionally performed in specialist units to help the physician make a decision [51, 52]. We suggest that all elderly people with memory or cognitive deficits be screened with the Mini-Mental State Examination, as those with early dementia may be more prone to developing delirium in flight.

The physician who deals with older patients should be able to offer advice, counselling and screen those who are at risk and advise against travelling in certain situations (Table 1). Some recommendations are given in Table 2.

Finally, the elderly person should take out adequate medical insurance to cover any eventuality as the costs of medical care for non-residents in many countries are high.

Table 1. Contraindications to long-distance air travel in the older person

Cardiovascular
Recent acute myocardial infarction (within last 3 months)
Recent, new-onset or unstable angina
Uncontrolled congestive cardiac failure
Uncontrolled cardiac dysrhythmias
Malignant hypertension
Respiratory
Unresolved pneumothorax
Emphysema with bullous disease
Vital capacity of $<50\%$
Arterial PO_2 of <60 mmHg with oxygen at ground level
Neuropsychiatric
Recent stroke (within last 4 weeks)
Poorly controlled epilepsy
Dementia with delirium
Others
Severe anaemia (<8 g/dl)
Recent eye, abdominal or brain surgery (within last 2 weeks)
Acute sinusitis
Acute otitis media

Table 2. Recommendations for air travel in older people

Before the trip
Start preparations early
Consider group tours or travel with a younger person
Ensure appropriate vaccinations have been given
Take out adequate travel insurance cover
Those with cardiopulmonary conditions, recent acute medical illnesses or recent hospitalizations should have a pre-flight examination
Low-dose anxiolytics for anxiety and antihistamines for motion sickness may be taken before the flight
During the flight
Bring usual aids and medications into the cabin
Obtain a seat along the aisle, away from the engines
Avoid excessive alcohol ingestion
Avoid gas-producing food and carbonated drinks
Ensure adequate fluids throughout the flight
Avoid smoking
Avoid prolonged sitting by taking regular walks
Periodic leg muscle contracting exercises may be useful

Conclusion

More older people travelling by air—and most will complete their journeys uneventfully. Very little research has been carried out on travel medicine for the older population. Most of our knowledge is based on

extrapolation and inference rather than direct evidence. Issues that await clarification include the epidemiology of morbidity and mortality in the older traveller, how the adverse physiological conditions of the aircraft cabin affect the health of older people and the utility of pre-flight screening.

Key points

- More older people are travelling by air because of increased affluence, cheaper airfares and demographic changes.
- The aircraft cabin can be deleterious to the older traveller because of its low oxygen, humidity and pressure conditions.
- Doctors who treat older people should be able to provide advice on how to minimize the risk of air travel.

References

1. Voss MW. Air travel for the chronically ill and elderly. Am Fam Physician 1983; 27: 235–43.

2. Jagoda A, Pietrzak M. Medical emergencies in commercial air travel. Emerg Med Clin North Am 1997; 15: 251–60.

3. AMA Commission on Emergency Medical Services. Medical aspects of transportation aboard commercial aircraft. J Am Med Assoc 1982; 247: 1007–11.

4. Cottrell JJ. Altitude exposure during aircraft flight. Chest 1988; 92: 81–4.

5. Wachtel TJ. Medical hazards of air travel for older people. Geriatrics 1983; 38: 78–82.

6. Simons R, Krol J. Jet leg, pulmonary embolism and hypoxia [letter]. Lancet 1996; 348: 416.

7. Rayman RB. Passenger safety, health and comfort: a review. Aviat Space Environ Med 1997; 68: 432–40.

8. Shuster S. Jet flight leg. Lancet 1996; 347: 832–3.

9. James PB. 'Jet leg', pulmonary embolism and hypoxia. Lancet 1996; 347: 1697.

10. Cruickshank JM, Gorlin R, Jennett B. Air travel and thrombotic episodes: the economy class syndrome. Lancet 1988; ii: 497–8.

11. Black J. Deep-vein thrombosis and pulmonary embolism. Lancet 1993; 342: 352–3.

12. Milne R. Venous thromboembolism and travel: is there an association? J R Coll Physicians Lond 1992; 1: 47–9.

13. Paganin F, Laurent Y, Gaüzere BA *et al.* Pulmonary embolism on non-stop flights between France and Reunion Island. Lancet 1996; 347: 1195–6.

14. Lederman JA, Keshavarzian A. Acute pulmonary embolism following air travel. Postgrad Med J 1983; 59: 104–5.

15. Teenan RP, McKay AJ. Peripheral arterial thrombosis related to commercial airline flights. Br J Clin Pract 1992; 46: 165–6.

16. McIntosh IB, Swanson V, Power KG *et al.* Anxiety and health problems related to air travel. J Travel Med 1998; 5: 198–204.

17. Cox ID, Blight A, Lyons JP. Air-terminal stress and the older traveller. Age Ageing 1999; 28: 236–7.

18. Cummins RO, Schubach JA. Frequency and types of medical emergencies among commercial air travellers. J Am Med Assoc 1989; 261: 1295–9.

19. Callanan JG. Medical hazards of air travel [letter]. Br Med J 1977; 1: 1473–4.

20. Chan YP, Yau CY, Lewis RR, Kinirons MT. Acute confusion secondary to pneumoencephalus in an elderly patient. Age Ageing 2000; 29: 365–7.

21. Harik SI, Behmand RA, LaManna JC. Hypoxia increases glucose transport across the blood brain barrier. J Appl Physiol 1994; 77: 896–901.

22. James PB. Hypoxic responses in infants: risks associated with hypoxia during flights need to be investigated. Br Med J 1998; 317: 677.

23. Rutherford M, Pennock J, Schwieso J *et al.* Hypoxic–ischaemic encephalopathy: early and late magnetic resonance imaging findings in relation to outcome. Arch Dis Child 1996; 75: 145–51.

24. Anon. Illness in the clouds [editorial]. Br Med J 1975; 1: 295.

25. Cummins RO, Chapman PJC, Chamberlain DA *et al.* In-flight deaths during commercial air travel. J Am Med Assoc 1988; 258: 1983–8.

26. Schwartz J, Bencowitz H, Moser K. Air travel hypoxemia with COPD. Ann Int Med 1984; 100: 473–7.

27. Harding R, Mills F. Fitness to travel by air. In Harding R, Mills F eds. Aviation Medicine. London: British Medical Journal Publishing, 1993; 7–23.

28. Gong H Jr. Air travel and oxygen therapy in cardiopulmonary patients. Chest 1992; 101: 1104–13.

29. Stonehill RB, Fess SW. Commercial air transportation of a patient recovering from pneumothorax. Chest 1973; 63: 300.

30. Symington IA, Stack BHR. Pulmonary thromboembolism after travel. Br J Dis Chest 1977; 71: 138–40.

31. Eklof B, Kistner RL, Masuda EM *et al.* Venous thromboembolism in association with prolonged air travel. Dermatol Surg 1996; 22: 637–41.

32. Sarvesvaran R. Sudden natural deaths associated with commercial air travel. Med Sci Law 1986; 26: 35–8.

33. Thomas JEP, Abson CP, Cairns NJW. Pulmonary embolism: a hazard of air travel. Centr Afr J Med 1981; 27: 85–7.

34. Mercer A, Brown JD. Venous thromboembolism associated with air travel: a report of 33 patients. Aviat Space Environ Med 1998; 69: 154–7.

35. Hamilton M, Thompson EN. Unusual manifestations of pulmonary embolic disease. Postgrad Med J 1963; 39: 348–53.

36. Landgraff A. Economy class syndrome: rheology, fluid balance and lower leg oedema during a simulated

12 hour long distance flight. Aviat Space Environ Med 1994; 65: 930–5.

37. Colon VF. To help prevent circulatory problems on long trips. Med Times 1977; 105: 52–4.

38. Holliday J. Atypical presentation of multiple pulmonary emboli in a young air traveller. J R Coll Gen Pract 1985; 35: 497.

39. The Pulmonary Embolism Prevention (PEP) Trial Investigators. Prevention of pulmonary embolism and deep vein thrombosis with low dose aspirin. Lancet 2000; 355: 1295–302.

40. Kay S. Safe air travel. Preventing in-flight medical problems. Nursing Pract 1994; 19: 43–6.

41. Csortan E, Jones J, Haan M, Brown M. Efficacy of pseudoephedrine for the prevention of barotraumas during air travel. Ann Emerg Med 1994; 23: 1324–7.

42. Cottrell J, Callaghan J, Kohn G *et al*. In-flight emergencies: one year of experience with the enhanced medical kit. J Am Med Assoc 1989; 262: 1653–6.

43. Donaldson E, Pearn J. First aid in the air. Aust N Z J Med 1996; 66: 431–4.

44. Schoken V, Lederer L. Unscheduled landings for medical reasons: a five year survey of the experience at American Airlines. In Busby D ed. Recent Advances in Aerospace Medicine. Dordrecht: Reidel, 1970; 126–9.

45. Wick RL Jr, Irvine LA. The microbiological composition of airliner cabin air. Aviat Space Environ Med 1995; 66: 220–4.

46. Clayton AJ, O'Connell DC, Gaunt RA, Clarke RE. Study of the microbiological environment within long- and medium-range Canadian Forces aircraft. Aviat Space Environ Med 1976; 47: 471–82.

47. Kenyon TA, Valway SE, Morgan WM *et al*. Transmission of mycobacterium tuberculosis associated with air travel. J Am Med Assoc 1994; 272: 1031–3.

48. Anon. Air travel and the elderly. Med J Aust 1975; 2: 77–8.

49. Hordinsky J, George M. Response capability during civil air carrier in-flight medical emergencies. Aviat Space Environ Med 1989; 60: 1211–4.

50. Gong H Jr, Lee JA, Cowan MN. Pre-flight medical screenings of patients. Analysis of health and flight characteristics. Chest 1993; 104: 788–94.

51. Dillard TA, Berg BW, Rajagopal KR *et al*. Hypoxia during air travel in patients with chronic obstructive pulmonary disease. Ann Intern Med 1989; 111: 362–7.

52. Gong H Jr, Tashkin DP, Lee EY, Simmons MS. Hypoxia–altitude simulation test: evaluation of patients with chronic airway obstruction. Am Rev Resp Dis 1984; 130: 980–6.