Flying and health

inside

The author

ASSOCIATE PROFESSOR TONY HOCHBERG is adjunct associate professor in aviation medicine and occupational medicine at Edith Cowan University school of postgraduate medicine, Perth; tutor in occupational medicine at Curtin University, Perth; and medical director of Prime Health Group.

Background

ABOUT two billion passengers a year now fly on civilian aircraft. Air travel exposes passengers, air crew and pilots to a range of unique physiological stresses and health risks, particularly when they have preexisting medical conditions.

While long-distance air travel is now cheaper than ever, the risks are greater because journeys are longer, more people are travelling, and more frequently, and there are large numbers of elderly passengers who often have complex medical problems.

The new Airbus A380 promises cheaper long-haul flights at the same speed as the original long-haul Boeings introduced more than 40 years ago, but with the ability to cover almost twice the distance with no stopovers. The A380 has a maximum range of 15,000km, sufficient to fly non-stop from Sydney to Chicago.

The GP has an important role in minimising the health risks associated with air travel through pre-flight screening for medical fitness to fly, advice on risk reduction for long-haul travel and managing post-flight medical conditions, including jet lag and DVT.

Depending on the airline and destination, pre-flight travel clearance will be required for patients with certain medical conditions, such as myocardial infarction or acute psychosis.

Travel vaccinations, first aid kits, bird flu kits and adequate medical supplies with associated official medical documentation to support the need for medication are important additional considerations.

In-flight physiological changes include (to name just a few):

- Lowered partial pressure of oxygen (altitude hypoxia).
- Dry cabin air (relative humidity ranging from 10% to 20%).
- Exposure to noise and vibration.
- Motion sickness.
- Dry skin and dry eyes.

'Aerotoxic syndrome' now graces the headlines of magazines and refers to fumes from toxic fuel contaminants leaking into cabin air supply through air circulation driven by the plane's engines.

An explanation of the various factors that can affect the health and wellbeing of air travellers follows.

Aviation physiology

THE main physiological changes with ascent to altitude relate to the effect of reduced barometric pressure on oxygen tension (or partial pressure of alveolar oxygen), and to gas expansion in confined spaces, which correlates clinically with various forms of barotrauma.

The relationship between the amount of oxygen in the alveolus at altitude and the severity of hypoxia resulting is complex and subject to a range of variables.

Cabin air pressure

Figure 1 shows that a significant drop in percentage haemoglobin saturation occurs after 10,000 feet, when the sharp descent on the sigmoid curve begins. This phenomenon explains the general effects of high altitude (table 1) and the need for cabin pressurisation.

From figure 1 and table 1 we can see that maintaining a cabin pressure equivalent to that at about 6000-8000 feet (1800-2400 metres) above sea level should be tolerated by most passengers, and this is the cabin pressure maintained in aircraft with typical cruising altitudes in the range of 36,000-40,000 feet (11,000-12,200 metres).

Passengers with certain medical conditions (see Medical contraindications to air travel, page 29), in particular cardiovascular and respiratory disease and blood disorders such as anaemia, are at the greatest risk for in-flight decompensation. Such passengers are usually able to travel safely if arrangements are made with the airline for provision of an additional oxygen supply during the flight.

Barotrauma

An additional well-recognised effect of ascent to altitude is barotrauma (table 2, page 28). Barotrauma may result from natural gas expansion in areas of the body that contain air, such as the middle ear, sinuses, lungs and gut.

Iatrogenic barotrauma may occur when air has been introduced by medical procedures, for example, after any form of laparoscopic surgery, open abdominal or chest surgery, eye surgery or occasionally in pathological conditions, such as rupture of an emphysematous bulla.

Care must be taken not to use air to inflate an endotracheal tube cuff when transferring a patient by air. Normal saline should be used instead.

The likelihood of barotrauma is related to:

- The volume of entrapped air.
- The size of any opening to equalise air pressure.
- The compliance characteristics of the cavity containing the air.
- The rate of pressure change with descent.

Figure 1: Effect of altitude on the oxygen-haemoglobin dissociation curve.

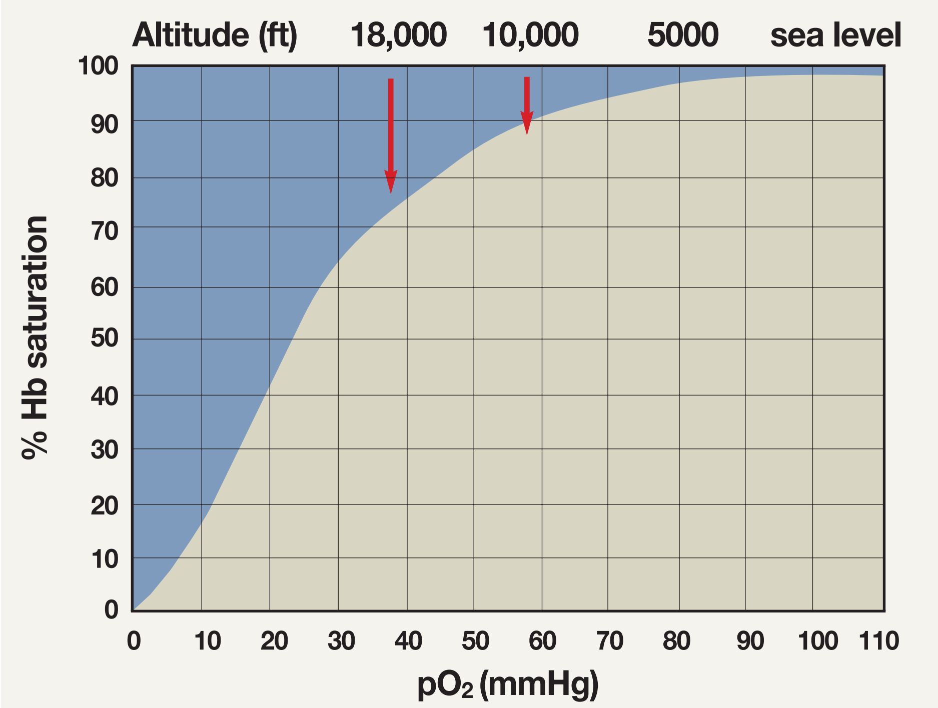


Table 1: General effects of hypoxia at different altitudes

Altitude (feet)	% HbO_2 sat	Symptoms
0-10,000	98-90	Decrease in night vision, decreased ability to perform complex new tasks
10,000-15,000	90-80	Drowsiness, poor judgment, headache, reduced work capacity, poor co-ordination
15,000-20,000	80-70	Loss of self-criticism, decreased skill levels, impaired vision, loss of peripheral vision, decreased colour perception, poor co-ordination, bad handwriting, decreased short-term memory, marked changes in emotional state (euphoria, belligerence, moroseness). Also, symptoms due to hypercapnia, such as lightheadedness, paresthesiae and tetany
20,000-25,000	70-60	Accentuation of all symptoms, myocolonic jerks, convulsions, circulatory collapse, death

*Reproduced with permission from Edith Cowan University course on aviation physiology.

Author's case study — severe otic barotrauma

AN ambitious 30-year-old woman in middle management flew to an interview in Perth from an eastern state. She felt slightly non-specifically unwell on landing. The job interview was successful and a pre-employment medical was organised for the next day to complete her recruitment.

At the time of her medical examination she was clearly unwell, with a slight fever, dull tympanic membranes and rhinopharyngitis. The ear drums would not move during a Valsalva manoeuvre.

The patient was adamant she needed to return home on the 'red eye' that night. She was advised against this and the clinical findings and advice not to fly were clearly documented in the medical record. Unfortunately she did return home and experienced severe otic barotrauma in flight, with severe dizziness on landing and for several weeks afterwards.

She was referred by her GP to an ENT specialist, who diagnosed round-window rupture and perilymph fistula (figure 2), which was operatively repaired. Because she had given notice to her former employer and was unable to take up the job in Perth because of her illness, she was without income for several months.

Care must be taken not to use air to inflate an endotracheal tube cuff when transferring a patient by air. Normal saline should be used instead.

Most airlines repressurise the cabin at about 400 feet per minute (fpm) which is usually comfortable for the vast majority of people. Military aircrew need to be able to cope with a 5000 fpm descent rate and parachutists with a rate of 10,000 fpm.

The most common causes of barotrauma are due to the common cold and allergic rhinitis. Swelling of the nasopharyngeal end of the eustachian tube and mucus plugging prevents autoinflation of the middle ear, leading to otic barotrauma.

Gas expansion during the climb causes air to escape from the middle ear and the sinuses, usually without causing problems. This airflow can sometimes be perceived as a 'popping' sensation in the ears.

As the aircraft descends, air must flow back into the middle ear and sinuses to equalise pressure differences. If this does not take place, the ears or sinuses may feel as if they are blocked and, if the pressure is not relieved, pain and damage to the drum can result.

Equalising middle-ear pressure

If patients consult you before a flight, check both ears for easy movement of the ear drum when performing a Valsalva manoeuvre (a short forceful expiration against a pinched nose), or check for normal movement of the drum using an air insufflator bulb attached to an auriscope. If you have a tympanometer, check for a normal tympanogram.

If your patient can equalise without difficulty and can hear the opening pop, and/or the ear drum can be seen to move easily with a Valsalva or on air insufflation, they are medically fit to fly.

It is best not to fly with a cold. For pilots and aircrew with a higher level of responsibility, it is mandatory that they do not fly or pilot an aircraft if they may endanger the safe operation of the aircraft and a medical certificate should be issued.

Techniques to equalise middle-ear pressure while in flight include:

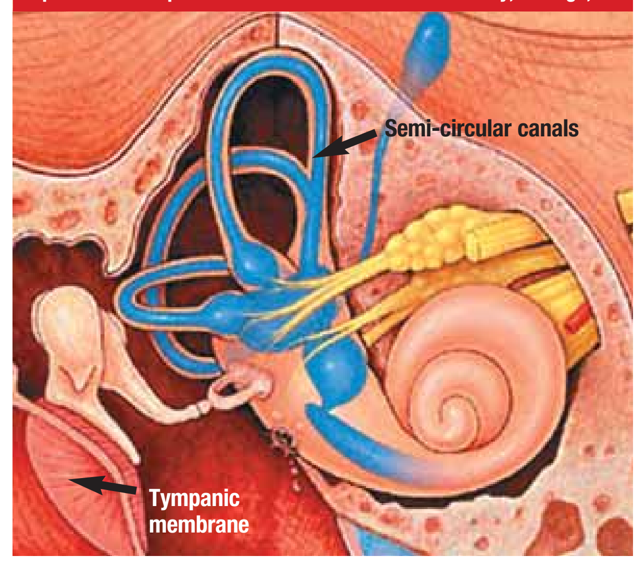
- Swallowing, chewing, yawning or forward movement of the lower jaw to relieve any discomfort. If the problem persists, a Valsalva may help.
- For infants, feeding or giving a dummy to stimulate swallowing may reduce the symptoms. While embarrassing for parents, screaming will succeed in opening the eustachian tube by contracting the palator levator and tensor tympani muscles.
- Using nasal decongestants such as Otrivin may help if used 10 minutes before descent of the aircraft. However, this should not be recommended as a guaranteed method to combat any risk of barotrauma (see Author's case study — severe otic barotrauma, above).

If all else fails the Toynbee or Frenzel manoeuvres may help:

- Joseph Toynbee lived in the 1800s and first identified the crackling sound present in the head with the anatomical opening of the Eustachian tube during swallowing. His technique is to pinch the nostrils shut while swallowing. The muscles in the back of the throat pull open the Eustachian tube and allow air to equalise if a gradient is present.
- Herman Frenzel was a Luftwaffe commander who taught the following technique to dive-bomber pilots during World War II. The nostrils are pinched closed and an effort is made to make a 'K' or guttural 'guh' sound. By doing this you raise the back 1/3 of the tongue and the Adam's apple elevates. You can practise the technique by watching the nose inflate and by watching the Adam's apple move up and down. The Frenzel manoeuvre is my preferred pressurisation manoeuvre.

The bottom line is that if you cannot easily equalise middle-ear pressure on the ground (the pop or click in the middle ear when you swallow) you should not fly.

Figure 2: Round-window fistula. An opening in the round window allows perilymph to leak out into the middle ear which causes dizziness. In this artist's depiction, for clarity, bone is not shown between the middle and inner ears. While it is difficult to be sure, it seems likely that in most cases there is only a small oozing of fluid between the perilymphatic space and the air-filled middle ear.
Reproduced with permission from Northwestern University, Chicago, US.



Risk of the bends (decompression sickness)

The bends is a rare complication of flying and occurs almost exclusively in scuba divers who fly too soon after diving. Symptoms may include joint pains and evolving paraplegia. (See South Pacific Underwater Medicine Society web site under Online resources, page 30).

It is recommended that scuba divers do not fly until at least 12 hours after their last dive. This period should be extended to 24 hours:

- If they have undertaken several days of sequential scuba diving.
- After more than one dive on any day.

cont'd next page

from previous page

- After diving that requires decompression stops ('decompression diving').

Passengers undertaking recreational diving before flying should seek specialist advice from a certified diving school or a hyperbaric medicine unit before flying. If the scuba diver develops any symptoms of the bends, the following numbers are helpful:

- For emergency help within Australia, toll free 1800 088 200.
- Australia from overseas (user pays): +61 8 8212 9242.

Altitude decompression sickness

This has been described in pilots and occurs in unpressurised aircraft. It may also be seen in altitude 'chamber runs' (being in a pressurised chamber where the atmosphere is removed by compressors and the internal pressure drops) after acrobatic flying or in air force pilots. Symptoms frequently resolve on descent.

Figure 3: Experimental preparation of cerebral arterial gas embolism demonstrating the presence of bubbles passing within the vasculature of the cortical subarachnoid space (arrow). Note the regions of surface haemorrhage (upper right) on surrounding gyri.

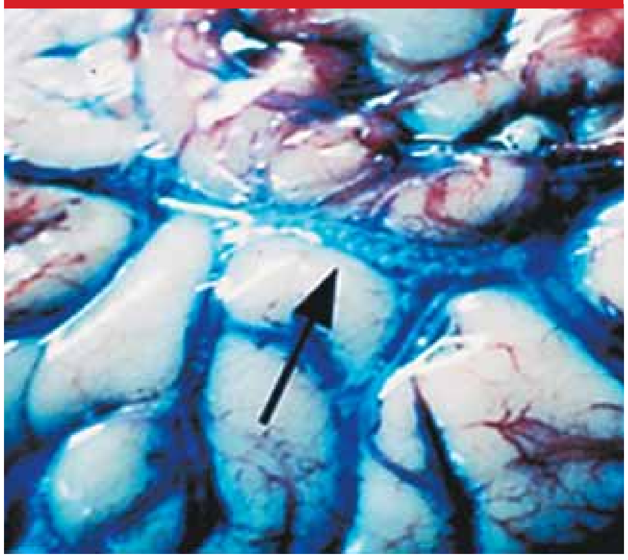


Table 2: Types of barotrauma — frequency and clinical effects

Otic barotrauma/barotitis media
- Common
- Involves rupture of the ear drum and bleeding into the middle ear
- A possible complication is round-window rupture, which causes persistent vertigo and a chronic labyrinthine fistula
- Permanent sensorineural hearing loss is a rare complication after otic barotrauma and is attributed to rupture of either the stapediovestibular ligament or the round window, with the creation of a perilymph fistula

Sinus barotraumas (aerosinusitis, barosinusitis)
- Uncommon and variable in nature
- May cause severe pain and haemorrhage into the sinus to relieve pressure. A rare complication is pneumocephalus, which usually presents with headache, nausea, vomiting and vertigo, with the most specific sign being 'bruit hydroaerique' — a splashing sound heard only by the patient on postural change

Barodontalgia (aerodontalgia)
- Uncommon
- A specific tooth is painful with descent
- Often associated with inflammation of the tooth pulp (pulpitis)

Pulmonary barotrauma/overpressure accidents
- Very uncommon
- Presents as pneumothorax (shortness of breath and chest pain), surgical emphysema (crepitus beneath the skin of the neck) or cerebral arterial gas embolism (stroke symptoms)

Cerebral arterial gas embolism

Cerebral arterial gas embolism as a result of lung rupture due to rapid decompression is extremely rare in altitude decompression sickness but occurs more frequently in diving accidents. It may present with a headache, loss of consciousness or symptoms similar to those of a TIA (figure 3).

Cabin air quality

Cabin humidity and dehydration

IT is well known that long-haul flying is associated with an array of symptoms arising from low cabin humidity, which usually ranges from 10% to 20%. Low humidity may cause skin dryness and discomfort of the eyes, mouth, nose and exposed skin but presents no risk to health.

Using a skin moisturising lotion, a saline nasal spray to moisturise the nasal passages and wearing spectacles rather than contact lenses can relieve or prevent discomfort.

Cabin fever (aerotoxic syndrome)

The occurrence of a variety of symptoms in pilots, air crew and passengers has stimulated the investigation of cabin air quality. The basis for the hypothesis is that cabin air is routinely drawn off engines and supplied to aircraft cabins (not so in the new Airbus A380).

If seals within the engine compartment are not secure, engine oil can leak and the products of this pyrolysis can leak into the cabin air supply. These products include tricesyl phosphate, the tri-ortho isomer of which is an organophosphate cholinesterase inhibitor capable of inducing a delayed neuropathy.

Typical symptoms reported include headaches, nausea, metallic taste in the mouth, tight chest, dry stinging eyes, dizziness, blurred vision, difficulty concentrating and temporary paralysis (which has been reported in pilots!). Longer-term reported symptoms include memory loss, chronic fatigue, and neurological and respiratory problems.

Current terminology appearing in recent literature refers to 'aerotoxic syndrome'. There is no single symptom or set of symptoms that characterises aerotoxic syndrome. Odours described as "dirty socks" or "musty" may or may not be present and it is unknown how altitude hypoxia affects the toxicology of oil pyrolysis products.

If you suspect you may have a patient with aerotoxic syndrome you would be well advised to seek advice from an aviation toxicologist or aviation-trained doctor.

Communicable diseases

H5N1 avian influenza, SARS, multidrug-resistant tuberculosis and polio have all been transmitted in-flight. The adage of recommending to your patients not to attend work when they are actively infectious applies even more so when they are planning air travel.

Any passenger with a potentially serious transmissible infection must not board an aircraft and must seek clearance to fly from the airline. Airlines may deny boarding to passengers who appear to be infected with a communicable disease.

The quality of aircraft cabin air is carefully controlled. Ventilation rates provide a total change of air 20-30 times an hour. Most modern aircraft have recirculation systems, which recycle up to 50% of cabin air usually through high-efficiency particulate air (HEPA) filters, of the type used in hospital operating theatres and ICUs, which trap particles, bacteria, fungi and viruses.

While the overall risk of transmission is exceedingly low in terms of kilometres travelled versus the risk of develop a transmissible disease, the following measures can help.

- Wash hands thoroughly with alcohol wipes before eating or touching the face.
- When possible, keep social distance to >1 metre. Transmission is still possible via fomites on common surfaces touched by the infected person and other passengers.
- Use a P2 or N95 mask if a passenger nearby seems infectious. Face masks are available in many different styles, offering different levels of protection. The most common and most economical face mask is the standard surgical mask.

A good-quality surgical mask should be three-ply, having an inner hydrophilic layer (worn closest to the skin and absorbing moisture), a middle filter layer and an outer hydrophobic layer.

While a standard surgical mask does not have to be tested for its efficiency in filtering out particles to meet Australian and international standards, it must be able to filter bacteria to a level of 95% at 3.0 microns. The N95 particulate respirator mask is able to filter out 95% of oil-free microscopic particles, down to 0.3 micron in size (the 'N' stands for 'Not oil proof').

This is an American standard; the Australian equivalent is known as P2 ('P' for 'particulate'). These masks are very lightweight and easily carried and are available from some pharmacies or medical suppliers.

- Comprehensive H5N1 (bird flu) kits suitable for home, work or travel are commercially available and generally include gloves, gowns, proper H5N1 face masks, such as a P2 or N95 respiratory mask, alcohol swabs, avian flu pocket advice sheet and a toll-free contact number or web site references.

Author's case study — blurred vision after a long-haul flight

A 25-YEAR-old patient with Eisenmenger's syndrome (left to right cardiac shunt), with symptoms only on exertion up stairs (NYHA grade II), requested medical clearance from her GP to fly to attend a work-related conference in Chicago for one week.

Her regular treatment included monthly venesections for control of secondary polycythaemia, hydralazine and aspirin.

After discussion with her haematologist, venesection to ensure a haematocrit of 0.52 two days before flight was arranged and she wore anti-embolism stockings throughout the flight.

Twenty-four hours after arrival in Chicago the patient developed blurred vision in one eye and was found to have a left central retinal arterial occlusion. She was given warfarin and the return journey was altered to include multiple stops with no flight exceeding six hours.

There was a permanent minor residual central visual field defect. Dehydration was thought to be the most significant modifiable contributing factor to this presentation.

Comment

This case highlights some of the complexity involved in assessing medical fitness to fly and that airlines or aviation authorities do not record or report the vast majority of post-flight complications or deaths that pertain to air travel.

The most likely cause was paradoxical embolism through the cardiac shunt while straining, contributed to by dehydration and prolonged immobility. The patient acknowledged sleeping for most of the flight and not drinking fluids soon after arrival in Chicago.

The question of suitability and fitness to fly was discussed with the patient's cardiologist and haematologist. Approval was given subject to venesection before travel.

Questions posed by this case include:

- Should this individual not have flown long haul at all?
- Should the forward journey have been reduced to smaller segments of six-hour flights, with associated extra costs?
- Would subcutaneous heparin have prevented this event?
- Why did the compression stockings not assist? Were they incorrectly sized?
- Can future long-haul travel be contemplated and, if so, which parameters apply?

There are no correct answers!

Cosmic radiation

AIRLINE pilots and aircrew are occupationally exposed to ionising cosmic radiation (radiation that comes from the sun and from outer space). Typical exposures in this occupational group are about 2-6mSv a year, compared with a background radiation exposure of about 1mSv in the general population. Natural background radiation comes from soil, rock and building materials as well as from cosmic radiation that reaches the Earth's surface.

The Earth's atmosphere and magnetic field are natural shields, so cosmic radiation levels are lower at lower altitudes. Cosmic radiation is more intense over polar regions than over the equator because of the shape of the Earth's magnetic field and the flattening of the atmosphere over the poles.

The overall risk from cosmic radiation is low for flight crew and much lower for passengers. In an occupational setting the cosmic radiation exposure generally falls within acceptable exposures compared with other occupational groups such as radiographers.

Whether there is an excess of cancer due to cosmic radiation (eg, breast or skin cancer) is very controversial. Time-zone shifts, shiftwork and stress all increase breast cancer risk, as may electromagnetic fields. In addition, flight attendants are usually compared with teachers as a control group, and this may not be appropriate. There are numerous confounding factors and a definitive position on cosmic radiation causing cancer in flight crew is yet to be firmly established.

Jet lag

JET lag is the term used for the symptoms caused by the disruption of the body's circadian rhythms that occurs when crossing multiple time zones, that is, when flying east to west or west to east.

Typical symptoms include:
- Indigestion.
- Bowel disturbance.
- General malaise.
- Daytime sleepiness.
- Difficulty in sleeping at night.
- Reduced physical and mental performance.

Its effects are often combined with tiredness due to the journey itself. Symptoms gradually disappear as the body adapts to the new time zone, which may take 2-7 days or more. Consequently long-haul flights with 1-2-week stays are particularly disruptive.

There are no known reliable measures to counteract jet lag. Many products are touted to reduce the symptoms but only melatonin has shown any promise in scientific studies, although effects are small and the dosing complicated (see below).

General measures to reduce the effects of jet lag include:
- Being as well rested as possible before departure and resting during the flight. Short naps can be helpful.
- Eating light meals.
- Limiting consumption of alcohol and caffeine. Alcohol increases urine output, which can result in disturbed sleep by promoting the urge to urinate.
- Trying to create the right environmental conditions for sleep. Eyeshades and earplugs may help. A minimum block of four hours' sleep during the local night (known as 'anchor sleep'), is thought to be necessary to allow the body's internal clock to adapt to the new time zone. If possible, make up the total sleep time by taking naps at times when feeling sleepy during the day.
- Getting exposure to daylight at the destination, which usually helps adaptation.

Use of short-acting hypnotics in flight should be discouraged because:
- They may elevate the risk of DVT by promoting immobility.
- The probability of an in-flight mechanical problem requiring the pilot to return to base is highest in the early phase (first two hours) of flight — being assisted from the passenger cabin in a stretcher or in a stuporous state is never appealing. Thus, hypnotics should especially not be used in the first two hours of a long-haul flight.
- Altitude hypoxia and other factors may increase susceptibility to side effects. The aircraft cabin is therefore never the place to first test a hypnotic. If they are to be used it is always better to do a 'ground test' first.

Several human trials suggest that melatonin taken by mouth, started on the day of travel (close to the target bedtime at the destination) and continued for several days, reduces the number of days required to establish a normal sleep pattern, diminishes the time it takes to fall asleep ('sleep latency'), improves alertness and reduces daytime fatigue.

The scientific evidence suggests a slight to modest benefit of melatonin in up to 50% of passengers who take it for jet lag. More trials are needed to confirm these findings and to determine optimal dosing.

Melatonin dosage regimens vary from 0.3mg daily to 5mg or higher. Higher doses may cause melatonin to become ineffective. Side effects are generally mild and may include headache, dizziness and nausea. Drug interactions with monoamine oxidase inhibitors are known to occur.

Medical contraindications to air travel

MEDICAL contraindications may be absolute (eg, pneumothorax) or relative (eg, pregnancy). Each airline has their own set of standards and it is essential that any doctor or passenger liaise with the airline if unsure of the risks. Table 3 summarises common conditions that prevent travel or require a medical clearance to fly. (See Online resources for more details, page 30)

In-flight emergencies

There is about one medical event for every 11,000-50,000 passengers, or about 30 such events a day on a global basis.

True medical emergencies are rare and most in-flight medical incidents are due to minor conditions such as musculoskeletal injuries, GI upset, dehydration or leaving essential medication in stowed luggage. Serious emergencies are rare, with cardiopulmonary resuscitation being required rarely (incidence rate of one emergency per 20,000 passengers).

The most common significant problem is fainting and/or dizziness. Other relatively common events are asthma, allergies (especially to peanuts), head trauma (usually as a result of objects falling from overhead lockers and sometimes from turbulence), anxiety and panic attacks, chest pain and heart attacks. Births have been recorded in-flight.

It has been shown that a doctor is travelling on board an aircraft as a passenger in 85% of cases. In several studies the rate of on-board doctor participation in in-flight medical events has been variously reported at anywhere from 8% to 63% of cases.

Aircraft diversion is a complex issue and the captain has the ultimate decision. It may take 30-45 minutes to prepare for a diversion and cost up to $US100,000-200,000 (about $A113,500-227,000) depending on the situation.

Medical kits

Airlines are required to provide basic levels of medical equipment on aircraft and to have cabin crew trained in first aid. The equipment carried varies, with many airlines carrying more than the minimum level of equipment required by the regulations. Equipment carried on a typical international flight includes:
- One or more first-aid kits, to be used by the crew.
- A medical kit, normally to be used by a doctor or other qualified person to treat in-flight medical emergencies. This will usually have a stethoscope, adrenaline, lignocaine, glucose, a glucometer and nitroglycerine spray.
- An automated external defibrillator (AED) to be used by the crew in case of cardiac arrest.

In addition, many airlines have facilities to enable crew to contact a medical expert at a ground-based response centre for advice on how to manage in-flight medical emergencies.

Table 3: The Qantas/Jetstar guidelines for passengers with medical conditions

Conditions that usually prevent travel

Heart attack — within seven days of intended travel
Stroke — within three days of intended travel
Psychiatric disorder — acute or uncontrolled
Contagious or infectious disease — if this poses a direct risk of infection to passengers or crew
Angioplasty — within three days of travel
Angioplasty with stents — within two days of travel
Pregnancy:
- Domestic flight — multiple pregnancy after 36th week
- Flights >4 hours — single pregnancy after 36th week
- International flight — multiple pregnancy after 32nd week

Conditions that require travel clearance

If any one or more of the following conditions apply to you, you may be unable to travel. If travel is to be undertaken within the time specified below, your doctor must complete the *Travel Clearance Form* if they believe it is safe for you to travel.

Asthma	Recent deterioration within 48 hours of travel
Head injury	Within two weeks of travel or if there is air in the cranium
Heart attack	Within 21 days of travel
Chest surgery	Within 10 days of travel
Ear and/or sinus pathology	Within 48 hours of travel
Stroke	Within 10 days of travel
Phobias	If doubt about ability to cope with air travel
Abdominal surgery	Within 10 days of travel
Anaemia	Hb <75g/L (Hb <95g/L if there is significant lung or cardiac disease)
Infants (newborn babies)	Within seven days of birth
Decompression sickness	Requires clearance from a specialist in hyperbaric medicine
Penetrating eye injury	While there is air in the eye or a vitreous leak
Pneumothorax	Within 14 days of resolution
Plaster casts	Plaster cast must be split if the injury is <48 hours old
Fractured jaw that has been wired	Must carry wire cutters onboard. Must travel with an escort capable of cutting the wires if necessary. Suitable documentation must be carried because of security issues
Psychiatric disorder that may deteriorate during flight	Must travel with medical escort. Escort must sit in adjacent seat
Inability to sit upright	Passengers are generally required to sit upright for take-off and landing
Inability to toilet, eat or administer own medication	Subject to the length of the flight, a competent escort (arranged by you) must be available to travel with you. Your escort must sit in an adjacent seat

Medical conditions and flying

Deep vein thrombosis

THERE is little doubt that the immobility associated with flying increases the risk of DVT and that this risk is apparent on flights of four hours or more. Studies have shown an incidence of 4.5-10% in DVT detected using ultrasound scanning (rather than clinical presentation) in passengers flying for longer than eight hours.

A study of 160 patients admitted to hospital with clinically apparent DVT showed that the odds ratio for venous thromboembolism in association with travel of more than four hours' duration in the previous four weeks was 4.0.

The Fifth Report on Science and Technology from the House of Lords suggests that for every million persons undertaking a long journey in a year, there will be 200 additional cases of venous thromboembolism attributable to travel in addition to 1000 background cases. This translates to one additional case for every 5000 passengers making long-haul flights.

It has been estimated that one in 250,000 passengers over age 65 dies suddenly from pulmonary embolism during long-distance flights. Relevant risk factors for DVT and suggested prophylaxis are listed in table 4.

General advice to counteract DVT includes:

- Maintaining good hydration.
- Moderation with alcohol (best avoided).
- Regular calf exercises.
- Exercise during flight — every 30 minutes up and down aisles and during stopovers.

Low-dose aspirin (eg, 75-150mg, two hours before take-off and again 24 hours later) has been reported to reduce the risk of DVT by about one-third.

Travellers at moderate to high risk should consider requesting an aisle seat. For those at high risk, low-molecular-weight heparin (eg, dalteparin 5000 IU or enoxaparin 40mg) should be given subcutaneously two hours before take-off, as this reduces the risk of VTE by about two-thirds. The use of graded compression stockings is synergistic with either aspirin or heparin.

Table 4: Risk factors for DVT and suggested prophylaxis

Risk category	Relevant risk factors	Suggested prophylaxis
Minimal risk	Age <40, otherwise fit and healthy	General advice
Low risk	Age >40, obesity, active inflammation, minor surgery within previous three days	As above ± graduated compression stockings
Moderate risk	Varicose veins, poorly controlled heart failure, MI within six weeks, oestrogen therapy (including oral contraception), polycythaemia, pregnancy/puerperium, lower-limb paralysis/trauma within six weeks	Consider aspirin if not contraindicated ± graduated compression stockings
High risk	Previous VTE, known thrombophilia, major surgery within six weeks, previous stroke, malignancy, family history of VTE	As above but consider low-molecular-weight heparin in place of aspirin

Source: US Aerospace Medical Association Medical Guidelines. Medical Guidelines for Airline Travel. 2nd edition. Task Force Alexandria, VA, USA. In: *Aviation, Space and Environmental Medicine* 2003; 74 (5): Section II.

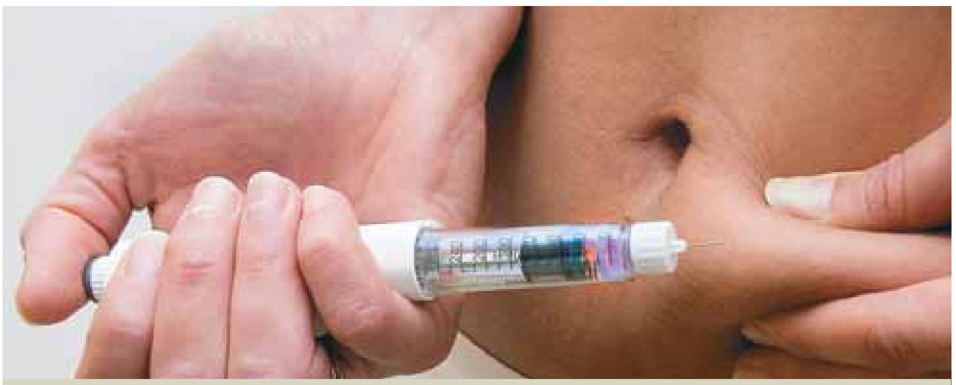


Table 5: Insulin adjustment when travelling east across multiple time zones

Usual regimen	Day of departure/travel (east bound)	1st day at destination
Multiple-injection regimen with pre-meal soluble insulin and overnight intermediate insulin	Usual pre-meal soluble insulin. If <4 hours between meals, reduce dose of the third soluble injection by 1/3 and add carbohydrate (ie, extra large evening snack if one meal missed) and reduce overnight intermediate insulin by 1/3 to avoid nocturnal hypoglycaemia	Return to usual insulin regimen if you overcompensated when reducing the evening intermediate insulin. Consider adding 1/3 of usual morning dose of soluble insulin if fasting blood glucose level is >14mmol/L

	Day of departure	First morning at destination	10 hours after morning dose	Second day at destination
Two-dose schedule	Usual morning and evening doses	2/3 usual morning dose	Usual evening dose + 1/3 morning dose if blood glucose level is >14mmol/L	Usual two doses
Single-dose schedule	Usual dose	2/3 usual dose	Remaining 1/3 of morning dose if blood glucose level is >14mmol/L	Usual dose

Source: *Aviation, Space and Environmental Medicine* 2003; 74 (5): Section II.

Diabetes

Patients with diabetes should plan well in advance of travel. There are usually no restrictions on flying for those whose diabetes is well controlled, but those with an unstable condition should seek medical clearance from the airline before flying.

It is timely to remind your patients with diabetes that one of the most common reasons for people with diabetes having in-flight medical problems is forgetting to carry on their medication.

Those who use insulin during flight should carry a letter of authorisation from their doctor to allow carriage of needles and insulin vials.

The following check list should assist in counselling your patients with diabetes about air travel. Checking with a diabetic specialist or nurse educator is invaluable:

- Ensure adequate equipment supplies and medication, eg, testing strips, batteries for glucometer, etc.
- Split insulin vials, if possible, between two different carry-on bags in case one is lost or stolen.
- Insulin should not be carried in stowed baggage, as this may be exposed to freezing temperatures, which may cause the insulin to denature. The bags may also be lost.
- Increasing fluid intake, avoiding alcohol and arranging appropriate meals is important.
- Diabetic meals are often designed for people with type 2 diabetes and may contain insufficient amounts of carbohydrate for those with type 1 disease, who may risk hypoglycaemia. The 'vegetarian meal' usually contains pasta-based or rice dishes, which may be more suitable. It is important to have snacks on hand and rapid acting sugar to cover unforeseen circumstances, such as delayed meals due to turbulence.
- Oral agents should be taken at the usual times.
- Those using insulin may need to adjust their dose for east or west trips with time-zone changes of more than four hours; consultation with a diabetes specialist may be needed. Table 5 provides a guide for insulin adjustment.
- Frequency of blood glucose monitoring should be increased during travel.
- A Medic Alert bracelet and brief medical summary are invaluable, particularly when travelling alone.

See Online resources for recommended web sites for patient information on diabetes.

Pregnancy

Pregnancy-related emergencies are most common in the first and third trimester. Increased risks also apply to women with multiple pregnancies, history of preterm labour, cervical incompetence and pre-eclampsia.

As mentioned above, a doctor's certificate to verify fitness to fly should be forwarded to the airline well before the anticipated travel and clearance to fly sought.

Because of the beneficial properties of fetal haemoglobin (HbF), at usual cabin pressure there are few, if any, changes in fetal arterial oxygen pressure even though the maternal haemoglobin may be 90% saturated (corresponding to a PaO_2 of 65mmHg).

It is important for pregnant women travelling overseas to check their travel insurance coverage. Some insurers will only insure until a certain stage of the pregnancy (eg, 24 weeks) and others will not cover for an overseas birth. Australia does have reciprocal medical arrangements with Britain, Ireland, New Zealand, Italy, Malta, Finland, Sweden and the Netherlands.

Conclusion

THE GP is faced with a complex array of potential problems when assessing fitness for air travel. Unanticipated problems can occur in previously healthy patients or present new challenges in elderly patients with multiple medications when travelling through multiple time zones.

A logical and methodical approach with the application of basic clinical skills should be sufficient for most consultations. For example, a detailed history of air travel, patient's reasons and expectations for air travel, patient's understanding of health risks and the GP's written instructions should be well documented.

Medical insurance, prophylaxis for DVT and travel vaccinations should be discussed at all consultations. Advice on prevention and treatment of STIs, avian flu, culture shock and stays at high altitude warrant further consideration.

An extended consultation with the use of a prepared overseas travel health consultation form covering the points raised in this article is recommended.

Further reading

- Pain MCF, et al. Department of Respiratory Medicine, Clinical Epidemiology and Health Service Evaluation Unit 2 and Intensive Care Unit 3. The Royal Melbourne Hospital.
- Medical Guidelines for Airline Travel. 2nd Edition – Aerospace Medical Association Medical Guidelines Task Force. *Aviation, Space and Environmental Medicine* 2003; 74(5): Section II.
- Toxic fumes impairing our ability to fly, say pilots. *New Scientist* 2007, 19 June.
- Olsen SJ, et al. Transmission of the severe acute respiratory syndrome on aircraft. *New England Journal of Medicine* 2003; 349:2416-22.
- A position paper of The Thoracic Society of Australia and New Zealand. *Venous Thromboembolism and Air Travel.*

Online resources

- ATSB Transport Safety Report Aviation Research and Analysis Report – B2006/0171. An Analysis of In flight Passenger Injuries and Medical Conditions 1 Jan 1975 to 31 March 2006 Dr David G Newman: www.atsb.gov.au/publications/2006/pdf/B20060171.pdf
- House of Lords Science and Technology — Fifth Report: http://www.parliament.the-stationery-office.co.uk/pa/ld199798/ldselect/ldsctech/064v/st0501.htm
- South Pacific Underwater Medicine Society: www.spums.org.au

Guidelines for passengers with medical conditions

- Qantas travel clearance guidelines: www.qantas.com.au/infodetail/flying/beforeYouTravel/mediform.pdf
- Virgin medical clearance guidelines (Med-02): www.virginblue.com.au/pdfs/makingBooking/Medical_Clearance_Guidelines_V1-2.pdf
- British Airways medical clearance and fitness to fly, information for passengers: www.britishairways.com/travel/healthmedcond/public/en_gb#medical
- Information on travel overseas and medical care available can be found at the Australian Department of Foreign affairs web site: www.dfat.gov.au

Recommended web sites for patients with diabetes

- Diabetes UK: www.diabetes.org.uk
- American Diabetes Association: www.diabetes.org
- Canadian Diabetes Association: www.diabetes.ca

GP's contribution

DR MATILDA METLEDGE
Sydney, NSW

Case study

MISS M, 20, was noted at check-in to be acting strangely and likely to be "under the influence". The cabin crew is advised not to serve her any alcohol. About two hours into a long-haul flight, assistance is sought from a doctor on board, as her behaviour is disruptive.

It is obvious to the doctor that it is not alcohol at play but a hallucinogenic substance — likely ecstasy. As the doctor did not use anything in the doctor's bag, no recording of this medical incident is made by the air crew.

Questions for the author

Is the effect of 'party drugs' likely to be exaggerated in flight?

As you might expect, there have been no studies on this topic. However, given that the behavioural changes of alcohol are well documented in flight (for a routine flight one standard drink has the clinical effects of two on the ground) one would expect that altitude hypoxia would have an effect and that administering medical oxygen might assist.

You mentioned that there are about 30 medical incidents in flight a day internationally. Is there a standard reporting of events across airlines or are these only the incidents for which the doctor's bag was used?

Each airline has its own procedures for reporting. The International Civil Aviation Organisation (ICAO: www.icao.int) sets minimum standards for reporting and has produced the document *Air Passenger Health Matters* (www.icao.int/icao/en/assembl/a35/wp/wp122_en.pdf) for use by airlines (see page A-9, Part 2).

All incidents should be recorded in the manifest of the aircraft by the chief purser, but as to how often they are not recorded I do not know. In my own experience I know that some have not been reported.

Miss M was noted at check-in to be acting strangely and likely to be "under the influence".

Are we aware of what training ground staff are given to decide who is medically fit to board a plane?

All staff go through an induction and training program (about three weeks' duration) set through agreement between the airline and CASA or the local organisation responsible for aviation safety. The quality varies.

The more established airlines have a medical department and airline medical officers who assist ground staff. Once again, ICAO have set the minimum standard here.

General questions for the author

From recent personal experience the 'basic medical equipment' that all airlines should carry was somewhat inadequate. For example, only a single pair of very small gloves was supplied, with no sharps container available. The dosing on vials of medications such as adrenaline were also not the same as used in Australia. Is there an international agreement on what doses of drugs should be available? Is there a reason that lignocaine vials would be included but not maxolon?

Refer to ICAO document and link. There is agreement, but individual airlines may do what they wish and deviate from the standards set by ICAO. Both drugs should be included (see above document).

All women taking oral contraceptives are noted to be at moderate risk of DVT. You mention that aspirin should be offered. Can you suggest on which length of flight this should be offered?

Aspirin is definitely recommended for flights over six hours, and possibly in those of 4-6 hours. If there are other risk factors for DVT, such as smoking, the threshold for recommending aspirin is lowered.

How to Treat Quiz

Flying and health — 14 December 2007

INSTRUCTIONS

Complete this quiz to earn 2 CPD points and/or 1 PDP point by marking the correct answer(s) with an X on this form. Fill in your contact details and return to us by fax or free post.

FAX BACK	FREE POST	ONLINE
Photocopy form and fax to (02) 9422 2844	How to Treat quiz Reply Paid 60416 Chatswood DC NSW 2067	www.australiandoctor.com.au/cpd/ for immediate feedback

1. For which TWO medical scenarios would patients usually need to provide written medical clearance to be able to fly?

- ❑ a) Anaemia with an Hb level of 70g/L
- ❑ b) Normal neonates aged less than one month
- ❑ c) Within two weeks of resolution of a pneumothorax
- ❑ d) Exacerbation of asthma in the past two weeks

2. Marwain, 68, has COPD of moderate severity, with breathlessness on walking more than 100m on flat ground. His Hb level is 175g/L and resting oxygen saturation is 92%. He plans to fly to the US to visit family. Which TWO statements about this flight for Marwain are correct?

- ❑ a) As Marwain does not need supplemental oxygen at home, he will not require this for the flight
- ❑ b) He plans to visit Denver, Colorado, at an elevation of about 1600m (or 5280 feet) for a few days. As this is less than typical cruising cabin altitude, you have no significant concerns with this visit
- ❑ c) He is at a moderate risk of DVT on this flight
- ❑ d) Marwain should be reviewed by his respiratory physician during planning of his trip

3. Bruce, 63, has been holidaying in Malaysia. His daughter tells you he is in hospital, having just had a heart attack. What information can you give his daughter about the restrictions that are likely to be imposed on Bruce's return to Australia (choose TWO)?

- ❑ a) It will be at least one month before the airline would allow him to fly
- ❑ b) He will not be allowed to fly on his scheduled return flight in five days' time
- ❑ c) He will need medical clearance if he wishes to return home before three weeks' time
- ❑ d) Even when stable he will need an escort to travel with him on the return journey

4. Ellen, 32, presents two days before a trip from Sydney to Brisbane for work. She has had an URTI during the past week and just popped in to "have her ears checked for the flight". She has not had any significant ear pain but does have a feeling of blockage in both ears. Which TWO statements about flying with a middle-ear effusion are correct?

- ❑ a) There is a risk of permanent sensorineural hearing loss
- ❑ b) The greatest risk of barotrauma occurs on take off and climbing to cruising altitude
- ❑ c) If you can see an air fluid level or air bubbles in the middle ear on otoscopy, this implies that the effusion is clearing and the patient is safe to fly
- ❑ d) If Ellen's ear drum cannot be seen to move and she does not easily feel her ear pressure equalising on Valsalva, she should be advised not to fly

5. Which TWO statements about the cabin environment are correct?

- ❑ a) Humidity of the air is controlled at 50%
- ❑ b) A total change of cabin air occurs about 10 times an hour
- ❑ c) The level of cosmic radiation for pilots is about 2-6 times the background exposure of the general population
- ❑ d) Cabin pressure is such that most healthy people's Hb oxygen saturation ranges from about 93% to 97%

6. Ahn, 24, is travelling to the UK and comes to ask your advice about minimising the effects of jet lag. Which TWO pieces of advice about reducing jet lag are correct?

- ❑ a) Ahn should make himself sleep deprived before the flight so that he sleeps better on board
- ❑ b) He should limit alcohol and caffeine during the flight
- ❑ c) He should try melatonin, as it is likely to be of benefit in >80% of people
- ❑ d) Exposure to daylight at the destination will be helpful

7. Which TWO statements about in-flight emergencies are correct?

- ❑ a) All airlines are required to have some medical equipment on board
- ❑ b) All airlines have cabin crew trained in first aid
- ❑ c) Serious medical emergencies during the flight are a frequent event
- ❑ d) The most common significant medical problem managed in-flight is chest pain

8. Janice, 57, consults you before flying to Scotland for a holiday. She has bilateral lower leg varicose veins. She takes oral HRT for menopause symptoms. Janice has heard about DVT associated with flying and comes to discuss this with you. Which TWO statements about DVT and flying are correct?

- ❑ a) Risk of DVT starts to increase with flights longer than six hours' duration
- ❑ b) Varicose veins and oral oestrogen therapy are additional risk factors for DVT during a flight
- ❑ c) Patients such as Janice should be screened for thrombophilia before travel
- ❑ d) Age >40 is a risk factor for DVT

9. What advice do you give Janice to reduce her risk of DVT (choose THREE)?

- ❑ a) Wear graduated compression stockings during the flight
- ❑ b) She should receive low-molecular-weight heparin before travel
- ❑ c) She should take low-dose aspirin two hours before take-off and again at 24 hours
- ❑ d) Increase fluid intake during flight

10. Bob, 68, has type 2 diabetes. He takes metformin tablets and twice-daily insulin. What advice do you give Bob to help him with managing his diabetes while flying to Italy (choose THREE)?

- ❑ a) He should keep some of his insulin with him and keep the rest in his stowed luggage
- ❑ b) He will need a letter from you to allow him to carry needles and insulin vials on board
- ❑ c) He should arrange with the airline to have diabetic meals
- ❑ d) He should take his metformin at the usual time, but will need to adjust his insulin dose

CONTACT DETAILS

Dr: .... Phone: .... E-mail: ....

RACGP QA & CPD No: .... and /or ACRRM membership No: ....

Address: .... Postcode: ....

Australian Doctor Education.

HOW TO TREAT Editor: **Dr Marcela Cox**
Co-ordinator: **Julian McAllan**
Quiz: **Dr Marcela Cox**

The mark required to obtain points is 80%. Please note that some questions have more than one correct answer. Your CPD activity will be updated on your RACGP records every January, April, July and October.

NEXT WEEK This was the last How to Treat for 2007. Thanks once again to all our readers for your continuing support. Next year (18 January) we kick off with a review of the investigation and treatment of bone marrow failure. The author is **Dr William Stevenson,** haematologist, department of haematology and transfusion medicine, Royal North Shore Hospital, Sydney, NSW; fellow, NSW Cancer Institute (department of leukaemia) and MD Anderson Cancer Center, Houston, Texas.