Aviation Medicine

Fitness to travel by air

I: Physiological considerations

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"I always love to begin a journey on Sundays, because I shall have the prayers of the church, to preserve all that travel by land, or by water." (Jonathan Swift, 1667-1745)

Commercial aviation has added a new dimension to everyday travel, and for most passengers it is a safe and efficient method of transport. For some patients, however, it means exposure to additional medical risks that may not be apparent to them or indeed to their doctors. Often, critically ill patients may need the speed of air travel to receive specialised treatment. There are, however, various considerations that must determine whether patients are fit to fly as farepaying passengers on civil airlines.

General considerations

The prime concerns of an airline are the safe transportation of the public and the maintenance of a high standard of service. These objectives may be affected adversely by the carriage of sick passengers. For example, an unescorted psychotic patient could be a grave threat to the safety of an aircraft and its captive passengers. Alternatively, a patient whose disease is well controlled on the ground may become acutely ill when subjected to the different physiological conditions of flight. Cabin staff are trained in basic first aid, but in some cases expert medical attention may be obtained only if the aircraft makes an unscheduled landing. Apart from being extremely expensive for the airline such a diversion will also cause delay and inconvenience to other passengers. For these reasons, airlines not unreasonably reserve the right to refuse passage to those who are not medically fit to travel by air. Most major carriers, therefore, have a medical department to advise on a patient's suitability for air travel and if feasible to make special arrangements, such as giving extra help for passengers in wheelchairs and accommodating stretcher cases on board the aircraft. Provision of these extra services requires previous notification of the patient's condition to the airline. British Airways, for example, welcomes inquiries from doctors and provides a simple form (available from travel agents or direct from British Airways) to be completed by the patient and his doctor so that all relevant information can be obtained in advance. (Most other members of the International Air Transport Association use a similar form.)

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Circumstances sometimes dictate that travel has to be undertaken at short notice, and many airlines, including British Airways, have a specialist medical officer available at all times to answer urgent inquiries from doctors with problem cases. Such inquiries should be directed to the medical officer (passenger services), British Airways Medical Service, Speedbird House, Heathrow Airport, Middlesex TW6 2JA (telephone either 01-759-5511 ext 2378 or 01-750-5616). The advice given by the airline will be determined in particular by physiological and specific medical considerations.

Physiological considerations

A patient will commonly be advised not to fly when he has a disease which will be affected adversely by the hypoxia or pressure changes produced by altitude or both (see later article on the problems of altitude).

CONDITIONS ADVERSELY AFFECTED BY HYPOXIA

Respiratory diseases

At a cabin altitude of 6000 ft (1829 m) the alveolar partial pressure of oxygen will have fallen from 13·6 kPa (102 mm Hg) to 9·9 kPa (74 mm Hg), but the sigmoid shape of the haemoglobin oxygen dissociation curve is such that the oxygen saturation of haemoglobin will have been reduced by only about 3%. Some older aircraft are still flying with a maximum cabin altitude of 8000 ft (2438 m) but even at this height saturation will have fallen to only about 90%. Such reductions present no problems to the healthy passenger but may exacerbate certain medical conditions, the most obvious of which are those where pulmonary function is impaired. Thus in chronic bronchitis, emphysema, bronchiectasis, and cor pulmonale oxygenation is already compromised, and exposure to altitude may result in severe tissue hypoxia.[1] Most of these patients may be transported satisfactorily provided that supplementary oxygen is available during the flight. The use of 100% oxygen may, however, worsen some cases, since lack of oxygen is a drive to respiration. The measurement of blood gases in flight may be desirable, but it is impractical on board an aircraft. With ear oximetry, however, haemoglobin saturation may be monitored relatively easily even in flight.[2]

In general, dyspnoea at rest is a contraindication to flight, and patients with poor exercise tolerance (dyspnoea after walking 50 m on level ground) require further assessment[1] with full pulmonary function tests and a trial of 100% oxygen. Well controlled asthma should not be a contraindication to flight,[3] but patients who produce large amounts of offensive sputum may not be permitted to fly, despite satisfactory ventilation, because of disturbance to other passengers[4]—a

commercial consideration that applies to some other medical conditions—for example, urinary and faecal incontinence.

Anaemias

Severe anaemia, usually defined as a haemoglobin concentration of less than 7·5 g/dl, is a relative contraindication to air travel[1] depending on the chronicity of the condition and the length of the flight to be undertaken. Transfusion before flight may be required, and the airline medical department should be consulted so that supplementary oxygen is readily available on board the aircraft. Cases of sickling crisis precipitated by flight have been reported,[5] and though hypoxia is usually the major predisposing factor prolonged sitting causes abdominal compression and venestasis, which are also conducive to the development of sickling. The particular groups at risk are those with sickle cell haemoglobin C disease and sickle cell β-thalassaemia.[6] Affected subjects should be advised to avoid air travel, but if this is not possible additional oxygen should be readily available. Sickle cell trait—that is, the heterozygous carrier state—is no longer a serious risk because of cabin pressurisation. Surprisingly, patients with sickle cell anaemia are at little risk in pressurised aircraft, possibly because of autosplenectomy.[5]

Cardiovascular diseases

Patients who have poor cardiac reserve require careful assessment before flight, because they may be unable to tolerate the slight reduction in inspired oxygen tension which occurs at high cabin altitudes.[7] As a guideline those who are able to walk about 80 m and to climb 10-12 stairs without symptoms should be able to fly without incident,[8] but uncontrolled cardiac failure is a contraindication to flight.

In a study of 25 patients admitted to hospital after collapsing at London airport with conditions affecting the cardiovascular system, myocardial insufficiency tended to occur on the ground rather than in the air.[9] The stress and exhaustion imposed by air travel seem to be at least as important as other predisposing factors such as hypoxia during flight. In another study of 615 commercial passengers with established cardiovascular and respiratory disease, those with myocardial ischaemia did not have a significantly greater number of problems than the survey population as a whole.[10] The incidence of complications was, however, much higher than in a poorly defined control group. Interestingly, the number of episodes of angina in flight was more than double that on the ground, but in this study help with documentation and baggage at embarkation and disembarkation kept "ground stress" to a minimum. Of patients with a history of myocardial infarction, those who had had a recent infarct (less than two months before flight) or a history of multiple infarcts had a significantly higher incidence of problems during flight than those with an intermediate history—that is, an infarct between two and six months before flying. Thus recent myocardial infarction should be regarded as a contraindication to air travel. But, as many patients wish to convalesce abroad, British Airways recommends as a compromise that patients in uncomplicated cases do not fly for a minimum of two weeks after an infarction.

Neurological diseases

Hypoxia may affect patients who have had a recent cerebral infarction, but problems are less likely to arise the longer the interval after the stroke.[10] A minimum of three weeks after the acute episode is the recommended interval before flight. Atherosclerosis may already have diminished cerebral oxygenation in the elderly passenger, and, though this may not be severe enough to produce symptoms on the ground, the mild hypoxia at cabin altitude may tip the balance towards frank cerebral hypoxia. As such patients commonly become confused, they should be escorted by a friend or relative. As a general rule, patients who tend to become confused at night are likely to develop similar symptoms during flight. Age alone is not, however, a contraindication to flying as a passenger.[3]

Epileptics may be more liable to seizures while travelling by air because of several predisposing factors including hypoxia, hyperventilation, fatigue, and stress. Poorly controlled epileptics should be advised to increase their medication 24 hours before flight and maintain a high dose until arrival at their ultimate destination when the dosage may be reduced gradually. During long flights the patient may have his routine disturbed by time changes and should therefore be warned to continue his medication on a regular basis, usually by remaining on home time throughout his journey and adjusting his drug regimen on arrival.

Other factors

The effects of hypoxia may be worsened by several factors but especially by cigarettes and alcohol. Patients who are at risk from hypoxia should therefore be advised to abstain from both habits before and during flight. Even so, hypoxia may still be an overwhelming physiological challenge at certain destinations; a patient with chronic bronchitis is ill advised to convalesce in Mexico City, for example, which lies 7460 ft (2273 m) above sea level!

CONDITIONS ADVERSELY AFFECTED BY PRESSURE CHANGES

Gas taken up to 6000 ft (1829 m) above ground level will, if free to do so, increase its volume by about 30% because of reduced atmospheric pressure. Air contained within body cavities also undergoes this physical change—hence the need to "clear" one's ears during ascent and descent. Otitic barotrauma is an uncommon complication of flying, but otitis media and sinusitis greatly increase the chance of it developing; those who are affected should be advised not to fly during the acute stage of the illness. Patients who have had recent middle ear surgery are particularly at risk and should not fly until the middle ear cavity is dry and normally aerated.[1] Patients who have undergone stapedectomy require special attention because the prosthesis may be driven into the labyrinth by pressure changes thus causing vertigo and cochlear failure[11]; specialist advice must be obtained for these patients before flight is allowed.

Expansion of gas within the gastrointestinal tract may cause problems after abdominal surgery because of dehiscence of the abdominal wound or, more particularly, disruption of a bowel anastomosis. At least 10 days should elapse between abdominal surgery, however minor, and flight, but this time limit should be extended if the postoperative recovery was complicated by paralytic ileus. Recent gastrointestinal haemorrhage may be reactivated by distension of the bowel so that flying should not be undertaken for at least three weeks; also motion sickness could further aggravate the problem. Those with ileostomies or colostomies may need to vent the increased volume of gastrointestinal gas and should be warned to take extra bags and dressings in their hand luggage.[1]

Since air may be introduced into the thoracic cavity during thoracic surgery, and its expansion result in respiratory embarrassment, three weeks is the recommended interval between major chest surgery and air travel. For the same reasons patients with pneumothorax should not fly[4] until it has been confirmed radiologically that the lung has re-expanded fully.

Air trapped within the cranium during air encephalography is an absolute contraindication to air travel,[1] and at least seven days should be allowed for the air to be absorbed. Similar restrictions apply to patients who have a skull fracture extending into a sinus or the middle ear cavity through which air may have

entered the cranium.[12] Trapped air may also produce problems after eye injury and surgery.[4]

When air trapped within plaster casts expands the enclosed limb may be sufficiently compressed to cause ischaemia.[13] Casts should therefore be split before a flight if the underlying soft tissues are still oedematous, especially if the flight is going to be lengthy. Passengers with plasters extending above the knee may also create problems by obstructing aisles or emergency exits. Often the only solution is for the passenger to travel first class, where more leg room is available, or to travel on a stretcher; the traveller and not the airline will have to meet the additional costs.

Next week's article will cover specific medical considerations that affect a patient's fitness to fly.

References

[1] Green RL. The carriage of invalid passengers by air. *Br J Hosp Med* 1977;**17**:32-7.

[2] Cissik JH, Yochey CC, Byrd RB. Evaluation of the Hewlett-Packard ear oximeter for use during routine air transport of patients. *Aviat Space Environ Med* 1981;**52**:312-4.

[3] Committee on medical criteria of the Aerospace Medical Association. Medical criteria for passenger flying. *J Aviat Med* 1961;**32**:369-82.

[4] Bergin K. Transport of invalids by air. *Br Med J* 1967;iii:539-43.

[5] Green RL, Huntsman RG, Serjeant GR. The sickle-cell and altitude. *Br Med J* 1971;iv:593-5.

[6] Green RL, Huntsman RG, Serjeant GR. Sickle-cell and altitude. *Br Med J* 1972;i:803-4.

[7] Jackson F. The heart at high altitude. *Br Heart J* 1968;**30**:291-4.

[8] Peffers ASR. Carriage of invalids by air. *J R Coll Physicians Lond* 1978; **12**:136-42.

[9] Beighton PH, Richards PR. Cardiovascular disease in air travellers. *Br Heart J* 1968;**30**:367-72.

[10] Richards PR. The effects of air travel on passengers with cardiovascular and respiratory disease. *Practitioner* 1973;**210**:232-41.

[11] King PF. Otorhinolaryngology in aviation. In: Dhenin G, ed. *Aviation medicine*, Vol 2. London: Tri-Med Books Ltd, 1978:232-63.

[12] Ellingson HV. Aerial transportation of patients. In: Randel HW, ed. *Aerospace medicine*, 2nd ed. Baltimore: Williams and Wilkins Company, 1971:602-13.

[13] Parsons CJ, Bobechko WP. Aeromedical transport: its hidden problems. *Can Med Assoc J* 1982;**126**:237-43.

Letters to a Young Doctor

Research

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Research as an educational tool is often misunderstood. Few people are destined to be Nobel Prize winners or will make a major, lasting contribution to the sum of public knowledge. But all doctors can be alert, inquiring, and show special interest in some subject. When you have reached the stage to do research, which is usually after a higher diploma has been obtained and you are at registrar or senior registrar grade, you have to think of something to do that will make you stand out from your competitors when you apply for senior registrar or consultant jobs. How will those who prepare the shortlist recognise that you are better than most of the others, who have the same experience as you and a higher diploma as well, for a particular post? You have to show that you have energy beyond the average, which a research project will indicate.

Research is not done solely so that it will look good and sell you to those who shortlist and to appointments committees. It is done as well because it is fun to find new things out and it heightens critical faculties and enthusiasm for what you are doing. It boosts the ego, too, when you become the expert on some particular subject. Because of your work you know more about it than anyone else in your hospital, and perhaps, ultimately, further afield. What you find out may not be new to others who know about the subject, but research is also a voyage of discovery of things for oneself. Big research catches headlines, but your research is done, in the first instance, for the effect it has on you. It adds mainly to your private knowledge and development, and with luck to public scientific knowledge. Quite apart from any obvious importance of your work you will at a lower level have contributed to the thinking and teaching about your subject in your immediate circle.

When all those on a firm or in a division have some special interest that they pursue with enthusiasm and interest the whole team develops an esprit de corps in which mind plays on mind and there is delight in intellectual activity and work. It changes drudgery and labour into pleasurable adventure in working together. This pragmatic test alone justifies the simplest forms of research. It changes attitudes for the better in the person doing it and in those with whom he mixes.

Keep it simple

Etymologically, research means only searching again. You must get out of the habit, instilled by too much learning, listening, and reading to pass examinations of thinking that everything is known and has been discovered. In everything there is a point where knowledge runs out and is inadequate. There are always new ways of looking at pieces of knowledge and correlating them in different ways from previously so that new insights emerge. If you do research this will certainly happen to you personally, giving a little glow of satisfaction, and the insights may be illuminating to others too. So even the old problems can bear looking at again. Interesting topics on old themes are to be found in the leading articles of the *BMJ* and *Lancet* every week. They come up fresh again because someone has recently thought about them in a slightly different way than before. You can do it too, and you should.

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