MEDICAL GUIDELINES FOR AIRLINE TRAVEL
2nd Edition

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Introduction

Each year approximately 1 billion people travel by air on the many domestic and international airlines. It has been predicted that in the coming two decades, the number of passengers will double. A global increase in travel, as well as an increasingly aged population in many countries, makes it reasonable to assume that there will be a significant increase in older passengers and passengers with illness. Patients frequently ask their physicians whether or not it is advisable for them to travel, and if so, what precautions they should take. Consequently, physicians need to be aware of the environmental and physiological stresses of flight in order to properly advise their patients. In addition, because international travelers can fly to the four corners of the world in just hours, a basic understanding of vaccinations is requisite.

Two caveats are brought to the attention of the reader. First, if inflight illness or even death has occasionally been reported by the airlines, the event was not necessarily caused by airline travel or the stresses of flight. The physician must be mindful that, with so many passengers spending so many hours inflight, flying and the medical event may be coincidental rather than causal. Second, the guidelines described herein are just that– guidelines, and not rigid criteria or hard and fast rules. Like all patient management, these guidelines must be individualized and tempered by the physician's clinical judgment.

This publication was prepared by the Aerospace Medical Association Medical Guidelines Task Force. The information contained herein is for primary care and specialist physicians so they will be better prepared to advise patients who are contemplating air travel. (The reader is cautioned that the material applies only to passengers and not to airline crews or cabin attendants.) The authors sincerely hope that this publication will educate the physician and contribute to safe and comfortable flight for passengers.

Stresses of Flight

Modern commercial aircraft are very safe and, in most cases, reasonably comfortable. However, all flights, short or long haul, impose stresses on all passengers. Preflight stresses include airport tumult on the ground such as carrying baggage, walking long distances, and being delayed. Inflight stresses include lowered barometric pressure and partial pressure of oxygen, noise, vibration (including turbulence), cigarette smoke, uncomfortable temperatures and low humidity, jet lag, and cramped seating (64). Nevertheless, healthy passengers endure these stresses which, for the most part, are quickly forgotten once the destination is reached. In general, passengers with illness (i.e., stable illness) also usually depart the destination airport none the worse. However, there is always the potential for such passengers to become ill during or after the flight due to these stresses.

The primary difference between the aircraft environment and the ground environment relates to the atmosphere. Contrary to popular belief, modern aircraft are not pressurized to sea level equivalent. Instead, on most flights the cabin altitude will be between 5000 and 8000 ft (1524 m and 2438 m). This results in reduced barometric pressure with a concomitant decrease in partial pressure of oxygen (P_{O_2}). While the barometric pressure is 760 mm Hg at sea level with a corresponding P_{aO_2} (arterial O_2 pressure) of 98 mm Hg, the barometric pressure at 8000 ft will be 565 mm Hg with P_{aO_2} of about 55 mm Hg. If these last data are plotted on the oxyhemoglobin dissociation curve, we obtain a blood oxygen saturation of 90%. Although most healthy travelers can normally compensate for this amount of hypoxemia, this may not be true for coronary, pulmonary, cerebrovascular, and anemic patients. Because these patients may already have a reduced P_{aO_2} on the ground, further reduction in aircraft cabin pressure will bring them to the steep part of the oxyhemoglobin dissociation curve with a resultant very low saturation, which could cause distress and/or exacerbation of their illness (**Fig. 1**).

The hazards of cigarette smoking, active and passive, are well known and need not be recounted here. There is a worldwide movement to ban inflight smoking, with the International Civil Aviation Organization (ICAO) having asked all member States to comply. U.S. air carriers prohibit smoking on all flights. As a result, there has been vast improvement in cabin air quality and commensurate crew and passenger comfort. (For passengers with the potential for inflight nicotine withdrawal symptoms, nicotine gum or patch might be considered.)

Today's aircraft have very low cabin humidity, usually ranging from 10-20%. This is unavoidable because the air at high altitude is practically devoid of moisture. As a result, there can be a drying effect of airway passages, the cornea (particularly under contact lenses), and the skin.

Jet lag or circadian desynchronosis results from the desynchronization of the body clock with surrounding

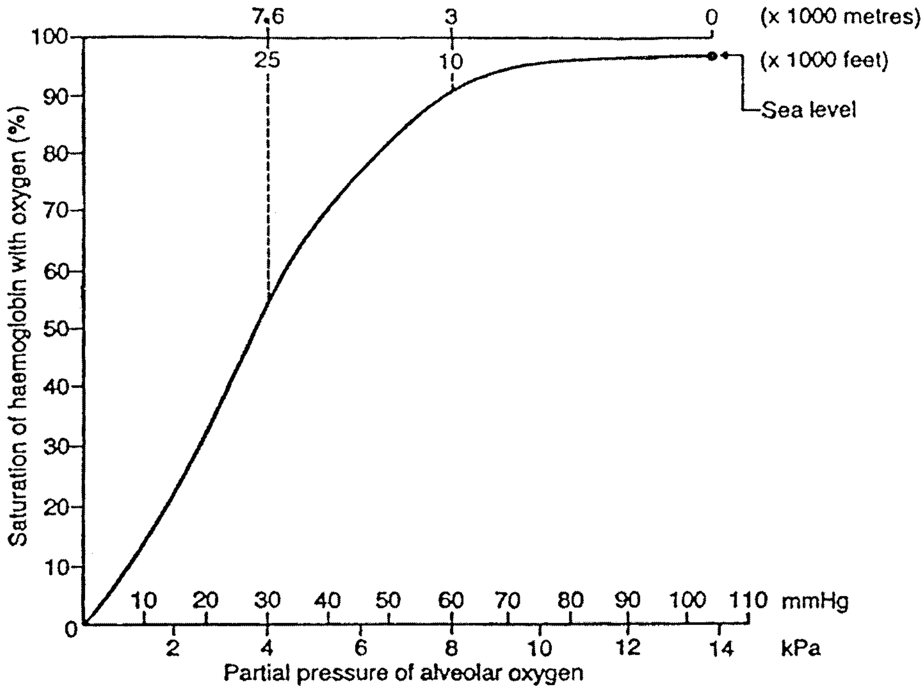

Fig. 1. Oxyhemoglobin Dissociation Curve.

environmental cues. It may not only be an annoyance for healthy passengers, but it can also complicate the timing of medications, such as insulin (See Jet Lag and Diabetes sections).

On commercial flights, regardless of aircraft type, many passengers sit in small, cramped spaces. This is not only uncomfortable, but also reduces the opportunity to get up, stretch, and walk about the cabin. Sitting for long periods is tolerable for most passengers, but for some there is the potential for exacerbating peripheral edema, cramps, and other circulatory problems. Of particular concern are deep venous thrombosis and, even worse, the potential for pulmonary embolus (See Deep Venous Thrombosis section).

Medical Evaluation and Airline Special Services

Medical Evaluation

The time before a commercial airline flight (preflight) is the best time to assess fitness of the prospective passenger. The private physician should review the passenger's medical condition, giving special consideration to the dosage and timing of any medications, contagiousness, and the need for special assistance or requests.

As a general rule, an individual with an unstable medical condition should not fly. Instability combined with the stresses of flight could pose a serious threat to the health and well-being of the sick or injured traveler. As mentioned in previous paragraphs, a lowered inflight barometric pressure and ambient oxygen partial pressure, as well as low humidity, are of particular significance for passengers with cardiopulmonary disease. Therefore, the absolute cabin altitude and duration of exposure are important considerations when recommending a passenger for flight. The altitude of the destination airport should also be considered.

Common medical conditions which should be addressed in a preflight medical evaluation include cardiovascular disease (e.g., angina pectoris, congestive heart failure, myocardial infarction), deep venous thrombosis, asthma and emphysema, surgical conditions, seizure disorder, stroke, mental illness, diabetes, and infectious diseases.

The passenger's health care provider should also consider vaccination status and the public health aspects of infectious diseases. Individuals with any contagious disease that could be transmitted to other passengers should postpone air travel until they are no longer contagious. Of particular concern is tuberculosis. Prospective passengers who have tuberculosis should have had adequate therapy and be noninfectious prior to flight.

If the physician has fully reviewed the prospective traveler's condition and there is any question regarding the suitability to fly or any special requests for assistance, the airline should be contacted (in many cases, this will be the airline medical department). For a passenger with a special medical condition that could lead to inflight illness, injury, or risk to other passengers, some airlines will require a medical certificate from the health care provider stating that the passenger is currently stable and fit for air travel. For a contagious disease, the certificate should also state that the passenger is not infectious.

For the traveling public, "Useful Tips for Airline Travel" and "Medical Guidelines for Airline Passengers" have been prepared by the Aerospace Medical Association. Both are available on the internet (http://www.asma.org).

Airline Special Services

With increased attention to passengers with disabilities, many special services are offered on major carriers.

For example, special meals, dictated by medical or personal needs, are generally available. In addition, wheel chairs and trolley service within the airport can be requested. Finally, early boarding is usually available to passengers with ambulatory difficulties.

As more passengers use air travel for business and leisure, a growing demand for inflight therapeutic oxygen can be expected. Some airlines will provide therapeutic oxygen for a small fee, while others will not. The availability and costs vary from airline to airline worldwide, each subject to its own national and company policies. Hence, passengers who require oxygen should contact the airline as far in advance of their journey as possible in order to make proper arrangements. Passengers should be cautioned that those airlines that do provide oxygen usually only do so inflight. Therefore, a traveler cannot always count on having oxygen continuously available from point of origin to destination. If oxygen is required in the airport preflight, while waiting for connections, or on arrival, arrangements should be made with oxygen vendors.

For safety and security reasons, passengers are prohibited by most airlines from bringing onboard their own oxygen supply procured from an outside source. Such passengers must use the oxygen provided by the airline. Use of the emergency drop-down masks for therapeutic oxygen is also prohibited by most airlines, as these are only to be used for inflight emergencies, such as decompression of the cabin. Most airlines carry a very limited supply of oxygen for use in the event of an unexpected inflight emergency or unscheduled medical need. However, if medical oxygen is needed inflight, advance arrangements must be made with the airline.

With respect to use of stretchers for ill passengers, each airline has its own policy. Those that provide this service may require the purchase of as many as six seats (in the first class section) and that an attendant travel with the passenger. The airline may also require that the stretcher conform with its specifications to meet safety regulations.

Since 1997, many aircraft and airports have been equipped with automatic external defibrillators (AEDs). These devices are small, safe, and easy to use and maintain. They significantly increase the survival rate following a cardiac arrest. Flight crew and airport emergency personnel are trained in their use.

Inflight Medical Care

Every airline in the world has some capability to render medical care inflight. Most have medical kits of varying sophistication and provide flight attendants with first-aid and CPR training. Policies regarding contents of the kit , training of the crew, and treatment of passengers are at the discretion of each nation and its airline(s). Because the kits are for emergency use only, physicians should not consider them available for routine treatment inflight.

Commercial carriers train their flight attendants to recognize common symptoms of distress and to respond to medical emergencies with first-aid, basic resuscitation techniques, and the use of emergency medical oxygen. The cabin crews might ask for assistance from onboard medical providers and will release the medical kit to providers with appropriate credentials. Interestingly, in a 1991 Federal Aviation Administration (FAA) study, physician travelers were available in 85% of reported inflight medical emergencies (43).

Many of the world's airlines have greatly increased their capacity for providing medical care to passengers inflight by enhancing their onboard emergency medical kits (EMKs). One of the more significant changes is the greater availability of automatic external defibrillators (AEDs). Cathay Pacific Airlines and British Caledonian Airlines were among the first to install AEDs in the mid-1980s; in addition to the new equipment, programs were implemented to train flight attendants to use the defibrillators. Qantas Airlines equipped their international aircraft beginning in 1991 and by 1994 had reported two successful cardioversions of ventricular fibrillation inflight (25). By 1997, Qantas reported five successful cardioversions of six episodes of ventricular fibrillation with two long-term survivors without residual neurological defect (58). Many airlines today carry onboard AEDs. In the United States, AEDs were first introduced by American Airlines in 1997 for over-water flights (51).

The U.S. Congress passed the Aviation Medical Assistance Act (Public Law 105-170, 49 USC 44701) in 1998 requiring the Federal Aviation Administration (FAA) to collect inflight and in-airport medical events data over a 1-yr period to determine whether current minimum requirements for air carrier crewmember emergency medical training and emergency medical equipment should be modified. In response to the Act, the study was conducted from July 1998 to July 1999. It revealed 188 deaths (43 occurred inflight) of which approximately 2/3 were believed to be cardiac (Jordan J. Personal communication).

On June 12, 2001, in response to the Aviation Medical Assistance Act, the FAA issued a final rule that required passenger-carrying aircraft of more than 7,500 pounds maximum payload capacity with at least one flight attendant to carry at least one automatic external defibrillator (AED) and at least one enhanced emergency medical kit. The new rule becomes effective on April 12, 2004, giving the airlines 3 yr to meet the standards. In addition to the AEDs, the expanded medical kit contains additional equipment and medication as listed in **Tables I and II** (30,31). (Until April, 2004, the only medications required by the FAA are 50% dextrose, nitroglycerin tablets, diphenhydramine, and 1:1000 epinephrine.) Airlines also implemented flight crewmember training programs to use the AED.

The 1998 Aviation Medical Assistance Act also provided a Federal Good Samaritan Law that limited Federal and State liability for individuals and airlines providing a medical response to inflight medical emergencies.

Many airlines augment these services with inflight medical consultation by ground-based physicians. Some airlines provide these consultations with company physicians while others employ contract medical services. Communications are usually via phone lines

TABLE I. FIRST-AID KITS.

According to the new rule for aircraft registered in the U.S. there must be 1–4 onboard first-aid kits depending upon the number of passenger seats. In general, each first-aid kit must contain the following:

Contents	Quantity
Adhesive bandage compresses, 1-inch	16
Antiseptic swabs	20
Ammonia inhalants	10
Bandage compresses, 4-inch	8
Triangular bandage compresses, 40-inch	5
Arm splint, noninflatable	1
Leg splint, noninflatable	1
Roller bandage, 4-inch	4
Adhesive tape, 1-inch standard roll	2
Bandage scissors	1

or radio transmissions, although some inflight demonstrations of data and video transmissions have successfully occurred. Some manufacturers of integrated medical devices incorporate the ability to measure, record and transmit variables such as blood pressure, oxygen saturation, ECGs, and medical histories. The next evolution of inflight medical care may include telemedicine capabilities to augment expert medical consultations (e.g., British Midland International initiated such telemedicine services in 2002). The planned aeromedical evacuation of some patients via scheduled commercial airline transport may be facilitated by the incorporation of such devices into the inflight medical care capability.

Finally, one airline has reintroduced the concept that some passengers with medical problems may safely fly with a qualified nurse in attendance. These nurses are in addition to the flight attendant complement of the airline.

Although the Aviation Medical Assistance Act does not require U.S. air carriers to have onboard AEDs until April, 2004, most of the major airlines have already met this requirement. The European Joint Aviation Authorities already mandate similar requirements. The availability of AEDs with the enhanced EMK provide physicians with an increased capability for treating cardiac arrest and arrhythmias.

Reported Inflight Illness and Death

Although there are no established databases providing information on the number of inflight medical emergencies or deaths, the few studies published in the literature indicate that inflight illness is uncommon and, when it does occur, is usually minor, e.g., fainting, dizziness, hyperventilation (33). However, serious illnesses, such as seizures and myocardial infarctions, do occur.

Likewise, inflight deaths are rare events, with previous studies reporting 0.31 inflight deaths per million passengers (19). Also, as mentioned above, there were 43 deaths reported on U.S. air carriers during a 1-yr period. (Two-thirds of the deaths were believed to be cardiac.) Although this seems like a significant number, it becomes vanishingly small in the context of the 600 million passengers who flew aboard U.S. air carriers that year.

It would be useful if there were a system of reporting inflight medical events to a central repository from which the airlines could retrieve data. This would give aerospace medicine physicians a better idea of the incidence of inflight illness and injury which, in turn, would be of value in designing inflight medical kits. One can understand the reluctance of some airlines to make such information available, but it could be done anonymously. Perhaps, in the future we will see such a system.

In summary, with the availability of trained flight attendants, onboard emergency medical kits, AEDs, and ground medical consultants (as well as a high probability of a passenger health care provider), medical care inflight is almost always available. Nevertheless, an appropriate preflight evaluation is the key to prevention.

Immunizations and Malaria Prophylaxis

Because travelers can now reach practically any area of the globe within hours, an understanding of basic and supplemental vaccines is essential. Diseases that can be prevented by vaccination fall into two main categories: diseases that pose a threat to health world-

TABLE II. EMERGENCY MEDICAL KIT.

Contents	Quantity
Sphygmomanometer	1
Stethoscope	1
Airways, oropharyngeal (3 sizes): 1 pediatric, 1 small adult, 1 large adult or equivalent	3
Self-inflating manual resuscitation device with 3 masks (1 pediatric, 1 small adult, 1 large adult or equivalent	3
CPR mask (3 sizes), 1 pediatric, 1 small adult, 1 large adult, or equivalent	3
IV Admin Set: Tubing w/2 Y connectors	1
Alcohol sponges	2
Adhesive tape, 1-inch standard roll adhesive	1
Tape scissors	1 pair
Tourniquet	1
Saline solution, 500 cc	1
Protective nonpermeable gloves or equivalent	1 pair
Needles (2-18 ga., 2-20 ga., 2-22 ga., or sizes necessary to administer required medications)	6
Syringes (1-5 cc, 2-10 cc, or sizes necessary to administer required medications)	4
Analgesic, non-narcotic, tablets, 325 mg	4
Antihistamine tablets, 25 mg	4
Antihistamine injectable, 50 mg, (single dose ampule or equivalent)	2
Atropine, 0.5 mg, 5 cc (single dose ampule or equivalent)	2
Aspirin tablets, 325 mg	4
Bronchodilator, inhaled (metered dose inhaler or equivalent)	4
Dextrose, 50%/50 cc injectable, (single dose ampule or equivalent)	1
Epinephrine 1:1000, 1 cc, injectable, (single dose ampule or equivalent)	2
Epinephrine 1:10,000, 2 cc, injectable, (single dose ampule or equivalent)	2
Lidocaine, 5 cc, 20 mg/ml, injectable (single dose ampule or equivalent)	2
Nitroglycerin tablets, 0.4 mg	10
Basic instructions for use of the drugs in the kit	1

wide and diseases that occur only in certain geographic regions or threaten the health of people in specific occupations or life styles (45).

Basic Immunizations

Vaccination against diseases in the first category are basic ones that everyone should receive. Although there is not unanimity in the medical community worldwide, these vaccines, in general, include measles, mumps, rubella, diphtheria, pertussis, tetanus, H. influenzae, and polio. Bacille-Calmette-Guerin (BCG) vaccination is also administered in many countries.

Supplemental Immunizations

Vaccinations against diseases in the second category are supplemental vaccinations that should be considered for travelers, depending upon destination and length of stay. The supplemental vaccinations include cholera, hepatitis A and B, Japanese encephalitis, plague, rabies, typhoid, and yellow fever. At the time of this writing, the only mandatory vaccination required by the World Health Organization (WHO) International Health Regulations is for yellow fever, although this could change, or sovereign nations could add requirements depending upon conditions in the future (80). Malaria prophylaxis, although not a true vaccination, should also be considered.

Cholera: Because the vaccine against cholera is not very effective, it was dropped as an International Health Requirement in 1973. However, since cholera epidemics do occur from time to time in various parts of the globe, it should be considered for travelers staying for prolonged periods in such areas. Two new oral vaccines (live and killed) have been developed and are available in some countries (45).

Hepatitis A Virus (HAV): For travelers going to countries with a high prevalence rate, the HAV vaccine (administered at least 4 wk prior to departure) should be considered for prophylaxis. (HAV vaccine is effective in children 2 yr of age or older.) Immune globulin can also be given with the first vaccine dose in the event of emergency travel to a high risk area. Because of the vaccine's short term efficacy, a booster dose should be given 6-24 mo after the first dose (45).

Hepatitis B Virus (HBV): HBV is transmitted by contact with contaminated blood or needles or through sexual contact with infected individuals. Vaccination is particularly advisable for long-term visitors in countries where hepatitis B is endemic or where the safety of the blood supply is questionable. The series should be started at least 6 mo prior to departure.

Japanese Encephalitis: Japanese encephalitis occurs in East Asia. Because it is a serious illness, many children in China, Japan, and other East Asian countries are vaccinated against it. Travelers planning to stay for long periods in any of these countries, particularly away from urban areas, are advised to have the vaccination (45). (Note: The vaccine is ineffective in children less than 1 yr of age.)

Plague: Plague is transmitted to humans by fleas that infest wild rats. Because there is an effective treatment for plague, travelers are usually not vaccinated against this disease. However, for travelers to areas where there is plague or rat infestation, vaccination should be considered.

Rabies: Vaccination for rabies is necessary for travelers who plan to stay for long periods in the rural areas of developing countries. About 40% of rabies patients in developing countries are children 14 yr of age or younger.

Typhoid: In addition to the traditional injectable vaccine, an oral typhoid vaccine (OTV) is now available for adults as well as children 6 yr of age and older. Both are safe and effective. Antibiotics must not be taken at the same time as OTV because they prevent the vaccine from taking effect.

Yellow Fever: Many countries require that a valid certificate of vaccination against yellow fever be carried by travelers who are from endemic regions or who have passed through such regions. A certificate of vaccination against yellow fever is valid for 10 yr from the 10th day after vaccination. The vaccine is contraindicated for those with true allergy to egg protein and for infants 9 mo of age or younger because it may cause encephalitis. Consequently, infants from 4 to 9 mo should not be vaccinated unless they are likely to be at particular risk.

Pregnancy and Vaccination: Live, attenuated virus vaccinations are not usually given during pregnancy or to those likely to become pregnant within 3 mo. However, yellow fever and polio vaccine can be given during pregnancy if there is a substantial risk of infection. When vaccination for yellow fever is needed only to satisfy regulatory requirements, a certificate of exemption should be issued. Vaccinations are best accomplished during the third trimester since there is increased risk of adversely affecting the fetus in the first and second trimesters. There is no evidence of fetal risk from bacterial vaccines or toxoids. For travelers going to regions where unsterile delivery may occur, a complete tetanus toxoid series should be given.

Malaria Prophylaxis

Malaria is caused by the parasitic microorganisms Plasmodium vivax, P. ovale, P. falciparum, and P. malariae, which are transmitted to humans via mosquito (anopheles) bites, usually between sunset and sunrise. Each year, more than 10,000 travelers become ill with malaria after returning to their own countries. With each passing year, the prevention and treatment of malaria becomes more difficult because of the microorganisms' increasing resistance to conventional antimalarial drugs. Although there is no vaccine against malaria, antimalarial drugs such as chloroquine, proguanil, doxycycline, and mefloquine can be used for prophylaxis.

Malaria during pregnancy poses great danger to the mother and fetus, as the baby may be deformed or stillborn. Therefore, pregnant women should not travel to malarial regions if it can be avoided. Likewise, because malaria can be particularly serious in a baby or child, it is also advisable not to take them to malarial regions.

Unfortunately, malaria prophylaxis presents a clini-

TABLE III. CARDIOVASCULAR INDICATIONS FOR MEDICAL OXYGEN DURING COMMERCIAL AIRLINE FLIGHTS.

1. Use of oxygen at baseline altitude
2. CHF NYHA class III–IV or baseline PaO_2 less than 70 mm Hg (17)
3. Angina CCS class III–IV (14)
4. Cyanotic congenital heart disease
5. Primary pulmonary hypertension
6. Other cardiovascular diseases associated with known baseline hypoxemia

cal dilemma because some of the agents are contraindicated in pregnancy. Hence, this is another reason why travel to areas where malaria, particularly resistant P. falciparum, has been reported is not advisable during pregnancy. Pregnant women who anticipate travel to areas in which malaria prophylaxis is advised should consult their physician for the latest information. Besides prophlaxis, barrier measures such as use of clothing to reduce skin exposure, avoidance of mosquito feeding periods at dawn and dusk, and use of insect repellents and mosquito netting for sleep are highly recommended. (These preventive measures are advisable for any individuals traveling to a malarial area.)

Physicians giving advice to travelers should have an understanding of the available vaccinations as well as the health risks at the destination. For further information, physicians should contact their national center for disease control or travel clinic.

The Centers for Disease Control and Prevention of the U.S. Public Health Service offers travel information by telephone, 404-498-1600. Further information may be available from the following travel medical organizations:

1.) Centers for Disease Control and Prevention: www.CDC.gov/travel

2.) Travel Health Online: www.tripprep.com

Cardiovascular Disease

Hypobaric hypoxia (i.e., hypoxia due to a lowered oxygen pressure at altitude) is a major concern for airline travelers with cardiovascular disease. At a cabin altitude of 8000 ft (2438m), the inspired partial pressure of oxygen is 108 mm Hg (versus 149 mm Hg at sea level). This correlates with an arterial P_{O_2} (P_{aO_2}) of 50-60 mm Hg in people with normal baseline P_{aO_2} (8,39). Cardiac patients compensate to some extent for inflight hypoxia by increasing minute ventilation, mainly by increasing tidal volume. The primary cardiac response to hypoxia is mild tachycardia, which results in increased myocardial oxygen demand (39). In patients with limited cardiac reserve, the decreased oxygen supply at altitude and resultant tachycardia may result in symptoms and cardiac decompensation. Consequently, in some cases, medical oxygen may be required (**Table III**).

Despite these physiologic changes at altitude, most patients with angina pectoris can travel safely as long as they are cautioned to carry their medications. The managing physician must be mindful that the excitement and stress of air travel can precipitate symptoms in individuals with limited reserve. Unstable angina is a clear contraindication to flight.

Patients with recent uncomplicated myocardial infarction (MI) should not fly until at least 2-3 wk have passed and they are back to usual daily activities (although some airlines will allow travel earlier). A symptom-limited treadmill test at 10-14 d after MI for prognosis and functional capacity is recommended by the Task Force on Practice Guidelines of the American College of Cardiology/American Heart Association (66). The data obtained by stress testing these patients prior to flight is invaluable in estimating their ability to tolerate air travel. The absence of residual ischemia or symptoms on maximal testing is reassuring and probably more helpful than arbitrary time restrictions. Patients with complicated MIs or with limited ambulation should wait longer, at least until they are medically stable on their recommended treatment regimen. Patients with old MIs, in general, should not have a problem with commercial airline flight unless there is significant angina or left ventricular dysfunction.

Severe decompensated congestive heart failure (CHF) is a contraindication to air travel. However, in stable CHF, inflight medical oxygen is advisable for patients with New York Heart Association (NYHA) class III-IV CHF or baseline P_{aO_2} less than 70 mm Hg (17).

Coronary artery bypass grafting (CABG) and other chest surgeries should pose no intrinsic risk as long as the patient has fully recovered without complications. However, because air is transiently introduced into the chest cavity, there is a risk for barotrauma at decreased atmospheric pressure (at 8000 ft, trapped gas will expand 25%). Consequently, patients should wait until the air is resorbed (about 10-14 d) before air travel. Clinical evaluation prior to air travel is important to ensure a stable postoperative course and to rule out CHF, serious arrhythmia, or residual ischemia.

Patients with uncomplicated percutaneous coronary interventions (PCI), such as angioplasty or stent placement, are at low risk to travel by commercial airline once they are medically stable and back to usual daily activities. If PCI was complicated or if pre-PCI clinical status was tenuous, reevaluation should be done prior to airline travel. In these instances it is advisable to wait 1-2 wk before flying.

Symptomatic valvular heart disease is a relative contraindication to routine airline flight. Physicians should clinically assess patients, paying particular attention to functional status, severity of symptoms, left ventricular ejection fraction, and presence or absence of pulmonary hypertension to judge suitability for air travel. Medical oxygen should be prescribed if there is baseline hypoxemia. Similar clinical concerns apply to patients with complex congenital heart disease.

There is no contraindication to air travel for patients with hypertension as long as it is under reasonable control. Such patients should be reminded to carry their medications onboard.

Patients with pacemakers and implantable cardioverter defibrillators are at low risk for travel by commercial airline once they are medically stable. Interac-

TABLE IV. CARDIOVASCULAR CONTRAINDICATIONS TO COMMERCIAL AIRLINE FLIGHT.

1. Uncomplicated myocardial infarction within 2–3 weeks
2. Complicated myocardial infarction within 6 weeks
3. Unstable angina
4. Congestive heart failure, severe, decompensated
5. Uncontrolled hypertension
6. CABG within 10–14 days
7. CVA within 2 weeks
8. Uncontrolled ventricular or supraventricular tachycardia
9. Eisenmenger syndrome
10. Severe symptomatic valvular heart disease

tion with airline electronics or airport security devices is highly unlikely for the most common bipolar configuration (72), although there is the theoretical possibility of electromagnetic interference with unipolar pacemakers. If there is a question about a particular model, the personal physician should consult a representative from the pacemaker company.

Cardiovascular contraindications for commercial airline flights are listed in **Table IV**. These are only guidelines and must be tempered by clinical judgment, as well as by the length of the trip.

Lastly, the United States Federal Aviation Administration has mandated that all commercial aircraft with at least one flight attendant carry automated external defibrillators by 2004 (31). Although this may lead to lives saved within the flying public, it should not be construed as a safety net for borderline patients.

The following are some specific travel recommendations for cardiovascular patients:

1. Assure sufficient quantities of cardiac medications for the entire trip, including sublingual nitroglycerin, and keep in carry-on luggage.
2. Keep a separate list of medications including dosing intervals and tablet size in the event that medications are lost.
3. Adjust dosing intervals in order to maintain dosing frequency if crossing time zones.
4. Carry a copy of the most recent ECG.
5. Carry a pacemaker card, if a pacemaker patient; ECGs should be done with and without a magnet.
6. Contact the airline concerning special needs, e.g., diet, medical oxygen, wheelchair, etc., and consider special seat requests such as near the front or close to a restroom.
7. Limit unnecessary ambulation, particularly inflight. Consider curbside baggage check-in and arranging for a wheelchair or electric cart for in-airport transportation. Assure adequate time between connections.
8. Consider inflight medical oxygen if the patient has Canadian Cardiovascular Society class III-IV angina or baseline hypoxemia (14).

Deep Vein Thrombosis

Deep vein thrombosis (DVT) is a condition in which a thrombus develops in the deep veins, usually of the leg. The condition itself is not dangerous, but the complication of pulmonary embolism or venous thromboembolism (VTE) can be life threatening.

The term "economy class syndrome" was first used by Symington and Stack in 1977, and again by Cruickshank et al. in 1988 (18). This description erroneously implies that DVT does not occur in business or first class air travelers, or in travelers using other forms of long-distance travel, or indeed in non-travelers. The term "traveler's thrombosis" is more appropriate. At least 200 cases of traveler's thrombosis world-wide have been reported in the last decade (5).

It is known that up to 20% of the total population may have some degree of increased clotting tendency. The traveling public is drawn from the general population and because of preexisting risk factors, it follows that some air travelers are at risk of developing DVT when, or soon after, traveling. However, there have been no epidemiological studies published which show a statistically significant increase in cases of DVT when traveling in the absence of preexisting risk factors.

Factors which increase the likelihood of DVT include the following:

- reduction in blood flow;
- changes in blood viscosity;
- damage or abnormality in the vessel wall.

These factors were first described by Professor Virchow and, consequently, are known as Virchow's triad.

In the absence of any good prospective published study, the evidence linking DVT or VTE with flying is circumstantial. Whether DVTs and VTEs that occur in association with airline travel simply result from prolonged immobility in an individual with predisposing risk factors, or whether there is a causal or contributory relationship with the aircraft cabin environment is not known.

Risk factors for the development of DVT include the following:

- blood disorders affecting clotting tendency;
- impairment of blood clotting mechanism, such as clotting factor abnormality;
- cardiovascular disease;
- current or history of malignancy;
- recent major surgery;
- recent trauma to lower limbs or abdomen;
- personal or family history of DVT;
- pregnancy;
- estrogen hormone therapy, including oral contraception;
- age above 40 yr;
- prolonged immobilization;
- depletion of body fluids causing increased blood viscosity. (Note that this is not dehydration as a result of dry aircraft cabin air.)

In addition, there may be associations with tobacco smoking, obesity, and varicose veins.

Other theoretical risk factors that have been suggested associating DVT with flying include dehydration, excessive alcohol, poor air quality, circadian dysrhythmia, seasonal shifts, and hypoxia. However, there is little experimental or epidemiological evidence to support any of these theories.

It is unlikely that hypoxia or hypobaric changes are

TABLE V. SUGGESTED DVT PROPHYLAXIS.

Risk Categories		Prophylaxis
Low Risk	Age over 40; obesity; active inflammation; recent minor surgery (within last 3 days)	Advice about mobilization and hydration, ± support tights/non-elasticated long socks
Moderate Risk	Varicose veins; heart failure (uncontrolled); recent myocardial infarction (within 6 weeks); hormone therapy (including oral contraception); polycythemia; pregnancy/postnatal; lower limb paralysis; recent lower limb trauma (within 6 weeks)	Passenger advised to consult own medical practitioner who may recommend the above + aspirin (if no contraindication) ± graduated compression stockings
High Risk	Previous VTE; known thrombophilia; recent major surgery (within 6 weeks); previous CVA; malignancy; family history of VTE	As above, but passenger's medical practitioner may recommend low molecular weight heparin instead of aspirin

themselves etiological factors for VTE, as there is no reported increased incidence of VTE in populations living at high altitudes nor in patients with hypoxic lung disease. There is no evidence of any increased incidence of DVT among commercial airline pilots who spend their working lives sitting in a hypobaric environment.

In the absence of prospective studies conclusively showing a causal relationship between DVT and flying, there is no scientific basis for giving recommendations for the prevention of DVT related specifically to aircraft travel. However, the following recommendations are reasonably based on studies in other environments.

For passengers with no identifiable risk factors, it is recommended that they carry out frequent and regular stretching exercises, particularly of the lower limbs, during flight. They should also take every opportunity to change position and to walk about the cabin. However, the relative risk of injury from being unrestrained during unexpected air turbulence has not been compared with the risk of developing DVT as a result of immobility.

For passengers with one or more identifiable risk factors, the recommendations contained in **Table V** should be followed. Note that advice for travelers at moderate or high risk should be given by the individual's own medical practitioner. (It should also be noted that evidence for the efficacy of acetosalicylic acid in preventing DVT is conflicting.)

Pulmonary Disease

The physician's advice to pulmonary patients who intend to fly depends largely on: 1) the type, reversibility, and functional severity of the pulmonary disorder; 2) the evaluation of altitude tolerance and safety for the patient; and 3) the anticipated altitude and duration of the flight. In patients with significant cardiopulmonary disease, even a small degree of hypoxia may lead to problems correctable by therapeutic oxygen. The main challenge facing the physician is to identify those who will benefit from it.

This can best be done not only by preflight history, physical examination and routine laboratory tests, but also by pulmonary function tests and blood gas determinations. Abnormal lung function (e.g., vital capacity, exhaled flow rates, and diffusing capacity less than 50% of predicted) indicates that lung reserve is compromised and that further assessment and consideration for flight are in order (2). The measurement of arterial blood gas is the single most helpful test because the P_{aO_2} is considered the best predictor of altitude P_{aO_2} and tolerance. A stable ground level P_{aO_2} greater than 70 mm Hg is considered adequate in most cases (16,38), but a lesser P_{aO_2} may be effectively managed with inflight medical oxygen therapy (10,38,78). Elevated arterial P_{CO_2} (hypercapnia) indicates poor pulmonary reserve and increased risk at altitude, even with oxygen therapy.

A more sophisticated test to determine the suitability for flight is the hypoxia altitude simulation test or HAST. This is done by determining the patient's P_{aO_2} while breathing mixed gases simulating the aircraft cabin environment at altitude (85% N_2 and 15% O_2). If the P_{aO_2} is low (<55 mm Hg), medical oxygen must be considered.

The single most practical fitness-to-fly test for a physician is to see whether the patient can walk 50 yards at a normal pace or climb one flight of stairs without becoming severely dyspneic. The physician's judgment should also reflect the altitude of the departure airport, the length of journey, the destination, and history of prior air travel. In some cases, good judgment might dictate postponement of air travel. In others, the use of medical oxygen inflight might be in order. Other simple measures to assist passengers include early unflustered arrival and check-in, provision of wheel chairs, and avoidance of seating in smoking zones.

The majority of inflight medical oxygen requests are for chronic respiratory disorders such as bronchitis, emphysema, bronchiectasis, and pulmonary hypertension. Significant hypoxemia may develop in such patients because they often start with a low P_{aO_2} on the steep part of the oxyhemoglobin dissociation curve (Fig. 1).

Physicians should give particular consideration to patients with the following most common pulmonary conditions who are planning to travel by air (37).

Asthma: Bronchial asthma is the most frequently occurring chronic respiratory disease among the traveling population and will prompt most questions on fitness to travel and precautionary measures. Air travel is contraindicated for those with asthma that is labile, severe, or that has required recent hospitalization. For asthmatics of less severity who are fit to fly, it is imperative that they are reminded to hand-carry on board any vital medication, particularly inhalers for rapid relief of symptoms. All but the mildest asthmatics should probably be advised to take a course of oral steroids with them for use in an emergency during the trip.

Chronic obstructive pulmonary disease (COPD): Patients with chronic bronchitis and emphysema are susceptible to significant inflight hypoxemia, depending on their baseline P_{aO_2} (23). Their capability to hyperventilate and the acute effects of bronchodilators to improve oxygenation are relatively limited due to their disease. Therefore, medical oxygen therapy during flight can be an important adjunct to their safety and comfort (10,38,78). Preflight evaluation of these patients as described above (pulmonary function tests, P_{aO_2}, HAST, and ability to walk and climb stairs) is extremely important.

Bronchiectasis and cystic fibrosis: Control of lung infection and measures to effectively loosen and clear secretions are important aspects of medical care on the ground and during travel. Thus, appropriate antibiotic therapy, adequate hydration, effective cough and medical oxygen therapy are essential for both conditions (57). Children with cystic fibrosis may develop significant oxygen desaturation (less than 90%) during flight (57). Aerosolized enzyme deoxyribonuclease (rhDNase) should be considered for use prior to and possibly during flight to reduce sputum viscosity.

Interstitial lung disease: Patients with interstitial lung disease such as idiopathic pulmonary fibrosis and sarcoidosis can generally tolerate air travel. Although appropriate hypoxia-induced hyperventilation is usually not a problem, medical oxygen may be necessary in those patients with severe disease.

Malignancy: Patients with primary or metastatic malignancies can generally travel safely, although measures may be needed to palliate or relieve related hypoxemia, infection, pleural effusion and pain.

Neuromuscular diseases: Patients with spinal cord injuries, obesity, hypoventilation syndrome, kyphoscoliosis, muscular dystrophy, and other types of neuromuscular disorders have limited ability to hyperventilate and clear secretions. Some patients may require a tracheostomy and/or some form of mechanical ventilator during most or part of the day. These patients may fly, but often require some manual assistance, suctioning or ventilator capabilities, and medical oxygen—issues that must be discussed with the air carrier (4). Remember also that low aircraft humidity can cause excessive drying of the respiratory tree (see special conditions below).

Pulmonary infections: Patients with active or contagious respiratory infections, particularly pulmonary tuberculosis, are unsuitable for air travel (26) until there is documented control of the infection (i.e., negative cultures) and clinical improvement. Patients recovering from other acute bacterial pneumonias must be clinically improved, (i.e., afebrile and clinically stable enough to tolerate air travel). Because patients with respiratory viral infections (e.g., influenza) may infect fellow passengers, they should postpone air travel until cured.

Pneumothorax: The presence and etiology of a pneumothorax, pneumomediastinum, or other marker of extra-alveolar air (e.g., subcutaneous emphysema) must be established and corrected prior to flight. Pneumothorax is an absolute contraindication to air travel (1) since it may expand during flight and possibly progress to a tension pneumothorax (2,36). Hence, if suspected, an end-expiratory chest radiograph should be ordered. Generally, it should be safe to travel by air 2 or 3 wk after successful drainage of a pneumothorax (or uncomplicated thoracic surgery). Some stable patients with a persistent bronchopleural fistula can fly safely with a chest tube using a one-way Heimlich valve assembly. The presence of lung cysts or bullae is usually not a problem as long as the airways communicate with the abnormal air collection. Secretion removal and bronchodilators are useful in this setting.

Pleural effusion: A pleural effusion, especially if large, should be drained at least 14 d prior to flight for both diagnostic and therapeutic reasons. A post-thoracentesis chest radiograph is indicated prior to flight to assess reaccumulation of pleural fluid or the presence of pneumothorax.

Pulmonary vascular diseases: Patients with preexisting pulmonary embolism or pulmonary hypertension are at risk for hypoxia-induced pulmonary vasoconstriction during air travel and the related worsening of pulmonary hypertension with reduced cardiac output (39). Anticoagulation, medical oxygen, and restricted exercise during flight may reduce this risk. The immobilization related to long flights may predispose some patients to thrombophlebitis and pulmonary embolism, especially if other risk factors (e.g., congestive heart failure, prior phlebitis) are present (18). Isometric exercises of the lower extremities and support hose are highly recommended.

Special conditions: Patients with tracheostomy or transtracheal oxygen catheters typically produce increased respiratory secretions on the ground. The low humidity in aircraft cabins tends to exacerbate this problem. Humidification of inspired air (or oxygen), adequate hydration, and suctioning can reverse some of the effects of mucus hypersecretion and dry air. Apparatus such as a suctioning machine or nebulization unit may be used during flight if agreed to by the air carrier. Appropriate electrical power connection (without electrical interference) must be available on the aircraft, although some equipment can operate with leak-proof dry-cell batteries.

Consideration is needed for the growing number of patients on long-term domiciliary oxygen therapy who are now flying. The majority of home oxygen users are on flow rates of only 1 to 2 $L \cdot min^{-1}$ and can be accommodated inflight with flow rates of 4 $L \cdot min^{-1}$. The airline companies usually supply nasal prongs and commonly flow rates are fixed to either 2 or 4 $L \cdot min^{-1}$.

In some pulmonary patients, changes in atmospheric pressure may expand trapped gases within the lung or pleural space, resulting in structural changes that may adversely affect cardiopulmonary function and gas exchange (2). Thus, a chest radiograph is a useful preflight test to exclude pneumothorax, pneumonia, and other acute abnormalities, if suspected. Referral to a subspecialist for further assessment and more specialized testing may be in order for some patients. Above all, clinical judgment and individualized decision making and planning are necessary.

Pregnancy and Air Travel

Maternal and Fetal Considerations

The commercial aircraft environment is not generally considered hazardous to the normal pregnancy and is a much safer and more comfortable mode of transportation during pregnancy when compared to most alternatives (6,7,12,20). At a cabin altitude of 5000–8000 ft (1524–2438 m), the maternal hemoglobin remains 90% saturated even though P_{aO_2} decreases to 64 mm Hg (55). Because of the favorable properties of fetal hemoglobin (HbF), including increased oxygen carrying potential plus increased fetal hematocrit and the Bohr effect, fetal P_{aO_2} changes very little.

Huch studied the fetal physiologic changes inflight at 32-38 gestational wk. Even though maternal cardiovascular changes were noted, there were no differences in fetal beat-to-beat variability, bradycardia, or tachycardia (44). Also, there is no evidence that chronic exposure in either commercial aircraft or living at 10,170 ft (3100 m) causes significant pregnancy-related problems, and some air carriers allow pregnant flight attendants and pilots to fly through the first two trimesters (13,15,22). In the event of sudden decompression, all passengers should use supplemental oxygen. Emergency descent procedures should negate the risk for fetal evolved gas disorder that is possible following prolonged decompression (46,56,63).

With increasing altitude, the pressure volume relationship for gases results in expansion of gas trapped in body cavities. Difficulty in equalizing pressure in the middle ear and sinus cavities most often occurs during descent from altitude. Hyperplasia of tissue in the nasal cavity and pharynx during pregnancy may accentuate this problem. Intestinal gas expansion at altitude could cause additional discomfort in late pregnancy due to abdominal crowding (11). For this reason, it is prudent to avoid gas-producing foods in the days before a scheduled flight.

One study associated preterm rupture of membranes with reduced barometric pressure, but there are no data to associate either premature rupture of membranes or premature labor with commercial flight parameters (61). There has been a single reported case of placental abruption during flight, but because abruption is not a rare event, this single event may well have been coincidental (50).

Because air travel can cause motion sickness, the practitioner should advise the pregnant traveler that the nausea and vomiting that occasionally occur in early pregnancy may be increased during flight (12). Antiemetic medication should be considered for individuals who are already experiencing difficulties. In addition, aircraft often encounter turbulent air, sometimes unexpectedly. Even relatively minor trauma to the abdomen in the third trimester of pregnancy may be associated with placental abruption. Pregnant travelers should be instructed to use their seat belts continuously while seated. The lap belt should be worn snugly over the pelvis or upper thighs, thus reducing the potential for injury of abdominal contents. Inflight ambulation in the cabin late in pregnancy should be done with caution due to changing center of gravity and abdominal prominence.

Because aircraft seating is usually cramped and passengers tend to remain immobile for long periods, there is the risk of lower extremity edema, thrombophlebitis, and deep venous thrombosis. Pregnancy significantly increases this risk due to obstruction of the vena cava from uterine compression, dependent lower extremities, and altered clotting factors. Therefore, it is particularly vital that pregnant flyers ambulate every hour or two. Constricting garments are to be avoided; however, support stockings and comfortable supportive shoes would be helpful. It may also be beneficial to request an aisle seat for easier ingress, egress, and periodic leg stretching. Those late in pregnancy should avoid the seat adjacent to the emergency exits. Pregnant women with prior venous thromboembolism phenomenon or medical conditions that predispose them to venous thrombosis need to discuss anticoagulant therapy with their physician.

Pregnancy-related emergencies are most likely in the first and third trimester. While the aircraft environment may not be causally related to pregnancy emergencies, the aircraft environment limits the ability for a medical response. In addition, diversion to an alternate airport is expensive and disruptive to other passengers. Approximately 15–25% of pregnancies end in spontaneous abortion with a rate of 12% for those less than 20 yr of age to over 25% for those over 40 (20). Additionally, there has been a dramatic increase in the number of ectopic gestations. About 1 in every 80 pregnancies now occurs outside the uterus and each is associated with a 10-fold increased risk of maternal mortality over normal delivery. Therefore, it is advisable that travelers, particularly in the first trimester, not initiate a flight if they are having either bleeding or pain associated with their pregnancy.

About 90% of pregnancies that reach the third trimester deliver after 37 wk gestational age (20). Even though national aviation authorities may have no official policy regarding pregnant pilots or passengers, many airline medical departments allow passengers to fly at their discretion up to 36 wk gestational age. Beyond 36 wk, medical certification by an obstetrician may be required, particularly for long haul, over-water flights. Since the onset of labor is difficult to predict, even when the cervix is unfavorable, caution is advised.

Women with multiple pregnancies, a history of preterm delivery, cervical incompetence, bleeding, or increased uterine activity that might result in early delivery should be encouraged to avoid prolonged air travel (27). Individuals with reduced oxygen carrying capacity of the blood, such as anemia, are encouraged to correct the deficit prior to flight. Other conditions that result in reduced placental respiratory reserve may preclude flight or necessitate medical oxygen therapy. These include intrauterine growth retardation, post maturity, preeclampsia, chronic hypertension, or placental infarction. Travelers with complicated pregnancies or conditions requiring medicines should be reminded to take a copy of their prenatal record and enough of their medication to complete the trip.

The practitioner must also consider the medical care available at the destination, endemic illnesses, and the dates for the return flight, if applicable. Certain destinations may present therapeutic dilemmas since the vaccination schedules and/or prophylactic medications needed may not be compatible with pregnancy. In addition, the traveler must consider the implications should a preterm delivery occur at the travel destination. It may be advisable to postpone travel to certain high-risk areas until after the pregnancy. In the event travel to a high-risk area is unavoidable, it may be prudent for the patient to consult with a travel medicine specialist. Patients should also be informed to check with their medical insurance carrier regarding coverage should medical attention or air medical transportation be required enroute or at the intended destination.

Travel With Children

The aircraft environment is generally not a problem for new-borns and children, with only a few exceptions. However, it would be prudent to wait about 1-2 wk after birth to assure that the child is healthy and free of congenital defects or acute respiratory distress syndromes, and that the alveoli have fully expanded.

Infants and toddlers usually have poor eustachian tube function and often have bouts of otitis media that can increase the risk of otalgia during descent. Consequently, it is helpful to have a baby nurse a bottle or breast, or suck a pacifier, in order to open the eustachian tube (older children may drink from a cup). In addition, children with upper respiratory infections and congestion may benefit from a nasal decongestant given 30 min prior to descent. Otitis media is not thought to preclude flight if appropriate antibiotics have been administered for at least 36 h and the eustachian tube is patent (69). Diarrheal disease is common at many international destinations, and children are particularly susceptible to dehydration. Parents taking children to areas where diarrheal illnesses are endemic should travel with prepackaged oral rehydration salts.

Travelers with children should consider endemic medical conditions at the destination and vehicular safety. It should be noted that the greatest risk of severe injury and death of children during travel is due to vehicular injury, and an appropriate car travel seat should be carried on-board or available at the travel destination (6). Immunizations should be current and appropriate for the travel destination, and a plan for appropriate prophylaxis for infectious illnesses should be considered, if indicated.

Ear, Nose, and Throat

Ear

To accommodate for pressure changes experienced during air travel, the passageways for the external and middle ear must be fully patent to allow pressure equalization primarily with descent but also with ascent. The middle ear space can trap gas, which can create pain, bleeding, discharge, or dizziness. Severe cases can cause tympanic membrane rupture or middle ear bleeding. Active conditions such as middle ear infections, effusions, recent procedures (tympanoplasty, mastoidectomy, stapedectomy, endolymphatic shunt, labyrinthectomy, acoustic neuroma removal, nerve section via middle cranial fossa, or other otologic surgery) are contraindications to flight until released by an otolaryngologist.

Some procedures such as ear tube placement or simple myringotomy help ventilate the middle ear and, therefore, are not contraindications to flight as long as no active discharge or obstruction is present.

The key to preventing blockage, hearing loss, tinnitus, pain, tympanic membrane rupture, or dizziness is to equalize the pressure. This is best accomplished in adults with frequent swallowing, chewing or a gentle Valsalva maneuver (holding the nose and generating pressure against a closed mouth and glottis every 30 s until the ears pop). In children, keeping them awake, upright bottle-feeding, pacifier use, eating, or crying all help eustachian tube function. If travel cannot be postponed, then antibiotics, decongestants or even temporary laser office myringotomy may be indicated.

The external auditory canal, if obstructed by nonventilated earplugs, severe cerumen impactions or ear infections, can be painful. This is best prevented by loosening earplugs and sometimes hearing aids and treating external auditory canal wax impactions or ear infections (swimmer's ear) preflight.

Dizziness sometimes occurs during descent following an aggressive Valsalva maneuver. This can be prevented by performing the maneuver gently or by avoiding flying if unable to clear (pop) the ears on the ground due to eustachian tube dysfunction.

Patients with hearing aids are often frustrated by decreased ability to hear in flight due to background noise in the cabin. They should be reassured and advised to turn their hearing aid down, because volume increase merely reduces discrimination.

Nose and Sinuses

Acute or chronic sinusitis, large polyps, recent nasal surgery, recurrent epistaxis and significant upper respiratory tract infections are contraindications to flying because of the risk of obstruction to sinus ostia and prevention of pressure equalization. Flying with these conditions can lead to severe headache, facial pain, orbital or central nervous system (CNS) sinus disease extension, or bleeding. Sometimes broad-spectrum antibiotic therapy, mucolytic agents, oral decongestants, steroids, and temporary use of nasal decongestant spray such as oxymetazoline may shrink the nasal mucosa adequately to provide temporary sinus ventilation and drainage. Nasal saline spray also helps with nasal drying and epistaxis due to low humidity. After landing, any patient with persistent sinus block that has not resolved with decongestant therapy or spray, or whose symptoms worsen within 24-48 h, should see a physician.

Nasal allergy can lead to congestion and obstruction impeding air flow and equalization of pressure. This is best prevented by preflight treatment with antihistamines, topical nasal steroids and, in some cases, immunotherapy.

Throat

Patients who have longstanding tracheotomy, laryngectomy, vocal cord paralysis or other laryngeal dysfunction may need extra moisturization and possibly removal of thickened secretions due to lower humidity inflight. To avoid this problem, extra oral hydration, moisture generator, and suctioning may be considered by the physician.

Following tonsillectomy and adenoidectomy, palatoplasty, or nasal or facial fracture repair, patients can fly once postoperative bleeding risk has passed, after about 2 wk in most cases, and after clearance by an otolaryngologist.

Patients who have undergone facial plastic surgical procedures such as facelift, blepharoplasty, otoplasty, peels, rhinoplasty, implants, or dermabrasion can fly once drains are removed and they are cleared by their surgeon (usually within 1-2 wk).

Surgical Conditions

The safety of air travel following a surgical procedure is becoming an important issue with the increasing frequency of ambulatory surgery. It is not uncommon for a patient to travel by air, have an outpatient surgical procedure performed, and then return to home by plane soon after. Consideration must be given to the optimal timing of a postoperative flight, the assessment of patient stability, and special medical needs, such as pain management and precaution awareness.

General anesthesia, frequently used for ambulatory surgery, is not a contraindication to flying because the cardiac depressant effects and the changes in vascular resistance of anesthetic agents are rapidly reversible following emergence. In addition, the anesthetic gases do not predispose to decompression symptoms because of their low concentration, rapid equilibration, or both. Nitrous oxide at 70% concentration has poor tissue solubility and a short equilibration time (15 min). Halothane, ethrane, and isoflurane are used in low concentrations (1-4%) and rapidly equilibrate, making decompression effects unlikely. However, severe postspinal headache precipitated by airline travel has been reported 7 d after a spinal anesthetic, possibly because of ambient cabin pressure changes inducing a dural leak (75).

It should be kept in mind, however, that postoperative patients are in a state of increased oxygen consumption due to the trauma of surgery, the possible presence of sepsis, and the increased adrenergic outflow. Concurrently, O_2 delivery may be decreased or fixed in patients who are elderly, volume depleted, anemic, or who have cardiopulmonary disease. Consequently, for such patients it may be wise to delay air travel for several days or provide medical O_2 during the flight. It must also be remembered that because of the decreased use of blood transfusions, many postoperative patients today are far more anemic than in the past. Where a hemoglobin of greater than 10.0 g was considered standard for a postoperative patient 10 yr ago, now it is not uncommon to see younger patients with hemoglobins down to 7.0 g and elderly patients with hemoglobins down to 8.0 g.

A potentially dangerous situation is the postoperative elderly patient who is anemic and who has underlying coronary artery disease. This patient is in a physiological state of increased O_2 consumption and has a diminished and possibly fixed state of O_2 delivery. With coronary artery disease and limited vasodilational ability, limited coronary reserve would put this patient at risk (42). If travel is necessary, this patient would benefit from medical O_2 during flight.

Patients who have had a recent pneumonectomy or a pulmonary lobectomy have minimal pulmonary reserve. Of further significance is the fact that the majority of these patients have a long history of smoking with associated chronic obstructive pulmonary disease (COPD). Their narrow margin of pulmonary reserve may not become apparent until flight. Therefore, these patients must be carefully evaluated. If possible, the preflight evaluation should also include a hypoxia altitude simulation test (HAST) (see Pulmonary Disease section). A ground level S_aO_2 of greater than 90% (or a P_aO_2 >70 mm Hg) usually does not require medical O_2 during flight.

It is important to remember that intestinal gas will expand 25% by volume at a cabin altitude of 8000 ft (2438 m). Post-abdominal surgery patients have a relative ileus for several days, thereby putting them at risk for tearing of suture lines, bleeding, and perforation. In addition, stretching gastric or intestinal mucosa may result in hemorrhage from ulcer or suture sites. To be safe, air travel should be discouraged for 1-2 wk after the procedure. (The time could be reduced to 1 wk if the intestinal lumen was not opened.) Likewise, flight would be inadvisable for 24 h following a colonoscopy with a polypectomy procedure because of the large amount of gas still often present in the colon and the risk of unexpected bleeding from the polypectomy site. A patient with an asymptomatic partial small or large bowel obstruction may also be unable to accommodate the gastrointestinal gas expansion during a flight, and should be advised not to travel by air.

Laparoscopic abdominal surgical procedures are less associated with ileus than open procedures and are not as restrictive. Flight can occur the next day if bloating symptoms are absent. The residual CO_2 gas in the intraabdominal cavity following a laparoscopic procedure is rapidly diffused into the tissues and is not a factor.

Travelers with colostomies are not at increased risk during air travel, although intestinal distention may increase fecal output. Therefore, the use of a large colostomy bag is recommended. If a small bag is utilized frequent changes may be necessary.

Mechanical considerations may play a role in the travel of neurosurgical patients. Gas trapped within the skull will cause increased intracranial pressure when it expands at altitude. A person who has had air or any other gas introduced into the skull by trauma or an open or closed procedure (such as the now infrequently performed pneumoencephalograph) should have reliable evidence—a lateral skull film radiograph or CT scan—that the air or gas has been absorbed. If such information is not available, it is advisable to wait at least 7 d before traveling. Likewise, a person with a cerebrospinal fluid leak from any cause should not fly because of the possibility of backflow and microbial contamination due to the pressure changes within the cabin (52).

Neuropsychiatry

Neurological and psychiatric disorders of particular concern for airline passengers are those that might be suddenly incapacitating, acutely progressive or dementing, or that might involve dangerous or disruptive behavioral manifestations. Physicians who must decide whether patients with such disorders should travel by air should recall their personal experiences with air travel, considering not only flights that went well, but also those that did not. Patients with some neurological or psychiatric disorders become very upset by changes to familiar routines, confusion over procedures, enforced crowding with strangers, or lack of privacy (41). What will be the effect upon a patient of such irritants as parking, luggage transport, long lines, security checks that may involve physical searches, confusing announcements, gate changes, cancelled flights, cramped seating, taxiway delays, turbulence, airsickness, inconvenient or delayed access to toilet facilities, lost luggage, disruption of schedules by weather, aircraft delays or missed connections, and other realities of air travel?

If a question arises about the effects of air travel on any patient, particularly those with known neurological or psychiatric disorders, physicians may wish to assess the mental status of the would-be traveler in a formal manner, or at least to receive an informed opinion about the patient's ability to travel from a knowledgeable family member, friend, or neighbor.

Concerning medication, one axiom to remember is, "Never prescribe a medication for inflight use unless the patient has used it before, is familiar with its primary effects, and has had no undue side effects." An airliner in flight is no place to discover that a patient reacts to a medication with allergic symptoms, severe side effects, or an idiosyncratic response. "Ground test" the medication first.

Keeping these principles in mind, physicians should consider the following specific elements when patients with neurological or psychiatric conditions wish to fly.

Neurological

In general, most patients with epilepsy can fly safely. However, patients with uncontrolled, frequent seizures should be cautioned about air travel including the attendant risk of limited medical care capability inflight. Individuals with seizures sufficiently frequent to cause immediate concern should consider traveling with a companion. Patients with epilepsy should be made aware of the potential seizure threshold-lowering effects of fatigue, delayed meals, hypoxia, and disturbed circadian rhythm if passing through multiple time zones (41,53). In addition, patients with epilepsy need to be cautious about consuming alcohol before or during air travel and should be reminded of the importance of complying with their treatment regimen. Compliance with medication dosage and time schedules should be emphasized and anticonvulsant medication should be readily available in carry-on bags (not only in checked luggage).

Patients who have had a recent cerebral infarction (stroke) or other acute neurological event should be observed until sufficient time has passed to assure stability of the neurological condition. Clearly, the risk of post-event complications, the physical and mental disability, and the decreased capacity to withstand the stresses of flight are cogent reasons not to fly. Once the acute phase of recovery is over and the patient is stable, travel may be reconsidered.

Psychiatric

Persons with psychiatric disorders whose behavior is unpredictable, aggressive, disorganized, disruptive or unsafe should not travel by air. Patients with psychotic disorders who are stabilized on medication and are accompanied by a knowledgeable companion may be able to fly. (Consider notifying the airline if the patient proposes to fly unaccompanied.) Many medications prescribed for psychiatric disorders have anticholinergic effects that may slow digestive processes, causing increased intestinal gas formation. The resulting symptoms may be aggravated by expanding gas volume at altitude.

Physicians should be alert for tendencies toward claustrophobia and phobias about air travel or interpersonal crowding. Increased anxiety may manifest itself in hyperventilation. An anxiolytic medication may be indicated if the patient has used it before with good results and without undue side effects. Anxiety may also be allayed by a calm and clear explanation of its nature, by use of previously learned relaxation techniques, and—in acute stages of hyperventilation—by using an airsick bag as a rebreathing device. When in doubt, prescribe prophylactic medication. Cognitive-behavioral treatment of fear of flying is effective for many people. [This subject has recently been reviewed (48,76)].

Fully detoxify patients diagnosed with drug or alcohol abuse before they travel, in order to avoid inflight withdrawal reactions. Carefully consider the social factors involved when such patients travel alone in an environment where alcohol is easily available, and counsel accordingly.

A person's cognitive abilities may be impaired for many reasons: some acute, some chronic, some progressive, some static. Remember that some patients who function reasonably well during daylight hours in familiar settings (e.g., with early to moderate Alzheimer's disease) may become progressively upset, disoriented and agitated in strange or over-stimulating surroundings, or during the hours of darkness ("sun-downing").

Take a careful history, listening particularly for details of how severely disoriented or disturbed the person has been in the past, and plan for care during travel based on these "worst-case" circumstances. A familiar and reliable companion may be all that is necessary for an uneventful flight, especially if care is taken to complete travel during daylight hours. If prophylactic or p.r.n. medication is provided, be sure that the patient's response to it is already known, for the reasons stated above.

Miscellaneous Conditions

Airsickness

Although airsickness is less common with jets than with propeller-driven aircraft, it may occur, particularly in susceptible individuals. Prevention requires premedication with oral medications such as phenergan with ephedrine, hyocine, dextroamphetamine, or with a transdermal scopolamine patch worn behind the ear. Medications are less effective if symptoms of nausea or vomiting have already started. In addition to medication, the passenger should direct cool ventilated air onto the face and gaze at the horizon to minimize the feeling of imbalance caused by mismatch of sensory input. It is also advisable for susceptible individuals to avoid excess liquids, high fat, spicy or gas-forming foods, and to sit close to the wing. Even small amounts of alcohol can increase sensitivity of the vestibular system. Susceptible individuals should avoid alcohol for 24 h prior to as well as during flight.

Airsickness and vomiting is a particular problem for persons who have had mandibulomaxillary wiring to treat a jaw fracture or after maxillofacial surgery. Because the passenger might have difficulty expelling the vomitus through a wired jaw, there is the possibility of aspiration and its attendant complications. Hence, the patient should be provided with wire cutters in case of such an emergency. (Because of today's security requirements, this must be coordinated with the airline.) In some cases, it would be advisable to have an escort. Another option is to replace the wires prior to flight with rubber bands, which can be easily removed or stretched in the event of vomiting.

Anemia

Although there are many types of anemia, advice to the traveler is similar for all. In general, special consideration should be given to anyone with a hemoglobin below 8.5 $g \cdot dl^{-1}$ because at such low levels, passengers may experience lightheadedness or even lose consciousness during flight, particularly with physical exertion such as going to the lavatory. Although this is the recommended standard for air travel, there may be individual variability depending upon how well compensated the anemia is. For example, a passenger with chronic renal failure may tolerate a lower hemoglobin level at cabin cruising altitude better than someone with a recent hemorrhage. If there is any question about suitability to fly, medical oxygen should be administered.

A particularly severe form of anemia is sickle cell disease, which may be exacerbated by reduced oxygen pressures. Because such a crisis could be life-threatening, such patients should be advised not to travel by air without medical oxygen. Sickle cell trait, on the other hand, has not been associated with problems at normal cruising altitude.

Decompression Illness (DCI)

Scuba diving has become a very popular sport with literally hundreds of thousands of people taking diving vacations. Because most of these divers fly to their destination and return home by air, the relationship between flying and diving must be appreciated.

The issue is the risk of developing DCI if a traveler flies too soon after diving. DCI is caused by excess nitrogen coming out of solution in the form of microbubbles in different tissues. This is facilitated by exposure to low barometric pressure (flying) too soon after exposure to high barometric pressure (diving) and could result in bends (joint/muscle pain), or more serious sequelae such as pulmonary chokes, neurological dysfunction, or neurocirculatory collapse.

In reality, DCI can occur in any diver (even without postdive flying), particularly if dive table recommendations are not adhered to. (These tables describe proper procedures for resurfacing.)

When is it safe to fly after diving? A precise answer is difficult because there are few scientific data on the subject (77). There are, however, some ongoing specific studies at the Hyperbaric Center at Duke University Medical Center. In addition, Divers Alert Network (DAN) has issued the following flying-after-diving guidelines based on the findings of the Undersea and Hyperbaric Medical Society (UHMS) 1991 Conference (3,9,35).

1. Divers making single dives per diving day should have a minimum surface interval of 12 h before ascending to altitude. This includes going to altitude by aircraft, automobile, or any other means.
2. Divers who make multiple dives per day, or over many days, or dives that require obligated decompression stops should take special precautions and wait for an extended surface interval beyond 12 h before ascending to altitude. Extended surface intervals allow for additional denitrogenation and may reduce the likelihood of developing symptoms. For those diving heavily during an extended vacation, it is advisable to take a day off at midweek, or save the last day to buy those last-minute souvenirs before taking to the air.

There can never be a rule that guarantees the prevention of DCI, no matter how long the surface interval. Rather, research has produced guidelines that represent the best estimate for the majority of divers for a conservative, preflight surface interval. There will always be an occasional diver whose physiological makeup or unique diving circumstances will result in DCI despite adherence to general guidelines.

Until there are more data from the ongoing research, these are the best recommendations that physicians can give travelers who plan to dive and fly. In preparing travelers for a diving vacation, the recommendation to leave the last day dive-free should be emphasized.

TABLE VI. INSULIN ADJUSTMENT WHEN TRAVELING EAST ACROSS MULTIPLE TIME ZONES.

Usual Regimen	Day of Departure/Travel (East bound)	First Day at Destination
Multiple injection regimen with pre-meal soluble insulin and overnight intermediate insulin.	Usual premeal soluble insulin. If less than 4 hours between meals this requires a slightly reduced dose of the third soluble injection (by 1/3) and additional carbohydrate (ie. extra large evening snack if one meal missed) and a reduction (1/3) in overnight intermediate insulin to avoid nocturnal hypoglycemia.	Return to usual insulin regimen if you have overcompensated with the reduction of the evening intermediate insulin. Additional soluble insulin (1/3 of usual morning dose) should be considered if fasting blood glucose > 14 mmol · L^{-1} (250 mg · dl^{-1}).

	Day of Departure	First Morning at Destination	10 hr After Morning Dose	Second Day at Destination
Two-dose schedule	Usual morning and evening doses	2/3 usual morning dose	Usual evening dose plus remaining 1/3 of morning dose if blood sugar over 14 mmol · L^{-1} (250 mg · dl^{-1})	Usual two doses
Single-dose schedule	Usual Dose	2/3 usual dose	Remaining 1/3 of morning dose if blood sugar over 14 mmol · L^{-1}	Usual dose

Finally, these guidelines assume that there are no signs and/or symptoms of DCI after the dive and before the flight. If there are, flying is contraindicated before appropriate treatment (recompression) is carried out.

Diabetes

Overseas travel should not pose significant problems for air travelers with well controlled diabetes mellitus. Preplanning is important and a discussion of the itinerary with the diabetic specialist management team plays an important part in the preparation for travel.

It is important that the diabetic carries adequate equipment, e.g., blood-sugar testing sticks, blood glucose meter and insulin supplies, in case these are not available in the area of travel. Those who are being treated with insulin should carry an ample supply in their hand luggage in two different bags, ideally one being carried by a relative or friend in case of loss or theft. The supply of insulin not being used in flight should *not* be packed in checked baggage as this may be exposed to temperatures which may cause the insulin to freeze and denature. There is an additional hazard that luggage may be mislaid en route. Insulin should be carried in hand luggage in a cool bag or precooled vacuum flask. However, it does not require refrigeration during flight. Extremes of temperature and high altitude can disable blood glucose meters and impair the accuracy of blood glucose test strips, so blood monitoring equipment should also be carried in the hand baggage where it will be immediately available for inflight use. The cabin altitude in modern jet aircraft is between 6000 and 8000 ft which should not affect the accuracy of most, if not all, blood glucose meters (32).

Journeys may cross several time zones and depending on the direction of travel, may shorten or lengthen the "regular 24 hour day" which may require an adjustment to insulin regimens. The consequences are most significant for those with Type 1 (insulin-dependent diabetes). For those patients with Type 2 diabetes treated with insulin, the endogenous insulin will provide a suitable buffer and compensate to some degree for deficiencies of an insulin regimen.

The use of short-acting soluble insulin or fast-acting insulin analogues during long flights, most conveniently given by a pen device, is recommended even if this does not form part of the usual insulin regimen (34). This gives the flexibility of allowing the short-acting insulin to be administered regularly with each meal for the duration of the flight period and can be supplemented by intermediate-acting insulin prior to the first night's sleep on arrival at the travel destination. The other advantage of familiarity with the short-acting insulins is their value in minor illness, such as gastroenteritis or upper respiratory infection, as an adjunct to a twice-daily regimen.

It makes sound sense to ascertain in advance the anticipated flight times and the local time of arrival, so that advice can be obtained from a diabetic specialist team on how to modify the individual's regimen.

There are a number of guidelines, but the following principle and examples may be helpful. When traveling East, the travel day will be shortened and if more than 2 h are lost, it may be necessary to take fewer units of intermediate or long acting insulin.

When traveling west, the travel day will be extended and if it is extended for more than 2 h, it may be necessary to supplement with additional injections of soluble insulin or an increased dose of an intermediate acting insulin.

Individuals who normally take insulin once daily before breakfast should be instructed to take their standard dose at the usual time of the day whether travel is east or west (**Tables VI and VII**). Although inflight meals will usually suffice, supplemental snacks may be necessary if meals are delayed. It is often advisable to leave the wristwatch unadjusted during flight so that it shows the time at the point of departure, thus making it simpler to judge the spacing between meals.

On the first morning at the destination (on an eastward flight) just before breakfast (local time), 2/3 of the usual morning dose of insulin should be taken because fewer than 24 h will have elapsed since the previous morning's insulin injection. This adjustment should prevent hypoglycemia as a result of extra activity or disrupted meal schedules.

TABLE VII. INSULIN ADJUSTMENT WHEN TRAVELING WEST ACROSS MULTIPLE TIME ZONES.

Usual regimen	Day of Departure/Travel (West Bound)	First Day at Destination
Multiple injection regimen with pre-meal soluble insulin and overnight intermediate insulin.	Usual premeal soluble insulin. Additional soluble insulin injection with additional meal/snack. Modest reduction (1/3) in overnight intermediate insulin to avoid nocturnal hypoglycemia.	Return to usual insulin regimen. Additional soluble insulin (1/3 of usual morning dose) should be considered if fasting blood glucose > 14 mmol $\cdot$ L^{-1} (250 mg $\cdot$ dl^{-1}).

	Day of Departure	18 hour After Morning Dose	First Morning at Destination
Two-dose schedule	Usual morning and evening doses	1/3 usual dose followed by meal or snack if blood glucose > 14 mmol $\cdot$ L^{-1}	Usual two doses
Single-dose schedule	Usual dose	1/3 usual dose followed by meal or snack if blood glucose > 14 mmol $\cdot$ L^{-1}	Usual dose

On the day of departure, when traveling west across five or more time zones, the diabetic traveler should take the usual doses of insulin before breakfast (Table VII).

During the flight, meals can be eaten according to the airline schedule. Consultation with the cabin crew on the timing of meals may be helpful. It is vital that patients check their blood sugar before meals at 4- to 6-hourly intervals, during the flight. About 18 h after the morning injection of insulin, regardless of whether the patient is still in flight or at the destination, blood glucose should be tested again. If the blood glucose is 14 mmol $\cdot$ L^{-1} (250 mg $\cdot$ dl^{-1}) or less, the individual may safely wait until the first morning at the destination and take the normal insulin dose at the usual time (local time), even though more than 24 h have elapsed. However, if the blood glucose is greater than 14 mmol $\cdot$ L^{-1}, an additional dose of insulin equal to one-third of the usual morning dose should be taken, followed by a meal or a snack. The next morning (local time) the usual dose of insulin should be taken. Individuals who normally take insulin twice daily should be advised to leave their wristwatches set to local time of the departure point during air travel. The normal second dose of insulin should be administered about 10-12 h after the morning dose followed by a meal or a snack (Table VII). From that point on they should follow the same plan as travelers who take one injection daily. Thus approximately 18 h after the first dose of insulin and 6 h after the second, the blood should be tested. If the blood glucose level is above 14 mmol $\cdot$ L^{-1}, an extra dose of insulin equal to one-third of the morning dose should be taken (68).

Some insulin-treated diabetics prefer a seat near a toilet for privacy during insulin injection although with pen devices this may be unnecessary. However, this is a matter of personal preference. Most airlines will try to accommodate such a request if notified well in advance. Many airlines provide "diabetic meals," but these are often designed for those people with Type 2 diabetes and may contain an insufficient amount of carbohydrate for Type 1 diabetics risking incipient hypoglycemia. The "vegetarian meal" choice is often suitable for people with Type 1 diabetes, containing pasta based dishes or rice. Type 1 diabetics should carry additional carbohydrate to cover contingencies such as delayed flights or, indeed, delayed meals (47). They should also consider alerting cabin crew to the fact that they are insulin-using diabetics, and should have readily accessible identification (e.g., medic-alert bracelet) stating this.

Individuals with Type 2 diabetes treated by oral agents should not have the potential problems of those taking insulin. Additional doses of tablets are usually not required to cover an extended day, although the use of a drug such as repaglinide may be valuable to cover an additional meal. A dose of the normal hypoglycemic agent may have to be omitted on a truncated day in the case of a long west-to-east air journey.

Diabetic travelers under reasonable control can fly anywhere safely if they plan adequately in advance and discuss the proposed journey with their diabetic specialist adviser. The wider use of short acting insulin and ease of administration with pen devices has greatly simplified the management of diabetes during intercontinental travel.

Useful web-sites for patient information:
American Diabetes Association: www.diabetes.org
Canadian Diabetes Association: www.diabetes.ca
Diabetes UK website: www.diabetes.org.uk

Jet Lag

The main symptoms associated with jet lag are tiredness, sleeping difficulties, and sleepiness during the day resulting from desynchronization between the individual's internal clock and the external environment. The internal clock controls all body functions (temperature, heart rate, hormone production, sleep, mood, performance, etc.) which vary according to individual circadian cycles (1-d cycles). The internal clock, on the other hand, is controlled by zeitgebers (time-givers), the most significant being light, social contacts and knowledge of clock time. Therefore, when traveling rapidly across time zones, the zeitgebers in the new environment will be sending conflicting messages to the internal clock, resulting in the above symptoms.

Besides zeitgebers, a number of other factors influence the severity of the symptoms. The main ones are: number of time zones crossed, the direction of flight (eastward vs. westward, with westward flight usually easier), the degree of stimulation in the environment, the cumulative sleep loss (quantity and quality), and individual differences (old vs. young, morningness vs. eveningness) (40,54,59,65).

An understanding of zeitgebers and these other factors will help physicians to intervene and minimize the severity of jet lag. To this day there is no miracle treatment, even though there has been and still is significant research on modalities such as bright light (21,79) and melatonin (49,60,70).

For the general traveling public, the idea is to try to adapt as quickly as possible to the new time zone. Since we know that light and social contacts are the most significant zeitgebers, the traveler should get as much exposure as possible to natural light during the day at the new destination as well as interacting with local people. For example, when traveling from North America to Europe, one could get a short rest (2 h is good because it tends to respect the sleep cycle for light vs. deep sleep) and then spend the rest of the day outside if possible.

The so-called "jet lag diet" (28) is only speculative and has no scientific basis. However, we know that smaller meals before and during the flight are better tolerated than larger meals. Also, the use of caffeine and physical activity can be used strategically at the destination to help control daytime sleepiness.

Judicious use of hypnotics helps control sleep loss but does not re-entrain the circadian cycle (24). If necessary, it is advisable to prescribe the lowest effective dose of a short- to medium-acting compound for the initial few days. Alcohol should not be used as a hypnotic because it disturbs sleep patterns and will sometimes provoke sleep apnea.

Exercise has only anecdotal support and probably acts indirectly through the influence of social cues, bright light and beneficial effects on subsequent sleep. Likewise, theories advanced by homeopathy, aromatherapy, and acupressure are only speculative and have no scientific basis.

Finally, the hormone melatonin, secreted at night by the pineal gland, purportedly helps travelers overcome jet lag. Since the first publication of these guidelines in 1996, research and publications on melatonin have continued to appear regularly in the literature. While the hypnotic activity of melatonin is generally accepted, its pure chronobiotic properties are still controversial (67,70,71).

Further, melatonin is still considered a dietary supplement in most countries including the United States and is, therefore, under no specific control. Studies have found nonidentified contaminants or even the absence of the active compound in some products. It would appear safer at this time to use a simple hypnotic like zolpidem or temazepam for which control is well established (71).

As already stated, there is no magic potion to eliminate jet lag, but proper pretravel medical advice given by a well-informed primary care provider can make the difference between a good and a bad trip.

Diarrhea

Traveler's diarrhea is a potential problem for any traveler, particularly those visiting the developing world where endemic disease and poor hygiene standards can facilitate the transmission of infection. Traveler's diarrhea, however, is not a specific disease. The term describes the symptoms of intestinal disturbance caused by infection with certain bacteria, parasites or viruses, transmitted by consumption of contaminated food or water. It can also be due to inflammation as a result of consuming unfamiliar food or drink.

Microorganisms commonly associated with the development of traveler's diarrhea include campylobacter jejeuni, salmonella, shigella, giardia lamblia, and parasitic amoebae.

The first line of defence is the prevention or treatment of fluid and electrolyte depletion, particularly in infants and the frail and elderly. Oral rehydration solutions enhance the absorption of water and electrolytes and replace the electrolyte deficit adequately and safely. They contain an alkalinizing agent to counter acidosis, and are slightly hypoosmolar (about 250 $\text{mmol} \cdot \text{L}^{-1}$) to prevent the possible induction of osmotic diarrhea. The World Health Organization (WHO) recommends a specific formula for this solution, to be used flexibly by giving extra water between drinks of oral rehydration solution. Commercially available rehydration solutions used in the developed world are lower in sodium than the WHO formulation (73). The adult dose is normally 200-400 ml of solution after every loose bowel movement.

Antimotility drugs relieve symptoms of acute diarrhea, but fluid and electrolyte replacement are of primary importance. Loperamide can be used as an adjunct to rehydration in acute diarrhea in adults and children over 4 yr. The dose is 4 mg initially, followed by 2 mg after each loose stool for up to 5 d, with a daily maximum of 16 mg (half the dose in children) (73).

Antibacterial drugs are generally unnecessary in simple gastroenteritis, even when a bacterial cause is suspected, because the symptoms will usually resolve quickly without such treatment. Ciprofloxacin is active against both Gram-positive and Gram-negative bacteria, including salmonella, shigella, campylobacter, neisseria and pseudomonas. The usual adult dose is 500-750 mg twice daily. Ciprofloxacin is occasionally used as prophylaxis against traveler's diarrhea, but routine use is not recommended because of the risk of developing bacterial resistance (73).

Diarrhea sufficiently severe to interfere with work or normal activity must be reported to the port health authority or to the public health service nearest to the airport of arrival.

Fractures

For safety reasons, passengers with full-length above-knee casts are required by some airlines to travel by stretcher. Otherwise, airlines require the purchase of an extra seat or seats, or alternatively to fly business or first class. Because air might be trapped beneath the cast, it is advisable for casts applied within 24-48 h to be bivalved to avoid harmful swelling, particularly on long flights. (For further information see http://www.britishairways.com/health.) Likewise, if a pneumatic splint is used, some air should be released to allow for gas expansion at altitude, which could otherwise cause discomfort as well as circulatory embarrassment or neuropraxia. (Some airlines will not allow the use of pneumatic splints in flight.)

Ophthalmological Conditions

The few conditions relevant to the eye and airline travel relate to the dry condition of the cabin atmosphere and potential problems in postoperative eye care in which there may be air left inside the eye, as in some forms of retinal detachment surgery. Contact lens wearers often find the dry cabin air difficult, as there may be insufficient tears to keep the lenses lubricated. Eye conditions that are inherently dry, such as keratoconjunctivitis sicca, should not preclude air travel, because supplementary tears can be used. The patient who has just had cataract surgery and a lens implant with sutureless surgery should avoid rubbing the eye if the air becomes dry, as wound leakage might result.

Ophthalmological procedures for retinal detachment involve the intraocular injection of gas to temporarily increase intraocular pressure (62). Until this intraocular bubble decreases to less than 30% of the volume of the vitreous, flight is contraindicated. This is approximately 2 wk if sulfur hexafluoride is used and 6 wk if perfluoropropane is used.

Minimizing the risk of trauma to the eye by minimizing movement in the cabin and keeping the seat belt fastened at all times when seated is advisable after any ophthalmological surgical procedure. The passenger who becomes easily airsick should not travel immediately after intraocular eye surgery, since the straining associated with retching and vomiting might rupture a wound.

Passengers needing eye drops for ocular conditions such as glaucoma should schedule their drops as usual. Any passengers with conjunctivitis should be in the noninfectious stage of recovery before flying, but should continue their antibiotic drops as directed.

Passengers with severely limited vision may need special assistance boarding and deplaning, and should be seated close to, but not at an emergency exit. Traveling with a companion or attendant should be considered.

Patients with glaucoma can travel safely as long as they take their medication as directed and are under reasonable control. In an unpublished study, it was found that the intraocular pressure of normal subjects increased very little with high altitude exposure.

Radiation

The Earth is continuously bombarded from space by radioactive particulates and photons originating from the Sun or other stars. The Earth's atmosphere serves as a highly effective radiation shield, but cosmic radiation exposures can increase with altitude and duration of exposure. This has particular relevance for supersonic flights which operate at higher altitudes (29).

It is unlikely that a passenger would sustain higher cosmic radiation exposures than commercial pilots or aircrew. Studies of commercial pilots and aircrew exposure to cosmic radiation do not indicate excessive radiation doses compared to occupational radiation limits in industry (74). Expectant mothers should not be considered to be at increased risk unless they are flying several times a week during their pregnancy. Radiation exposures are reduced by flying shorter flights at low latitudes.

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Medical Guidelines for Airline Travel, 2nd edition

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