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Are You Fit to Fly? Medica Fitness for Air Travel

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Abstract

All flights impose preflight, inflight and postflight stresses; most of them are well tolerated by healthy passengers. However, reduced barometric pressure with concomitant decrease in partial pressure of oxygen in the aircraft environment make it a hostile place for passengers with even minor cardiac, respiratory, psychological, neurological, and gastrointestinal diseases. Other problems like deep vein thrombosis (DVT), jet lag, airsickness, decompression sickness, and fear of flying cannot be ignored. Spread of highly infectious and communicable diseases amongst passengers in closed confines of the aircraft cabin, is a major concern today. Every airline in the world has capability to render inflight medical care with onboard availability of first-aid and physician's kits, oxygen, and trained cabin crew. Today, most of the airlines have automated external defibrillators (AED) installed onboard for cardiac emergencies, few also have telemedicine links with physician's on ground. In conclusion, a trivial medical condition, if overlooked, may become a serious medical issue at 1828 meters to 2440 meters (6000 feet to 8000 feet) in the confines of an aircraft cabin.

Introduction

Our fascination with the misadventures of travel dates back to the dawn of recorded history. Homer's epic tale of the 10-year wanderings, and Odysseus returning home to Ithaca after the fall of Troy, remains the classic account of journey-related hazards. By contrast, modern air travel is remarkably safe and the space-age technology has made it increasingly feasible to fly thousands of passengers across the globe, in the shortest possible time.

Most passengers feel that getting on a plane is no different than getting on a bus having no knowledge or regard for physiology and safe passage. They have little appreciation (as do aviation medicine physicians) of potentially adverse effects of flight other than the recently publicized economy-class syndrome. It is curious, the number of people who have no health problems when the ticket is purchased, but who ask for a wheelchair for the 500 m (1640 ft) walk to the airplane "in case I get angina or breathless". Nearly 2 billion people travel by air each year; the vast majority experience no ill effects from their journeys. Today a large number of patients, passengers with minor ailments, and the elderly travel by air each day, not being aware of the potential interaction of their illness with the environmental and physiological stresses of flight[1,2].

Infections can be spread through contaminated food[3,4,5], and by insects that enter airplanes during layovers in areas of endemic disease resulting in the spread of streptococci, meningococci, tubercular bacilli[6,7], the Ebola virus, and even diseases such as malaria. Most recently, the Corona virus that produces severe acute respiratory syndrome (SARS) by direct person-to-person contact through large or small droplets created a near pandemic situation for air travelers.

In recent years, there have been increasing complaints from passengers that the cabin air quality in commercial aircraft is deficient. Myriad complaints such as headache, fatigue, fever, abdominal discomfort, dizziness, nausea, and respiratory complaints have been registered by passengers on long flights. The issue here is whether these symptoms are really due to cabin air quality or other factors such as lowered barometric pressure, hypoxia, low humidity and circadian dysynchrony.

Cabin air is actually the outside air that is compressed, cooled, and then bled into the cabin at appropriate pressure, temperature, and ventilation rates. Older or last-generation aircrafts cyclically offloaded 100% of cabin air replacing it with outside cooled air. However, in the newer generation aircrafts 50% of the cabin air is cyclically offloaded with the other 50% recirculated in the cabin[8]. Apparently, this recirculated air is passed through the high-efficiency particulate air filter (HEPA) which is 99.7% efficient in removing airborne particles more than 0.3µ in size[9]. This effectively removes not only respiratory particulates, but also bacteria and fungi which are more than 1µ in size.

The message is clear that modern airplane odysseys are safe, and only occasionally do microbes create unexpected turbulence. These infective droplets act like a microscopic hot-air balloon, which can drift to a soft landing on the moist

landscape of the oxygen-rich human alveoli, which provides favorable conditions for replication of this strict aerobe.

As further protection of the passengers, the airflow into the cabin is laminar, with inlet ports near the ceiling and outlet ports on the floor of each row[8]. Therefore, air entering the cabin is not widely dispersed but rather confined to a single row or adjacent rows only. As such, any harmful particulate entering the cabin through cabin air is restricted to a few rows only. Other cabin air contaminants are volatile organic compounds, carbon monoxide (CO), carbon dioxide (CO_2), and ozone (O_3)[8], but their relative quantity is so low that they really do not cause any harmful effects.

Cabin Environment

A commercial aircraft operates at an altitude of 6500 meters to 13,500 meters (21,255 ft to 44,145 ft) above sea level. At these altitudes the outside temperature is -40 ºC to -50 ºC (-107.88 ºF to -134.85 ºF), barometric pressures 140 mm Hg to 110 mm Hg as compared to 760 mm Hg at sea level and humidity <20%. As such, it is not possible to survive without 100% oxygen at these altitudes.

The aircraft cabin would be a perfectly safe environment, if it reproduced barometric pressure, molecular oxygen concentration, ambient temperature, and humidity equal to sea level conditions. The aircraft design however, is a compromise between weight, expense, speed, convenience, and ease of manufacture. The compressors required to produce sea-level cabin pressure at operating altitudes would be too heavy and fuel-consuming, and the water needed to return sea-level relative humidity to the cabin air would be unfeasible heavy.

As the aircraft ascends, air from outside is taken in, compressed, heated, and forced into the cabin under pressure. The pressure within the cabin is then automatically controlled by regulatory outflow valves, thus overcoming most physiological problems encountered at that altitude[10]. The air that is sucked into the aircraft for pressurization is devoid of moisture[10].

In a pressurized cabin at 2440 meters (8000 feet) the barometric pressure falls to 565 mm Hg and partial pressure of oxygen (PaO_2) to 55 mm Hg[11]. This results in blood oxygen saturation of 90%, exposing the aircraft occupant to mild hypoxia. Most healthy passengers can compensate this hypoxia, but it may not be true for passengers with preclinical cardiac, respiratory, and cerebrovascular conditions or blood diseases such as anaemia.

Flight Stresses

All flights impose preflight, inflight and postflight stresses on traveling passengers; however, most of these are well tolerated by healthy passengers.

Preflight Stresses. Preflight stresses begin at home. Packing suitcases, accounting for all travel related documents, daily-use medicines, food for accompanying children, added to the fear of flying in a metallic tube at 10,670 meters (35,000 ft) can be quite unsettling. The airport environment may be bustling, unfamiliar, and complex for some travelers. Carrying baggage, walking long distances, traveling with children, and enduring lengthy security and, immigration processes can surely increase already high stress levels[12]. Lack of information, language barriers, flight cancellations, and departure delays add to these stresses.

It is impractical and unnecessary to screen large numbers of patients before air travel. However, patients with severe chronic obstructive pulmonary disease (COPD), asthma, or interstitial lung disease, and those with a history of air travel intolerance are among those who should be screened. Patients recently admitted to hospital because of deterioration in their respiratory condition, and those already receiving supplementary oxygen, should also be assessed[12].

A thorough preflight medical evaluation is also of paramount importance for passengers with any cardiac disease, angina, anemia, asthma, diabetes, convulsions, psychiatric problem, middle ear and upper respiratory infections, pregnancy, recent surgeries, treated fracture, dental treatment, eye infection or injury, any infectious or contagious disease, and post diagnostic and investigative procedures[12]. As a rule, an individual with any unstable medical condition affected by hypoxia and pressure changes should not fly. A simple useful test is to walk 50 meters (163 ft) or climb a flight of stairs without breathlessness and angina[13].

Passengers suffering from preexisting medical condition must travel with all medications required for their entire trip in their carry on baggage. A list should be kept separately (in a wallet or purse) of medications they are taking in case the medications in the carry on baggage are lost. All passengers with a history of any cardiac disease must carry their medical report with the most recent electrocardiogram (ECG) and carry the pacemaker card if they have one[12]. They must contact the airline for special dietary needs, oxygen, wheel chairs or to request a seat near the lavatories. Keeping the distances between the arrival and departure gates in mind, these passengers must make a prior arrangement with airline for electric carts for in-airport transportation. Avoiding carbonated drinks and heavy meals before boarding the flight is a healthy habit.

It is always better to inform the airline about the medical problems, obtain the medical certificate from the treating doctor and, if required, use the prescribed medical information form (MEDIF) of the respective airline to avoid any inconvenience at the time of travel.

Inflight Stresses. Besides noise, vibrations, turbulence, low humidity, effect of gravitational forces, disorientation, cosmic radiations[14] and much-publicized economy-class syndrome, two most important effects of high altitude producing in-flight stresses on the human body are hypoxia and low barometric pressure.

Hypoxia is produced due to exponential decrease in partial pressure of oxygen with increase in altitude. Oxygen being one of the most important gases for living beings has a concentration of 21%, which remains constant up to an altitude of 100,000 meters (327,000 ft). Passengers with anemia or preexisting coronary, pulmonary and cerebrovascular diseases may have reduced PaO_2 levels on ground and are likely to require oxygen while flying. Further reduction aboard the aircraft will bring them to the steep part of the oxyhemoglobin dissociation curve, resulting in exacerbation of their symptoms, due to hypoxia[12]. Smoking and alcohol accentuate effects of hypoxia in an otherwise

healthy passenger. Most airlines have banned smoking on flights and this has resulted in improved cabin oxygen concentration, air quality, and passenger comfort[12].

Lowered barometric pressures at higher altitudes, causes expansion of gases in body cavities to as much as 25%[8]. During ascent, air trapped in the middle ear, nasal sinuses, gastrointestinal tract, or any other body cavity, expands. This air must be passively ventilated and equalized. If it fails to do so, it causes severe pain in the paranasal sinuses in passengers suffering from sinusitis, "popping" sensation in the ear, pain in filled dental cavities or after root canal treatment, aerodontalgia, and abdominal discomfort[8]. Expansion of gases can also pose problems in patients who have recently undergone surgical operations, diagnostic or investigative procedures where gas was introduced in the abdominal cavity, or those suffering from pneumothorax or haemo-pneumothorax.

During descent, the air tries to equalize pressure between the atmosphere outside and pressure inside the body cavity. If descent continues without equilibration of pressures, it results in symptoms like acute pain and fullness in the ears with decreased hearing acuity, vertigo and even rupture of the tympanic membrane[8], especially with history of concurrent upper respiratory tract infection. This barotrauma can be prevented by ventilating the middle ear by jaw movements, yawning, chewing, swallowing, or performing the Valsalva maneuver[8]. Children who are sleeping during descent are more likely to complain of severe pain on landing or later, which can be avoided by nursing or feeding during descent. Use of nasal spray or drops can also help equalize the pressure by opening the eustachian tubes.

The cabin air has low relative humidity ranging from 10 to 20%[12]. The only moisture it contains is from expired air and evaporation from human skin leading to dryness of airway passages, cornea, and skin. During the flight, it is advisable to maintain good hydration with plenty of water and juices. Spectacles are preferred to contact lenses to avoid problems of corneal dryness. Coffee and alcohol cause dehydration and should be avoided.

Specific Medical Conditions

Cardiovascular Diseases. Cardiac patients compensate the mild hypoxia by increase in minute ventilation and mild tachycardia. The resultant increase in myocardial oxygen demand with reduced oxygen supply at altitude can result in symptoms and cardiac decompensation. Medical oxygen may be required in these cases[12]. Cardiovascular contraindications to commercial airline travel are listed below[12]:

1. Uncomplicated myocardial infarction within 2 to 3 weeks
2. Complicated myocardial infarction within 6 weeks
3. Unstable angina
4. Severe or decompensated Congestive heart failure,
5. Uncontrolled hypertension
6. Coronary artery bypass grafting within 10-14 days
7. Cerebrovascular accident (CVA) within 2 weeks
8. Uncontrolled ventricular or supraventricular tachycardia
9. Eisenmenger syndrome
10. Severe symptomatic valvular heart disease

Pulmonary Diseases. Assessing the patient's requirement for oxygen during the journey is important in patients suffering from pulmonary diseases. Arterial blood gas analysis is a very good indicator to predict PaO_2 onboard and the need for oxygen. PaO_2 of 70 mm Hg or greater is safe for flight, below which inflight oxygen may be required[15]. The Hypoxia Altitude Simulation Test (HAST) is a sophisticated test that simulates aircraft cabin environment, and PaO_2 is determined while breathing mixed gases. If PaO_2 is less than 55 mm Hg, oxygen will be required[13]. A practical test for exercise tolerance is useful to decide fitness to fly. A patient will tolerate flight well if he is able to walk 50 meters (163 ft) at normal pace or climb one flight of stairs without suffering severe dyspnea[13].

Pneumothorax is an absolute contraindication to air travel[8]. Conditions like asthma, COPD, interstitial lung disease, bronchiectasis, pulmonary infections, and malignancy may be allowed to fly if the disease is under control and must be considered for oxygen during the journey[12].

Anemia. Hemoglobin below 8.5 gm% can cause lightheadedness or unconsciousness in flight, especially on exertion. However, the cause and chronicity of the anemia as well as the duration of flight are important, since compensated conditions such as chronic renal failure (CRF) may tolerate flight even with low hemoglobin levels. Sickle cell disease may present serious problems of sickling crisis on exposure to hypoxia, unless provided medical oxygen[12]. Sickle cell trait however, is safe for flight.

Airsickness. This problem is more common with turbo propeller aircraft than modern jet aircraft. Using airsickness preventive medications before a flight, directing the cool-air towards the face, focusing eyes on the horizon, avoiding fatty gas-producing food, and sitting close to the aircraft wings can ease airsickness in susceptible passengers[12]. Alcohol should be avoided because it produces dehydration and increases the sensitivity of the vestibular system, thus increasing airsickness possibilities.

Decompression Sickness. Decompression sickness after scuba diving needs a special mention because a large number of passengers fly to their destination and return home soon after diving. The risk of decompression sickness looms large for travelers who fly too soon after diving. Nitrogen comes out of solution in the form of microbubbles in different tissues, especially joints[8]. This is due to exposure to low atmospheric pressure while flying, after high atmospheric pressure while diving. This leads to bends in the joints, muscles pain, pulmonary chokes, neurological dysfunction, and neurocirculatory collapse. It is advisable to avoid flying for atleast 24 h after diving[8].

Diabetes. Passengers with controlled diabetes mellitus normally do not pose major problems while flying. It is very important for them to carry their medications, especially insulin or oral hypoglycemic medications along with blood sugar testing kits in their hand baggage. It is suggested that before taking a long flight passengers consult their primary physicians to work out the details of insulin injections. It is

always helpful to check with cabin crew about the meal timings so that one can take medications at a suitable time. Diabetic meals are also available on most airlines, but a prior arrangement is required. Wider use of short-acting insulin and its administration with pen devices has greatly eased the management of insulin dependent diabetics traveling on long flights.

Deep Vein Thrombosis. Much has been written about the economy-class syndrome or cattle-class syndrome. Deep vein thrombosis (DVT) is a condition where a thrombus develops in the deep veins of the legs caused by three main factors: an endothelial lesion, venous stasis and hypercoagulability. Reduced leg space, small cramped seats, immobility for prolonged periods, and reduced opportunity to stretch and walk about in the cabin are contributing factors. This implies that DVT does not occur in first-class or business-class, but that is not true. Any form of travel where there is inactivity of the legs can lead to DVT, as such the appropriate term could be Travelers Thrombosis[12].

It is not the DVT which is dangerous, but the phenomenon of venous thromboembolism, which is life threatening. Passengers with circulatory or clotting disorders, obesity, recent surgery, pregnancy, varicose veins, smokers over 40 years of age, and female passengers taking oral contraceptives or hormone replacement therapy (HRT) are more prone to DVT[12]. Low humidity and atmospheric pressure in the aircraft cabin, dehydration contributed by excessive alcoholic drinks, and coffee are augmenters.

Frequent movement of the toes and feet while seated, stretching or periodic walking, along with intake of good hydration improve circulation and are highly recommended, as are wear loose clothing and avoid crossing ones legs for long period. Sleeping pills should be avoided on flight because they increase immobility. Some doctors recommend taking aspirin before traveling because of its blood thinning effects, but its role is questionable[12]. Passengers who have one or more of the risk factors mentioned above should seek medical advice before traveling. Anyone who develops swelling or pain in a leg or experiences breathing problems after a flight, must seek medical advice urgently.

Neurological Conditions. Patients with recent cerebral infarction or other acute neurological event should be allowed to fly only after the acute stage[12]. Epileptics may be slightly more prone to epileptic episodes in the air, more because of fatigue, the stress of flight, delayed meals and so on than hypoxia per se. Patients should be cautious about their alcohol intake and must continue regular medication (even inflight) carried in readily available hand baggage. Patients with closed head injuries and brain tumors usually tolerate air travel, but may need an escort[12].

Surgical Conditions. General anesthesia is not a contraindication to flying because cardiac depressant effects and changes in the vascular resistance of the anesthetic agents are rapidly reversible. Nitrous oxide, halothane, ethrane and isoflurane are used in low concentration and are rapidly equilibrated making decompression unlikely. A dural leak produced by low cabin pressure may be the cause of severe postspinal headache in some patient. It must be stressed that most post operative patients are in an increased oxygen consumption mode due to trauma, possible sepsis, and increased adrenergic response[12]. Passengers after cardiac and pulmonary surgery are most at risk due to mild hypoxic conditions in the cabin; as such, a thorough preflight medical assessment is of immense importance. It is also important to remember that intestinal gases will expand by nearly 25% at the cabin altitude of 2440 m (8000 ft). Post abdominal surgery patients have a relative ileus for several days, thereby putting them at serious risk for tearing of sutures, perforation, and bleeding. It is advisable to postpone travel for atleast 2 weeks postsurgery to avoid any complication. Passengers after laproscopic surgery can fly safely after 48 hr because as all the CO_2 introduced in the abdominal cavity during the procedure is absorbed by that time[12]. Travelers with colostomy bags need to use bigger bags due to increased fecal output.

Fractures. All passengers with above-the-knee casts are required to travel as a “stretcher case” or in first-class or business-class. Expansion of trapped air inside the casts may lead to pressure; as such, it is advised to split the cast at a proper level. Use of air splints is questionable, it is advised to use vacuum splints to avoid circulatory compensation due to expansion of trapped air.

Psychiatric Conditions. Persons with psychiatric disorders whose behavior is unpredictable, aggressive, disorganized, disruptive or unsafe should not travel by air. Patients with psychotic disorders, but who are stabilized on medication, may be allowed to fly with an escort[12]. Many medicines used for psychiatric disorders have anticholinergic effects that can cause intestinal gas formation and discomfort due to expansion of gases[12].

Passengers may suffer from claustrophobia, fear of flying, or interpersonal crowding. A long intercontinental flight involving stop-overs, changes of aircraft, flight delays, diversions, combined with the busy atmosphere of an airport, can all provoke extreme anxiety and irritability in a mentally ill patient. This is often overlooked by the physician examining a patient long before the flight in his consulting room. Excessive anxiety may manifest in hyperventilation. During the acute phase, an airsickness bag may be used as a rebreathing device[12].

Pregnancy. Commercial flying is among the safer modes of traveling for a pregnant passenger[16] and air travel does not pose specific problems either to the mother or the fetus. As such, most of the airlines allow pregnant mothers to travel up to 36 weeks of gestation. Maternal and fetal hemoglobin remain sufficiently saturated in the flight environment[12]. However, certain symptoms related to pregnancy may increase during flight, like abdominal discomfort, nausea, vomiting, and minor trauma. Pregnant travelers are advised to use their seat belts continuously while seated. A lap belt should be worn snuggly over the pelvis or upper thigh in order to avoid abdominal injury.

Pregnancy increases the risk of pedal edema, thromboembolism and DVT. Frequent ambulation is beneficial, but should be with caution. It is beneficial to ask

for an aisle seat for ease of movement, and constrictive clothing should be avoided. In case of previous history of thromboembolism or other predisposing factors, physicians can consider anticoagulant therapy.

Although the flight environment is not causal to pregnancy related complications, it is advisable to refrain from air travel in the first trimester in cases of previous history of bleeding and pain, and in the last trimester in cases of history of preterm delivery, cervical incompetence, bleeding, severe anemia,[12] etcetera. Conditions such as intrauterine growth retardation, preeclampsia, placental infarction, and postmaturity may need oxygen onboard. Travelers with complicated pregnancies should confer thoroughly with their physician and carry all prenatal records and medications during travel.

Traveling with Children. Newborn babies less than 7 days of age should not travel by air. Newborn babies older than 7 days may travel, provided they are healthy, had a normal birth and are free from any congenital defects or acute respiratory distress syndrome. Unhealthy or premature babies between the ages of 7 days and 2 years will require a doctor's clearance before being accepted for travel. Babies under the age of 2 years can travel using the aircraft bassinet (carry-cot). Bassinets should be requested when booking the air ticket, in order to ensure availability and to obtain advance confirmation. Special children's meals are available at no extra cost on most of the airlines if requested in advance. Almost all airlines carry diapers (nappies), talcum powder, soft toys and games for children, if requested.

Airlines do not insist a seat be purchased for children who are less than 2 years of age, but it is advisable to do so anyway. Turbulence can cause a child to be propelled from one's arms. Use of car seats on aircraft is advisable in the same manner as one would in a car. Changes in air pressure can cause ear pain in very young children[12]. A decongestant helps, given an hour before take-off and half an hour before descent but it is recommended that these medications are tried for a day or two before the flight because some brands can cause hyperactivity in children[12]. To equalize the ear pressure in young children it is advisable to give chewy food or a lollipop. Younger kids can be breastfed or given a bottle or a pacifier.

Diarrheal diseases are 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 be aware of endemic diseases at their destination.

Vehicular safety must also be addressed. 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 onboard or available at the travel destination.

Immunizations should be current and appropriate for the travel destination, and a plan for appropriate prophylaxis for infectious illnesses should be considered, if indicated

Elderly Passengers. Most airlines provide escorts for elderly passengers who might need special attention, and wheelchairs or carts, during embarkation, inflight or disembarkation. Special meals can be ordered in advance for any special dietary requirements (e.g., low-fat, low-cholesterol or diabetic meals). Request can be made to seat elderly passenger near the lavatories for easy access.

In certain circumstances a passenger may request an extra seat for their personal comfort or cabin baggage. An oversized passenger can either pay an additional economy seat or travel first-class or business-class where wider seats are available.

Passengers with Disability. A large number of passengers with various disabilities travel each year. All international and domestic airlines endeavor to minimize the special problems that travelers with disabilities face as they negotiate their way through the complex air travel system from origin to destination. The Air Carrier Access Act and Department of Transportation in the USA sweep aside many restrictions that formerly discriminated against passengers with disabilities[17]. An airline will not refuse transportation to a passenger solely because of a disability and will not limit the number of individuals with disabilities on a particular flight. All trip information that is made available to conventional passengers must be made available to passengers with disabilities. Passengers with vision or hearing impairments must have timely access to gate assignments, delayed flights, safety, and similar information given to other passengers at the airport or on the plane. Carriers must allow service animals to accompany passengers in the cabin, as long as they do not block the aisle or other emergency evacuation routes.

All commercial airlines must provide passage to an individual with a disability that may affect appearance or involuntary movements, even if this disability may offend, annoy, or be an inconvenience to crewmembers or other passengers.

There are a few exceptions; the carrier may refuse transportation if the individual with a disability would endanger the health or safety of other passengers, or if transporting the passenger would be a violation of safety rules.

Some airlines consider obesity as a disability. Air Canada allows obese passengers to purchase a second seat for 50% of the economy fare on flights within North America. It offers the same arrangement to parents traveling with children under 2 years of age or incapacitated people traveling with a companion. Most airlines have their own protocols to deal with the problem of obesity.

Communicable Diseases. As part of their responsibility to passengers, air carriers try to prevent the spread of infection and communicable diseases onboard. In situations where a person seeking passage has an infection or disease that would be transmittable during the normal course of a flight (and that has been deemed so by a public health authority knowledgeable about the disease or infection) the carrier may either refuse to provide transportation to the person or require the person to provide a medical certificate stating that the disease, at its current stage, would not be transmittable during the normal course of flight.

If the individual has a contagious disease but presents a medical certificate describing conditions or precautions that would prevent the transmission of the disease during the flight,

the carrier must provide transportation unless it is not feasible to act upon the conditions set forth in the certificate to prevent transmission of the disease.

Aviophobia or Fear of Flying. Estimates show that at least one out of every six adults has a fear of flying. Aviophobia (often referred to as aerophobia) is one of the most common fears because it encompasses a number of other fears such as claustrophobia, fear of heights, anxiety, fear of giving up control, and fear of the unknown. Often fears are caused by a general lack of understanding about what to expect during a flight. Many people who were able to fly, but with some difficulty, before "September 11", find flying far more difficult if not impossible. Though flying remains the safest way to travel, it may not feel safe. Whether the concerns are for actual safety or just the feelings, is very difficult to say. Most fearful flyers just need some help in the form of education, reassurance, and guidance.

In-flight Medical Incident

It is anticipated that inflight medical incidents will increase due to an increasing number of aged or diseased passengers, who fly over ever-increasing non stop distances. Most common nonserious inflight medical incidents are vasovagal (fainting, near-fainting, dizziness and hyperventilation), trauma and gastrointestinal episodes[18]. Maximum flight diversions have been due to cardiac, neurological, and respiratory diseases[18]. Most of the studies completed to date reveal that 1/10,000 to 1/40,000 passengers have a minor medical incident during flight[2] and 1/150,000[19] requires use of an inflight medical kit. With estimated death rate of less than 1 death per million passengers, studies conducted by the International Air Transport Association (IATA) found an average of 80 deaths recorded each year aboard aircraft. Most common causes of these inflight deaths have been due to cardiac arrest, heart failure, terminal cancer, injuries, AIDS, and allergic reactions[20].

Other medical emergencies onboard include injuries during turbulence, burns, allergies, and choking. Flight attendants are trained by the airline to handle these conditions. Renewed interest in the problems of inflight medical delivery system from airline industry and state governments has led to a great deal of research into provision of emergency medical care for passengers flying with a variety of health problems. This increased level of interest should result in greater cooperation within the aviation industry and a deeper understanding of all aspects of onboard emergency medical care.

Medical Care Onboard

First-aid and physician's kits of varying sophistications are available onboard for use by flight attendants and onboard physicians respectively[21]. Flight attendants are trained to recognize common medical emergencies, render first-aid and cardiopulmonary resuscitation (CPR) and use emergency medical oxygen. Should a doctor be available onboard, the physician's kit can be opened and used to provide medical care.

Most airlines supply nasal prongs and oxygen at flow rates of 2 $L.min^{-1}$ to 4 $L.min^{-1}$ [12]. The passenger however, needs to make separate arrangements for oxygen required at other times, such as preflight, while waiting for connections, and on arrival. For stretcher cases, special reservation and demands must be made with the airline in advance. Six to nine seats may be required for these cases depending upon the aircraft type. Onboard medical oxygen is provided by most airlines if requested at least 48 hours in advance. In view of flight safety, commercial airlines do not allow patients to carry their own oxygen cylinders from any outside source[12].

Any inflight medical emergency can be serious to the victim, costly to an airline and disruptive to passengers. Ideally, emergency medical systems emphasize on reducing the time from the onset of symptoms to the availability of advanced life-support services. In this endeavor, provision of first-aid and basic life support from the crew, availability of an experienced passenger physician onboard, use of inflight medical kits, satellite transfer of medical information for further management[22], lowering the altitude and diversion of aircraft if possible, play a very important role in saving a life. Many international airlines have augmented their inflight medical care by installing an automated external defibrillator (AED) and enhanced emergency medical kits onboard[12].

Some airlines have telemedicine links with doctors on ground[22]. The flight attendants and physician onboard can transmit information about pulse, blood pressure, PaO_2, electrocardiogram (ECG), and other vital parameters including images to the physicians on ground, who will advise further management[23]. This is particularly beneficial when a decision to divert needs to be taken. These diversions are costly to an airline and not as safe as routine landing. Some airlines, Lufthansa for instance, offer advanced cardiac or trauma life support onboard, with a special "patient transport compartment" in the aircraft where a patient can be transported with onboard life-support equipments, drugs and medical escorts.

Postflight Stresses

Jet lag is the most important postflight stress. It results from resynchronization between the individual's internal clock and the external environment. The internal clock controls all body functions, which vary according to the individual's circadian cycles. The internal clock is controlled by zeitgebers (time-givers) such as light, social contacts, and knowledge of time[12]. When traveling rapidly across time zones, the zeitgebers in the new environment send conflicting messages to the internal clock, leading to symptoms of jet lag. These are mainly tiredness, sleeping difficulties, and sleepiness during the day. Severity of symptoms depends on the number of time zones crossed, whether eastward or westward flight, degree of stimulation in the environment, cumulative sleep loss and individual differences. Jet lag can also complicate timing of medications such as insulin in diabetics.

At destination, it is advisable to follow the schedule of the new time zone (i.e., be exposed to light and social contacts during the day to avoid sleepiness). Small frequent meals before and during flight, along with plenty of fluids is best. Caffeine and physical exercise can also be used to control daytime sleepiness. Melatonin, the hormone secreted at night by the pineal gland, has been used by travelers to overcome jet lag, though its use is still controversial. Low-dose short-acting

or medium-acting hypnotics drugs such as zolpidem or temazepam may be used judiciously for the first few days[24].

Homeopathic medication (such as No-Jet-Lag), a jet lag preventive diet[25], exercises, aromatherapy, and acupressure have been advocated for treating jet lag, but these measures are only speculative with little scientific basis.

Legal Aspect of Inlight Medical Care

Medicolegal issues in aeromedical transport (such as jurisdiction, importation and exportation of drugs, international health regulations, and certification of births and deaths) are complex. In recent years, there has been a trend for doctors not to declare their availability onboard for fear of subsequent litigations[26]. Under the law practiced in the United Kingdom, Canada and the U.S.A. there is no legal obligation to give medical aid to a passenger, unless there is a preexisting passenger doctor-patient relationship. However, in most European countries, India and Australia, it is a criminal offense to not render medical assistance[27]. By international law, the country in which the aircraft is registered has legal jurisdiction[27]. However, the country in which the incident occurs or the country of citizenship of the plaintiff or defendant can also have jurisdiction.

An important step was taken in 1998 that helped reduce physician's concerns over liability when the Aviation Medical Assistance Act was signed into law in the U.S.A[28]. The act provides limited "good Samaritan" protection to any medically qualified passenger who provides medical assistance aboard an aircraft[28]. In addition to being medically qualified, the assisting passenger must volunteer their assistance, render care in good faith, and receive no monetary compensation. Gifts in the form of travel vouchers or seat upgrades are not considered compensation. The assisting passenger must also provide medical care similar to the care that others with similar training would provide under such circumstances, where there are limited resources in the aircraft. Although the Aviation Medical Assistance Act frees the "doctor-passenger" from responsibility for assisting during an in-flight medical emergency, the "doctor-passenger" is not free if suspected of gross negligence or willful misconduct[28].

It is also interesting to note that the Aviation Medical Assistance Act also relieves airline carriers from liabilities due to the performance of the air carrier in obtaining the assistance of a doctor-passenger in an inflight medical emergency. In the area of airline liability and medical liability onboard aircraft, as it involves the crossing of international borders, complex issues arise because of the various national legal systems around the world. As per International Civil Aviation Organization, no international convention protects a doctor from a malpractice lawsuit. Many airlines do, however, offer legal coverage to a doctor who comes forward.

The legal onus to help, therefore, depends upon the geography and possibly the nationality of the air carrier. This is understandable because inexperience in a particular field of medicine is no defense against allegations of negligence. Additionally, legal considerations may be taken a step further when a medicine legal in one country is illegal in another.

Aeromedical Transport

There has been an enormous growth in the air transfer of patients in recent years, and this may involve primary, secondary, or tertiary medical evacuations. Primary missions are those in which a helicopter serves as the means of transporting a patient to an emergency medical facility. Secondary missions transport patients from hospitals (where some degree of stabilization has been performed) to a higher level medical facility. Tertiary missions transport patients for further specialist care or repatriation. There is the capacity for doctors to work in all types of missions, but few are full-time; most opt to maintain clinical proficiency in their chosen specialty and work in transport part-time on an adhoc basis. Depending upon interest, there are opportunities to fly with primary helicopters, such as the helicopter emergency medical service, and international repatriations missions.

Conclusions

Each year, billions of passengers travel on commercial airlines, and there is very little literature on medical issues and medicolegal considerations for air travel. The number of medical events onboard aircraft will increase as air travelers increase (barring terrorism incidents similar to that of the September 11, 2001). Environmental and clinical aspects such as cabin pressures do increase the risk of hypoxia. Cabin air quality in aircraft should pose no risk to passengers. The goal of inflight medical assistance is to stabilize the condition of a sick passenger until the aircraft has landed. Passengers should undergo preflight medical reviews and declare all medical ailments to the airline staff, identifying themselves as having preexisting medical ailment. Improvement of the resources onboard aircraft to deal with inflight medical emergencies is crucial for passenger safety and comfort. Knowledge of resources available to deal with inflight medical events is important to both passengers and to physicians who volunteer to assist in any medical incident or accident onboard. Renewed interest, globally, among airlines, governing states, and the aviation industry to provide onboard state-of-the-art emergency medical care will provide a better platform for managing medical emergencies on board.

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