MEDICINE AT 40,000 FEET: IMPLICATIONS FOR OLDER ADULTS

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Abstract

Air travel has become an essential means of transport in the modern world and continues to increase exponentially as baby boomers age and continue the lifestyles to which they have become accustomed. Many of the frail elderly are medically complex, have multisystem disease and may require adaptations or close monitoring during air travel. This review aims to describe air travel from a medical perspective. It reviews the physiological challenges of air travel, such as decreased oxygen supply and time zone changes, the resources available on board (and on the ground) for physicians, the prevalence and outcomes of in-flight emergencies, and the ethical and legal ramifications of being a "good Samaritan."

Résumé

Le voyage en avion représente un moyen de transport essentiel dans le monde moderne, et son utilisation augmentera de façon exponentielle avec le vieillissement des « baby-boomers », qui souhaiteront maintenir longtemps leur mode de vie actif. Nombreuses sont les personnes âgées fragiles ayant des conditions médicales complexes et multi-systémiques, qui requièrent une surveillance serrée durant un voyage en avion. Cette revue de la littérature a pour objectif de décrire le voyage en avion d'un point de vue médical. L'article fera une révision des stress physiologiques associés au voyage en avion tels que la réduction des apports en oxygène et les changements de fuseau horaire, les ressources disponibles à bord (et dans les aéroports) pour les médecins, la prévalence et le pronostic des urgences en vol, ainsi que les ramifications éthiques et légales d'agir comme un « bon Samaritain ».

Air travel has become an essential means of transport in the modern world and continues to increase exponentially. Approximately two billion people fly each year,[1] and it is estimated that up to 500,000 people are in the air at any given time. As baby boomers age and attempt to continue to live the lifestyles they have been accustomed to, a larger and larger proportion of those passengers will be elderly. While not true for all older adults, many of the frail elderly are medically complex, have multisystem disease and may require adaptations or close monitoring during air travel. This review aims to describe the challenges older patients face on commercial airlines, the resources available on board, and the outcomes of in-flight emergencies.

Physiology of Air Travel

The barometric pressure on the inside of a commercial flight is similar to atmospheric pressure between about 1,500 and 2,500 metres (5,000 and 8,000 feet) above sea level.[1] With the drop in pressure, there is a corresponding drop in oxygen content. This decreases a healthy passenger's partial pressure of oxygen in arterial blood (Pa_{O_2}) to approximately 90%, and combined with the less than 10% humidity, causes up to 18% of patients with chronic obstructive pulmonary disease (COPD) to experience at least mild respiratory distress.[2] This effect is enhanced in older adults through multifactorial age-related decline in pulmonary function, including changes in musculature, gas exchange, and lung volumes.[3] Several published equations exist to determine any individual's potential level of hypoxemia during flight[4]:

$$\text{In-flight } Pa_{O_2} = 0.453 \times \text{ground-level } Pa_{O_2} \text{ (mm Hg)} + [0.386 \times FEV_1 \text{ (\% predicted)}] + 2.44$$

$$\text{In-flight } Pa_{O_2} = 0.519 \times \text{ground-level } Pa_{O_2} \text{ (mm Hg)} + [11.855 \times FEV_1 \text{ (L)}] - 1.760$$

where FEV_1 stands for forced expiratory volume in 1 second. The low pressure also causes

expansion of gas volumes creating potential problems for those with surgical wounds, middle ear and sinus congestion, feeding tubes, tracheostomy cuffs, and, of course, pneumothoracies.[1]

While the risk is low,[5] infection is always a concern among air travellers. Up to 80% of the inspired air is re-circulated,[6] and there are reports of transmission of common entities such as influenza and gastroenteritis as well as cholera, tuberculosis, smallpox, and severe acute respiratory syndrome (SARS).[7,8] Older adults are further susceptible to infection due to immune senescence, the aging of the immune system. This decline results in a multifactorial increase in the risk and severity of infection due to various factors, including decreased immune function (and vaccine efficacy), impaired mucosal barriers, and co-morbid conditions such as diabetes and cancer that are already known to increase the risk of infection.[9] Further, older adults also tend to have atypical clinical presentations; thus, the diagnosis may be missed or inadequately treated.[10]

Logistical Challenges of Air Travel

Elderly passengers face difficulty with the simple act of getting on and off a flight. Mobility issues are of particular concern as patients with limited mobility may have difficulty adopting a brace position for impact, getting on and off the plane, or simply remaining seated and immobile for hours on end.

Long-distance travel also presents unique challenges. Changing time zones may affect the timing of medication administration and almost certainly alters sleep-wake cycles. For those patients with mild cognitive impairment or dementia, travel can increase the risk of trans-locational delirium. Unfamiliar environments, large crowds, and even a lack of family washrooms may present significant challenges to the cognitively impaired. Planning ahead and minimizing travel time are essential for these individuals.

A lack of an adequate power supply for devices such as continuous positive airway pressure (CPAP) machines and oxygen concentrators can also present an issue on longer flights.

Finally, older adults may have difficulty obtaining adequate travel insurance coverage. This may result in individuals being unable to travel without paying excessive insurance rates or risking the possibility of paying out-of-pocket expenses in a foreign country.

Key Points

- *Air travel can act as a major stress on the geriatric population, with important physiological changes including decreased oxygen supply, increased gas volumes, and significant risk for infection.*
- *Physicians should counsel elderly patients who have co-morbid diseases on the risks of flying and, if necessary, perform an assessment to determine if they are "fit-to-fly" (with or without oxygen).*
- *Airline emergencies are common, and while serious injuries are rare, age is a risk factor for a poor outcome.*
- *All airlines are now required to have medical kits on board with basic first aid supplies, an AED, and a limited number of medications.*
- *As a physician in Canada, you are ethically required to assist passengers in need and are legally protected from litigation.*

Restrictions on Flying

Each airline has individual guidelines outlining who it feels is fit to fly. There is a large variation, but most are fairly similar and in line with the thorough guidelines set out by the British Thoracic Society (BTS)[11] and the Aerospace Medical Association (AsMA).[12] The list of contraindications includes any acute or unstable medical illness and many chronic conditions across all systems, including cardiovascular, respiratory, hematological, otolaryngological, neurological, psychiatric, infectious, and endocrine. Additionally, those having undergone a recent procedure should not travel within a specified time frame.

These conditions are almost all more prevalent in an older population and tend to occur in multiplicity, complicating matters fully. Some suggest a "fitness-to-fly test" that encompasses all co-morbid conditions. The test involves a patient walking 50 metres, unaided, at a normal pace or ascending one flight of stairs. However, there is little evidence to support the use of this test.[12] Further, a "hypoxic challenge test" (which involves inhaling a mixture of 15% F_{IO_2} [fraction of inspired oxygen] mixed with nitrogen) can simulate the cabin environment and may indicate the need for in-flight oxygen.

Aside from contraindications to flight, the BTS and AsMA recommend in-flight oxygen for those patients with severe cardiac or respiratory disease such that there is need for oxygen at sea level as well as for those with a baseline Pa_{O_2} <70 mm Hg. Additionally, those at high risk of dangerous levels of hypoxemia include patients with cyanotic congenital heart disease, primary pulmonary hypertension, and sickle cell anemia. Regardless, all patients with chronic or acute disease should consult their physician prior to flying. The treating physician may then determine an individual's risk based on some of the results of the tests above, calculated Pa_{O_2}, or co-morbid conditions.

Epidemiology of In-Flight Emergencies

Unfortunately, estimates of in-flight emergencies greatly differ as the standard for reporting an incident (in the United States) requires there to be "hospitalization for more than 48 hours, fracture of a bone (except finger, nose or toe fractures) or injury to an internal organ."[13] A survey of over 1,300 airlines yielded only 10 responses, which were widely variable. However, it is thought that a medical emergency happens in approximately 1 in 1,400 flights among travellers of all ages, with 1 in 14,000–100,000 requiring medical attention.[14–16]

While this number represents an infinitesimally small 0.003% of all passengers, the number is rising. Between 2000 and 2006, airline emergencies doubled, and so did deaths.[17] Other factors to consider with modern air travel include average flight distances, which increased from 1,984 to 2,167 kilometres (1,233 to 1,347 miles) during that time,[18] and the introduction of newer airplanes such as the Airbus A380-900 and the Boeing 777-200LR that can seat up to 1,000 passengers, travel up to 17,000 km, and have maximum flight times in excess of 20 hours. Moreover, the rate of plane diversion and in-flight death increase dramatically after the age of 60 years.[16] This may be related to the increased burden of disease among these passengers, the relative inexperience of the in-flight crew and/or flight physician, the paucity of inadequate supplies on board, or a combination. This

is a problem that will expand further as more and more elderly passengers continue the travel habits of their youth.

The most common in-flight emergencies include syncope, gastrointestinal illness, cardiac complaints, and respiratory illness.[19] Most of these are managed on board, but approximately 13% require diversion,[20] an expensive undertaking costing up to $893,000.[7,13] While accurate statistics are difficult to come by due to patient confidentially, some studies have shown rates of around 24.5% to hospital and 5.9% to the intensive care unit.[15] Overall, mortality is exceedingly rare, occurring in well under 1% of emergencies. However, for fliers between 60 and 90 years of age, an in-flight incident is 5–15 times more likely to be fatal compared with those in persons aged 21–30. One study found that those over 90 years old have approximately 60 times the likelihood of death.[16]

Supplies on Board

In recent years, there has been a push toward the standardization of the emergency medical kit (EMK) on board all aircraft that are over 3,400 kilograms (7,500 pounds) payload and have at least one flight attendant.[21] In addition to basic over-the-counter medications, bandages, and splints (found in any emergency first aid kit), the EMK contains advanced supplies for use by medical personnel.[13] The supplies include a stethoscope and blood pressure cuff, supplies for advanced airway management, intravenous tubing, and normal saline as well as six needles of various sizes and three syringes for the administration of medication. Since 2004, an automated external defibrillator (AED) has also been required. The EMK also comes with a standard supply of medications, including analgesics, antihistamines, inhalers, atropine and epinephrine, nitroglycerin, and acetylsalicylic acid.

While not required, some airlines have gone above and beyond the minimum requirements to include other supplies and medications that may be essential in an emergency. Examples include catheters, thermometers, advanced cardiac life support (ACLS) cards, corticosteroids, diuretics, β blockers, glucagon, and even naloxone. Further, while the above list of supplies and medications is a start, the kits themselves are not standardized and may be difficult to manage for a first-time user.

The Hippocratic Oath

The question of responsibility for physicians travelling on a flight is a complex one involving both ethical and moral considerations. Luckily, over three quarters of medical emergencies are handled by flight attendants,[22] who must be certified in the use of AEDs and performance of cardiopulmonary resuscitation (CPR) every 12–24 months.[23] However, there is a physician present the majority of the time (85% in one study),[8] so the dilemma of responsibility remains.

The law differs based on country, with no legal requirement to assist in the United States, the United Kingdom, or most of Canada (except in Quebec or if there is a pre-existing duty of care). However, some countries do place an obligation on the physician regardless of the pre-existing relationship, including several countries in Europe and Asia. As a Canadian physician, if you do choose to help, you will likely be protected under some incarnation of a Good Samaritan Law. These laws vary by province but include Ontario and British Columbia's Good Samaritan Acts, Alberta's Emergency Medical Aid Act, and Nova Scotia's Volunteer Services Act.[24] Any member of the Canadian Medical Protective Association would also be covered (assuming no gross negligence) should they be assisting a patient, but only if care was *emergently* required.

Ethical aspects are generally more clearly defined. The American Medical Association, Canadian Medical Association (CMA), and World Medical Association codes of ethics essentially agree than in an emergency situation, physicians should help in any way they are able.[25–27] According to the CMA, a physician on board should "provide whatever appropriate assistance [they] can to any person with an urgent need for medical care."

Future Directions

The demographic imperative of aging has far-reaching consequences that we have only begun to understand. Within the realm of air travel, emergencies may very well become more frequent and more serious. Looking to the future, there is much room for improvement. Potential innovations include a standardized reporting system for in-flight emergencies and a standardized medical kit (with an expanded profile of equipment and supplies) and improved medical training and access to land-based medical support for flight crews.[28] Hopefully, the ongoing advances in air travel can continue to be enjoyed by everyone, including the elderly and those with complex, multisystem disease.

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