On a wing and a prayer: medical emergencies on board commercial aircraft

Robert Drummond, MD CM;* Alan J. Drummond, MD CM†

ABSTRACT

Medical emergencies sometimes arise in the isolated and confined environment of a commercial aircraft. Because a physician passenger may be on board in 40% to 90% of all commercial flights, it follows that this physician may be asked to render assistance to an acutely ill passenger. Although data suggest that the incidence of such emergencies is low, the potential for serious events necessitates a degree of familiarity with the nature of emergencies in the air and with the options available to the travelling physician.

Key words: commercial aviation, inflight medical emergencies, medical kits, automated external defibrillators

RÉSUMÉ

Des urgences médicales se produisent parfois dans l'environnement isolé et restreint d'un avion commercial. Étant donné qu'un médecin est susceptible de se trouver à bord d'un avion dans 40 % à 90 % de tous les vols commerciaux, les chances sont qu'on sollicitera son aide si jamais un passager devenait gravement malade en cours de vol. Même si les données indiquent que l'incidence de telles urgences est faible, les risques d'incidents graves justifient qu'un médecin qui voyage ait un minimum de connaissances quant à la nature des urgences à bord d'un avion et aux options à sa disposition.

Introduction

In 40% to 90% of all commercial flights there is a physician on board,[1,2] and that physician may be asked to render assistance to an acutely ill passenger. Although illness and death do occur in flight, they are infrequent, given the number of travellers who fly. The exact number of medical emergencies on board commercial airlines is not well known because airlines are not required to report these occurrences or any flight diversions due to medical problems. A study[3] at the Seattle–Tacoma International Airport reported that 1 of every 39 600 passengers and 1 of every 753 flights experience an in-flight emergency, defined as "an event that began during a flight." Speizer and colleagues[4] reported the incidence of passengers developing symptoms requiring assistance while in flight to be 0.003%. However, 75% of "flight-associated" medical emergencies occur while travellers are on the ground, in the hours immediately before or after travel.[3] With hundreds of millions of people being transported by airlines each year, even such a low incidence amounts to a significant number of people experiencing medical emergencies during air travel.

Estimates of in-flight deaths in the United States vary from 21 to 100 passengers each year.[5] The Seattle–Tacoma study reported 0.35 deaths per million inbound passengers.[3] A similar rate was found in another study, from Los Angeles International Airport, where 7 deaths occurred in 11.3 million passengers.[4] This is further substantiated by data reported to the International Air Trans-

*St.Mary's Hospital Center, Montreal, Que.; †Perth and Smiths Falls District Hospital, Perth, Ont.

Received: Apr. 8, 2002; accepted: May 6, 2002

This article has been peer reviewed.

port Association between 1977 and 1984, where in-flight deaths occurred at a rate of 72 per year, 0.31 per million passengers, or 25.1 per million departures. The majority were men (66%), with a mean age of nearly 54 years, and most (79%) had reported no health problems before travel. More than half of these deaths (56%) were classified as "sudden," presumably cardiac.[6] This is echoed by a recent report on the use of automatic external defibrillators (AEDs) by a US airline, where the majority of patients were men, and the mean age was 58 years.[7] The fact that sudden cardiac death was more common among passengers with no reported health problems than among ill passengers has potential implications for prevention because it is known that apparently well individuals who suffer sudden cardiac death can more frequently be resuscitated.

Disease spectrum

For many, environmental conditions aboard aircraft constitute a physiological and psychological stress. Physiological stresses include hypoxia, barometric pressure changes, orthostasis, temperature changes, dehydration, noise, vibration, circadian disorders and fatigue. In addition, there may be an associated psychological stress surrounding the circumstances of travel.[8] The range of medical problems onboard aircraft varies widely — from trivial to life threatening. The most frequently reported medical problem varies, depending on the survey. A Federal Aviation Administration (FAA) survey of the status of in-flight medical care aboard domestic US air carriers was undertaken for the years 1990 to 1993 and it was found that neurological, syncopal and cardiac episodes were the most frequent medical emergencies and that they accounted for most flight diversions.[9] Cummins and Schubach[3] reported the most frequent complaints to be gastrointestinal, such as nausea, vomiting, diarrhea and abdominal pain, followed by dyspnea and cardiac-related complaints. Cottrell and coworkers[10] found that syncope (usually vasovagal) was the most common in-flight medical problem. This is further substantiated by the 2000 statistics from MedAire, an emergency telemedicine provider to the commercial aviation industry. Of the 8500 medical calls managed that year, the majority (21.4%) were for vasovagal syncope.[11]

On-board equipment

In general, when faced with a medical emergency onboard an airplane, physicians have 3 options: 1) use the on-board medical kit or humidified oxygen; 2) request lowering of flight altitude to a level at which cabin pressure is roughly that at sea level (about 22 500 feet) to alleviate an altitude-related problem; or 3) ask for a flight diversion. However, the person ultimately in charge is the pilot. This article will address only the first option.

The medical equipment available varies widely from one airline to another. Until December 1986, in the United States there was no federal requirement for medical equipment or medications other than a first-aid kit. Then, largely after petitioning from aviation consumer groups, the FAA established regulations that specified the minimum contents of "physicians-only" medical kits used aboard all US commercial carriers.[12] The International Civil Aviation Organization requires medical kits only on aircraft over 250 seats (Mr. Christopher Dann, Civil Aviation Safety Inspector, Cabin Safety Standards, Transport Canada; from the final report of the Working Group on Medical Emergencies: personal communication, Nov 2001). The contents of the FAA mandated kit are outlined in Table 1. Although the medical kit contents seem Spartan, physician's attitudes toward the kit vary. In 1989 Cottrell and colleagues[10] reported that 26% of physicians found the kit very useful, 55% found it somewhat useful, and 18% found it minimally useful. The frequency of use was 1 in every 1900 flights or 1 in every 150 000 passengers. On Apr. 24, 1998, the US congress enacted the Aviation Medical Assistance Act, which in part directed the FAA to determine whether current minimum requirements for air carrier crew member medical emergency training and air carrier emergency medical equipment should be modified.[13] As a result of the data collected pursuant to

Table 1. Federal Aviation Administration mandated contents of medical kits used aboard all US commercial carriers

Contents	Quantity
Sphygmomanometer	1
Stethoscope	1
Airways, oropharyngeal (3 sizes)	3
Syringes*	4
Needles*	6
50% dextrose injection, 50 cc	1
Epinephrine 1:1000, single-dose ampule or equivalent	2
Diphenhydramine HCl injection, single-dose ampule or equivalent	2
Nitroglycerin tablets	10
Basic instructions for use of the drugs in the kit	1
Protective latex gloves or equivalent	1 pair

* Sizes necessary to administer required drugs

this Act, the FAA, on June 12, 2001, issued a final rule that will require all carrier aircraft of more than 7500 lbs payload, with at least 1 flight attendant, to carry at least 1 enhanced medical kit in addition to an AED by Apr. 12, 2004.[14] Flight crew must also be appropriately trained. Additions to the kit include both medications (notably ASA, atropine, brochodilators, additional epinephrine, lidocaine and saline for intravenous infusion) and equipment (IV administration kit and a self-inflating manual resuscitation device with masks). The enhanced medical kit is located in the cockpit and if opened, the aircraft cannot fly again until the kit has been replaced.

However, even this enhanced medical kit pales in comparison with some of some international carriers. The British Airways (BA) kits contain drugs and medical equipment far in excess of the minimum specification and these kits are recognized worldwide as the benchmark. For example, they include obstetrical packs, suture sets and diazepam, metoclopramide, furosamide, dexamethasone, glucagon, atropine, nalbuphine and bicarbonate (www.britishairways.com/health; accessed 2002 May 10).

In Canada, only aircraft with 100 seats or more are required to carry medical kits. The minimum contents as mandated by Transport Canada are listed in Table 2. However, a Transport Canada working group was formed in January 1999 to review the contents of on-board medical kits. They recommended that the following items be added to the current list of medical kit contents: additional epinephrine, atropine, airways, IV administration kit, ASA, bronchodilator inhaler, nitroglycerin tablets or spray, protective gloves and a pocket mask (Mr. Christopher Dann, Civil Aviation Safety Inspector, Cabin Safety Standards, Transport Canada: personal communication, Nov 2001). In addition to the above, the medical kit used by Air Canada contains lorazepam, glucagon, dimenhydrate, haloperidol, furosamide, lidocaine, morphine, procainamide, solumedrol and salbutamol (Dr. Claude Thibeault, Medical Director, Air Canada: personal communication, October 2001). All commercial airlines carry humidified oxygen that is capable of providing 4 to 6l minutes of 100% oxygen.

Table 2. Transport Canada mandated contents of flight medical kits

Contents	Quantity
Sphygmomanometer	1
Stethoscope	1
Syringes*	4
Needles* and safe disposal method	6
50% dextrose injection, 50 cc	1
Epinephrine 1:1000, single-dose ampule or equivalent	2
Diphenhydramine HCl injection, single-dose ampule or equivalent	2
Nitroglycerin	10 tablets or equivalent
Basic instructions for use of the drugs in the kit	1

* Sizes necessary to administer required drugs

Automatic external defibrillators

Endorsed by the American Heart Association, AEDs are increasingly being found on commercial aircraft.[15] In 1996 the US Food and Drug Administration (FDA) approved the use of AEDs on commercial aircraft, and in July 1997 American Airlines became the first US carrier to carry them. Pursuant to the Aviation Medical Assistance Act, other airlines are following suit. To date, 8 major and 6 regional US airlines either carry or have committed to carry AEDs. Furthermore, AEDs are found in a growing number of airports, with Chicago O'Hare, London Heathrow, Detroit Metro and Toronto Pearson being notable examples. Despite their increasing prevalence, there is a paucity of data that would support or dispute the carriage of AEDs on board aircraft. Since the introduction of AEDs by American Airlines in 1997, they have reportedly been used on 200 persons (as of July of 1999). Of the 15 patients who received shocks (13 for documented and 2 for presumed ventricular fibrillation), 6 (40%) were subsequently discharged with full neurologic and functional recovery.[7] In response to the Aviation Medical Assistance Act, the FAA conducted a year-long data collection study. The study revealed 188 death or near-death incidents in which 108 people died. Of these deaths, 64 were cardiac related. There were 4 post-flight, long-term survivors who had been administered an AED shock on an airline that voluntarily carried the device, and 40 cases in which an AED might have been used if it had been available.[16]

Domestically, Transport Canada encourages but does not mandate the installation of AEDs on Canadian aircraft (Mr. Christopher Dann, Civil Aviation Safety Inspector, Cabin Safety Standards, Transport Canada: personal communication, Nov 2001). The charter airline Skyservice was the first to introduce AEDs on its fleet of Airbus A-320s and 330s in 1997. Air Canada has recently begun to equip some of its aircraft with Lifepak 500 AEDs and to train in-flight personnel in their use (Dr. Claude Thibeault, Medical Director, Air Canada: personal communication, Octo-

ber 2001). Air Transat has equipped all of its fleet with defibrillators (www.airtransat.com/en/4_2_5.asp; accessed 2002 May 10).

Other international carriers that have AEDs on board include Virgin Atlantic, British Airways, Varig, Lufthansa and Quantas, which was the first to place defibrillators on all of its 53 international routes and throughout its terminals in 1991.[17] Lufthansa started its AED program only after being found liable for not providing adequate care for a passenger who had a cardiac arrest.[18]

In discussing AEDs, it must be remembered that these units are produced by a number of manufacturers and, because they are often used by trained laypeople, many do not permit operator rhythm analysis and manual override capability.

In addition to AEDs, at least 1 carrier is planning to be able to perform on-board electrocardiography. Over the next 6 to 12 months British Airways will begin outfitting its long-haul 777s and 757s with the Biolog 3000 ECG monitor (www.micromed.com.au/08_products/09_biolog3000/). Slightly larger than a deck of cards, the Biolog monitor is a portable, handheld device capable of recording a full diagnostic ECG. The monitor can be connected via modem to a seat-back phone, allowing for electronic transmission. A similar product, VitalLink 1200, has the added capability of being able to monitor and transmit vital signs including oxygen saturation (www.telemedics.com; accessed 2002 May 10). It should therefore not be surprising that telemedicine is now commonplace in the skies. In July 2000 Air Canada joined forces with an emergency telemedicine enterprise (MedAire.Inc of Arizona) that will enable flight crews to contact attending physicians in the ED of the Good Samaritan Regional Medical Center in Phoenix, Ariz., 24 hours a day. Other MedAire commercial clients include Air Transat, British Airways, Cathay Pacific, Quantas, SAS, Varig, and Virgin Atlantic (www.medaire.com; accessed 2002 May 10).

Duty to care

With respect to one's duty to respond to an in-flight medical emergency, the authors cannot conceive of any physician unwilling to provide emergency services to an acutely ill or injured patient. In the general medical population in Canada, with the notable exception of the Province of Quebec, there is no legislated positive duty for a physician to come to the assistance of an individual whose life is in danger. However, there is very likely an ethical duty upon a physician to render emergency medical service. This ethical duty is outlined in the Canadian Medical Association's *Code of Ethics*, which reads: "Provide whatever appropriate assistance you can to any person with an urgent need for medical care." [19]

Physicians who render medical assistance during an in-flight medical emergency are, for all intents and purposes, protected from liability by various pieces of "Good Samaritan" legislation unless the physician acts in a grossly reckless, careless or negligent manner. In the US, the Aviation Medical Assistance Act provides immunity for the acts of a medically qualified passenger rendering medical assistance, in the absence of gross negligence or willful misconduct.[14] The Canadian Medical Protective Association (CMPA) is unaware of any proceedings commenced against Canadian physicians in Canadian courts or in foreign courts where allegations of negligence in the provision of medical attention aboard an aircraft were made (Dr. Louise Dion, CMPA: personal communication, November 2001).

How it happens

For those who have never been involved with an in-flight medical emergency, it may be of some interest to understand the process. When a passenger experiences a health problem that requires the assistance of a physician, the flight attendant will request that any physician on board identify him/herself to a member of the flight crew. The crew will usually request that the responding physician verify his medical licensure through such means as the wallet-sized certificate of licensure. The physician is then accompanied to the passenger and the medical kit made available. Following the initial examination and treatment of the patient, usually in their seat, the physician will be asked to speak to the Captain of the plane to discuss options with respect to disposition of the patient. This usually involves consideration for continuation of the flight with the physician's ongoing medical management of the patient or the less favoured option of the prohibitively expensive and inconvenient diversion of the aircraft.

It is important for the physician to realize that, with respect to the ultimate disposition of the patient, the Captain is in complete charge and bears ultimate responsibility for the safety and welfare of the passengers and crew. The physician, like a ship's doctor, acts solely in a consultative capacity. It is expected that the physician will respect the Captain's decision and continue to treat the patient to the best of his or her ability for the duration of the flight. Some airlines will occasionally acknowledge a physician who provides emergency medical assistance, through the presentation of an "honorary flight surgeon" plaque.[20]

Conclusion

The Canadian emergency physician is no stranger to air travel. Although in-flight medical emergencies are unusual, they are not rare, and all physicians must be prepared to respond. Forewarned is forearmed. Physicians should be aware of what resuscitative drugs and equipment are available on most commercial flights. And emergency physicians, by virtue of their expertise and interest, should become more formally and actively involved with the development of standardized medical kits and resuscitative protocols for the management of in-flight medical emergencies.

Competing interests: None declared.

References

1. Mills JF, Harding MR. Medical emergencies in the air. I: Incidence and legal aspects. Br Med J 1983;286:1131-2.

2. Jagoda A, Pietrak M. Medical emergencies in commercial air travel. Emerg Med Clin North Am 1997;15:251-60.

3. Cummins RO, Schubach MA. Frequency and types of medical emergencies among commercial air travelers. JAMA 1989;261: 1295-9.

4. Speizer C, Rennie CJ, Breton H. Prevalence of in-flight medical emergencies on commercial airlines. Ann Emerg Med 1989;18:26-9.

5. Rodenberg H. Medical emergencies aboard commercial aircraft. Ann Emerg Med 1987;16:1373-7.

6. Cummins RO, Chapman PJ, Chamberlain DA, Schubach JA, Litwin PE. In-flight deaths during commercial air travel: How big is the problem? JAMA 1988;259:1983-8.

7. Page RL, Joglar JA, Kowal RC, Zagrodzky JD, Nelson LL. Use of automated external defibrillators by a U.S. airline. N Engl J Med 2000;343:1210-6.

8. Rosenberg CA, Pak F. Emergencies in the air: problems, management and prevention. JEM 1997;159-64.

9. DeJohn CA, Veronneau SJH, Hordinsky JR. Inflight medical care: an update. Oklahoma City (OK): Federal Aviation Administration, Civil Aeromedical Institute; 1997. DOT/FAA/AM-97/2.

10. Cottrell JJ, Callaghan JT, Kohn GM, Hensler EC, Rogers RM. In-flight medical emergencies: one year of experience with the enhanced medical kit. JAMA 1989;262:1653-6.

11. Health Watch, Commercial Aviation. Stats reveal most common medical in-flight emergencies. March/April 2001 Available: www.medaire.com/MarchApril01Commercial.pdf (accessed 2002 May 10).

12. Emergency medical equipment (final rule). Federal Register. January 6, 1986;51:1218-23.

13. Aviation Medical Assistance Act of 1998, Publ no 105-170, H.R. 2843, 105th Cong. (1998).

14. Department of Transport, United States of America. Docket Number FAA-2000-7119. Available: http://dms.dot.gov/search

15. Weisfeldt ML, Kerber RE, McGoldrick RP, Moss AJ, Nichol G, Ornato JP, et al. Public access defibrillation. A statement for healthcare professionals from the American Heart Association Task Force on Automated External Defibrillation [practice guideline]. Circulation 1995;92(9):2763.

16. Staff Report, FAA Office of Aerospace Medicine. Final emergency medical equipment rule issued. The Federal Air Surgeon's Bulletin, Summer 2001. Available: www.cami.jccbi.gov (accessed 2002 May 10).

17. O'Rourke MF, Donaldson E, Geddes JS. An airline cardiac arrest program. Circulation 1997;96:2849-53.

18. Smith SC Jr, Hamburg RS. Automated external defibrillators: time for federal and state advocacy and broader utilization. Circulation 1998;97:1321-4.

19. Code of Ethics. Ottawa (ON): Canadian Medical Association. Revised, 1996. Available: www.cma.ca (click on "Inside CMA" and "Where We Stand").

20. Curtis LG. Air Canada's "honorary flight surgeon" [letter]. CMAJ 1984;131:98.

Correspondence to: Dr. Robert Drummond, St. Mary's Hospital Center, 3830 Lacombe Ave., Montreal QC H3T 1M5; fax 514 486-7144, robdrummond@videotron.ca