REVIEW ARTICLE

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In-Flight Medical Emergencies during Commercial Travel

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PHYSICIANS WHO TRAVEL MAY BE ASKED TO RENDER CARE TO A PASSENGER who is having a medical emergency during a commercial flight. A considerable proportion of passengers in whom medical issues develop during travel require hospitalization. Therefore, health care providers should understand which in-flight medical emergencies occur commonly as well as the roles the providers can play and the liabilities they may incur when offering assistance.

Estimating the frequency of in-flight medical events is challenging because no mandatory reporting system exists.[1] A study of a ground-based communications center that provides medical consultative service to airlines estimated that medical emergencies occur in 1 of every 604 flights.[2] This is likely to be an underestimate, however, because uncomplicated issues are probably underreported.

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CONSIDERATIONS FOR RESPONSE

ON-BOARD MEDICAL RESOURCES

Several resources are available to providers who respond to a medical emergency. The Federal Aviation Administration (FAA) mandates that United States–based airlines carry first-aid kits that are stocked with basic supplies such as bandages and splints.[3] At least one kit must contain the additional items listed in Table 1. At least one automated external defibrillator (AED) must be available.[3] These supplies are not comprehensive (e.g., there are no pediatric or obstetrical supplies). An Aerospace Medical Association expert panel has recently recommended an expanded cache.[4]

Because health professionals are not aboard every flight, most airlines contract with ground-based medical consultation services.[5,6] The clinicians at these centers can provide treatment recommendations. On-board volunteer providers can also consult these services during an emergency. In demanding situations that require more than one provider, a volunteer physician may ask whether other medical professionals can assist.[7] The FAA also mandates that flight attendants receive training every other year in cardiopulmonary resuscitation (CPR) and the use of AEDs.[6,8]

LEGAL RAMIFICATIONS

A physician who provides assistance creates a doctor–patient relationship, with its attendant obligations and liability risk. Liability is generally determined under the law of the country in which the aircraft is registered, but the law of the country in which the incident occurs or in which the parties are citizens could arguably

Table 1. Contents of In-Flight Emergency Medical Kits.*

Assessment Supplies
Sphygmomanometer
Stethoscope
Gloves
Airway and Breathing
Oropharyngeal airways
Bag-valve masks (3 sizes)
CPR masks (3 sizes)
Intravenous Access
Intravenous administration set
Saline solution, 500 ml
Needles
Syringes
Medications
Analgesic tablets, nonnarcotic
Antihistamine tablets
Antihistamine, injectable
Aspirin
Atropine
Bronchodilator inhaler
Dextrose, 50%
Epinephrine, 1:1000 solution
Epinephrine, 1:10,000 solution
Intravenous lidocaine
Nitroglycerin tablets

* These contents are required by the Federal Aviation Administration to be present on all commercial airliners based in the United States.[3] CPR denotes cardiopulmonary resuscitation.

apply.[5] Although U.S. health care providers traveling on registered U.S. airlines have no legal obligation to assist in the event of a medical emergency, ethical obligations may prevail. In addition, many other countries, such as Australia and many in Europe, do impose a legal obligation to assist.[5]

In 1998, Congress passed the Aviation Medical Assistance Act (AMAA), which protects providers who respond to in-flight medical emergencies from liability and thus encourages medical professionals to assist in emergencies.[9] This law applies to claims arising from domestic flights and most claims arising from international flights involving U.S. carriers or residents.[10] The AMAA does allow for liability of providers if the patient can establish that the provider was "grossly negligent" or intentionally caused the alleged harm.[9] With respect to "gross negligence," providers are liable only if they exhibit flagrant disregard for the patient's health and safety. An example of such disregard would be an intoxicated physician treating a patient.

The protections of the AMAA are not contingent on the care being provided for free or without gratuity.[9,11] Other aspects of the AMAA are presented in Table 2.

After the event, the provider should document the care that was provided and the treatment that was delivered and should use airline-specific documentation as required.[6] Providers should be mindful of the patient's privacy rights and should not discuss the patient's care with third parties (e.g., media) without appropriate authorization from the patient.[12] The captain of

Table 2. Features of the Aviation Medical Assistance Act (AMAA) of 1998.*

The protections of the AMAA apply only to care rendered for "medical emergencies" and do not cover care rendered or medical advice given for nonemergencies.
Providers do not have to be asked to provide assistance in order to receive the protections of the AMAA.
The AMAA does not give providers any legal authority over the plane or its crew; thus, they cannot be held liable if a pilot does not follow their recommendations (e.g., to divert the plane).
The AMAA does not make providers responsible if a patient is harmed because of the failure of the airline to have appropriate medical equipment available.
Providers are not absolved of their legal duties (e.g., to avoid "gross negligence") simply because they may use medical resources provided by the airlines.

* Information is derived from an advisory circular from the Federal Aviation Administration[8] and from the Aviation Medical Assistance Act of 1998 of the National Archives and Records Administration.[9]

Table 3. Suggested Response to In-Flight Medical Emergencies.*

Medical providers who respond to in-flight medical emergencies should take the following steps:
Introduce themselves and state their medical qualifications.
Ask the passenger for permission to treat, if feasible.
Request access to the medical kit or automated external defibrillator, as needed.
Use a language interpreter, if necessary, but be aware of patient privacy.
Take a patient history, perform a focused physical examination, and obtain vital signs.
Administer treatments within the scope of their qualifications, with the patient remaining seated, when possible.
Recommend diversion of the flight if the patient's medical condition is critical.
Communicate and coordinate with ground-based medical resources.
Continue to provide care until the emergency medical condition is stabilized or care is transferred to other qualified medical personnel.
Document the patient encounter.

* Information is derived from a publication of the Aerospace Medical Association[4] and from a review by Gendreau and DeJohn.[5]

the aircraft and the flight crew should receive appropriate medical information to support correct medical management and allow for appropriate flight diversion. The airline itself is not obligated to follow federal regulations regarding health care privacy, because it is not a considered to be a covered entity.

SUGGESTED GENERAL RESPONSE

A suggested general approach to handling in-flight medical emergencies is summarized in Table 3. It is important to first ascertain whether one is sufficiently capable to provide assistance (the consumption of alcoholic beverages, for example, may make one unsuitable to render care).

For some in-flight medical emergencies, flight diversion gives a critically ill passenger more rapid access to ground-based medical resources. The most common reasons for diversion are cardiac, respiratory, and neurologic emergencies.[2,13] The decision to divert lies solely with the captain of the aircraft.[1,6] Diversion is a complicated decision that must take into consideration factors such as fuel, costs, the ability of the aircraft to land at the closest airport, and the medical resources available at that airport.[6] A volunteer physician can advise the crew of the medical issue, its severity, the potential need for treatment, and the possible outcomes if a recommended diversion is not pursued.

SPECIFIC MEDICAL CONDITIONS

CARDIAC ARREST

Among in-flight medical emergencies, cardiac arrest is quite rare, accounting for only 0.3% of such emergencies, yet it is responsible for 86% of in-flight events resulting in death.[2] In the challenging setting of an aircraft cabin in flight, the potential interventions are limited owing to confined and restricted space for patient care and less-than-appropriate positioning of the patient, limited personnel with the appropriate skill set, and few supplies. During flight, the most appropriate and probably the only possible approach to the management of cardiac arrest is a basic approach. Thus, recognition of cardiac arrest, compression-only CPR,[14,15] and defibrillation with the use of an AED[16-20] represent the interventions that the volunteer physician should consider applying.

If the patient is resuscitated, diversion and emergency landing are probably the most appropriate recommendations to be made to the captain of the aircraft. When diversion is not immediately available, the volunteer physician should provide care and monitor the patient to the best of his or her abilities, given the medically austere environment.

If a return of spontaneous circulation is not achieved within 20 to 30 minutes, it is appropriate to consider cessation of resuscitation efforts

and pronouncement of death. The realities of cardiac-arrest outcome — particularly in this austere environment — provide justification for discontinuing treatment if the patient does not have a favorable response.[21] A shockable rhythm may prompt the clinician to continue resuscitation. Only a physician can pronounce death during flight.[6]

ACUTE CORONARY SYNDROMES

"Cardiac symptoms" represent 8% of medical emergencies on commercial airliners; other manifestations of an acute coronary syndrome that may occur include syncope or presyncope (37% of in-flight medical emergencies), "respiratory symptoms" (12%), and cardiac arrest (0.3%).[2] During a commercial flight, the volunteer physician may have only the patient's history and physical examination to guide clinical decision making and subsequent advice to the captain of the aircraft.

Symptoms of acute coronary syndromes include chest discomfort, dyspnea, nausea, vomiting, and diaphoresis.[22] A constellation of these symptoms in a middle-aged or older adult can suggest an acute coronary syndrome as a cause of the patient's cardiac symptoms. The patient's medical history can be of value, particularly if there is a history of an acute coronary syndrome.

Options for the management of a suspected acute coronary syndrome in an in-flight patient are limited. Aspirin is recommended in most adult patients with chest pain who are suspected of having an acute coronary syndrome[23]; the only absolute contraindications to administration include an active, clinically significant hemorrhage and a true allergic reaction. Sublingual tablets of nitroglycerin are also present in the medical kits, though they should be used with caution.[3] In certain situations, such as an acute inferior ST-segment elevation myocardial infarction with right ventricular infarction (a diagnosis that cannot be made on a commercial aircraft in flight), nitroglycerin can cause or exacerbate hypotension and shock. In an ill-appearing patient, intravenous access is appropriate; a limited fluid bolus may be helpful in patients with hypotension requiring intervention.

Supplemental oxygen should be provided if the clinician suspects respiratory compromise, and the clinician might request a descent to a lower altitude to improve oxygenation. Because of Dalton's law and because commercial airliners are usually pressurized to the equivalent altitude of 6000 to 8000 ft,[24,25] passengers typically have a partial pressure of arterial oxygen of 60 mm Hg (at sea level, it is normally 75 to 100 mm Hg).[26] A descent in altitude may permit higher pressures of oxygen, though at a risk of the use of more fuel, because fuel consumption is greater at lower altitudes.

A possible acute myocardial infarction in an ill-appearing patient or in a patient who is in an unstable condition should prompt a recommendation to the crew for immediate diversion. Conversely, a patient in stable condition who is at lower risk for an acute coronary syndrome event should prompt a less urgent recommendation; at a minimum, the patient should be offered transport to a hospital by emergency-medical-service personnel on landing.

STROKE

Acute stroke can manifest in various ways. Clinicians should consider this as a potential diagnosis in a passenger who has an abrupt onset of neurologic symptoms. Although performing a complete neurologic assessment is challenging in the confined environment of an aircraft, providers should evaluate patients for focal neurologic deficits. Suspected strokes account for approximately 2% of in-flight medical emergencies.[2]

Clinicians who suspect stroke in travelers with evidence of respiratory compromise should consider providing supplemental oxygen, because hypoxemia must be avoided to limit further injury to neural cells.[27] Clinicians should note that the available oxygen supply is limited and so should use the lowest necessary flow rate. Although aspirin is available in the emergency medical kit, this medication should not be given in flight for a suspected stroke because an intracranial hemorrhage may mimic an ischemic stroke.

Because strokes can also be mimicked by hypoglycemia, the blood sugar level should be measured, if possible. The standard in-flight emergency medical kit does not contain a glucometer, though some airlines carry one as part of an enhanced emergency medical kit. One possible solution when a glucometer is not provided in the medical kit is for health care providers to ask other passengers whether one of them has a glucometer they can borrow, though verification

of calibration may not be possible; the cleanliness of the device and potential for transmission of bloodborne pathogens must also be considered. Finally, the suspicion of an acute stroke should prompt the responding health care provider to recommend an expedited landing.

ALTERED MENTAL STATUS

The causes of altered mentation are myriad, and they represent a large number of in-flight medical emergencies. Seizures and postictal states, for example, account for 5.8% of aircraft emergencies, and complications from diabetes account for 1.6%.[2] Because altered mental status may be the result of metabolic derangement, infection, vascular pathology, intoxication, trauma, hypoxemia, or another clinically significant cause, the clinician assisting such a passenger must keep a wide differential diagnosis in mind.

Air travel may exacerbate underlying neurologic conditions. For example, seizure thresholds are potentially lowered by in-flight hypoxemia and perturbations in passengers' circadian rhythms.[28] Clinicians must assess for reversible causes of a patient's altered mentation. The blood sugar level should be determined, if possible. Patients with hypoglycemia may be given oral carbohydrates (if the level of mentation is sufficient) or intravenous dextrose.

Supplemental oxygen should be considered in patients in whom respiratory compromise is suspected, and the clinician might request a descent to a lower altitude. Because many causes of altered mental status are potentially debilitating or fatal, responding health care providers should consider recommending an expedited landing or diversion, unless an easily rectifiable cause of altered mentation is identified and treated.

SYNCOPE

Syncope and presyncope are relatively common medical events; in one study, these conditions accounted for 37.4% of all aircraft medical emergencies.[2] Passenger aircraft cabins are pressurized by air pumped through the engines, which results in a relatively arid environment. As such, many passengers are somewhat dehydrated.[29] Decreased arterial oxygen tension also occurs in passengers when aircraft are at cruising altitudes.[26] Altered eating patterns and fatigue from delayed flights may also contribute.

A responding health care provider should measure the passenger's blood pressure and pulse, because intravascular volume depletion or bradycardia can readily cause syncope or presyncope. The simple maneuver of laying the patient on the floor with the feet elevated may provide rapid relief. Patients with persistent hypotension may need intravenous fluids. The blood glucose level should be checked with a fingerstick device, if possible.

Syncope can be caused by many underlying medical conditions, some of which are potentially fatal. Risk stratification of these patients, rather than a focus on finding the actual cause, is crucial, particularly in this medically austere environment.[30] In the case of elderly passengers with serious cardiac disease, particularly those who have persistent symptoms or abnormal physical findings, the responding clinician should consider recommending a diversion because these patients are at increased risk for death.[31]

TRAUMA

Trauma is a relatively common occurrence in flight. Injuries on commercial airlines, however, are usually minor, often resulting from blunt force trauma due to turbulence.[32] In one study, lower-limb fractures were the most common injury requiring hospital admission, followed by head injuries, open wounds, and upper-limb fractures.[33] Although these are often nonlethal injuries, clinicians should always consider patient-specific factors, such as age, medical conditions, and use of anticoagulants.[34]

Most traumatic injuries can be assessed and treated with basic first aid. Cold compresses and analgesia can be offered. If a fracture or dislocation is suspected, the patient should be placed in a non–weight-bearing position with appropriate splinting. Head trauma is typically minor, but a thorough history should be taken and a physical examination performed. Frequent reassessment will allow for early recognition if the injuries sustained are more severe than originally suspected and necessitate consideration of expedited landing or diversion.

DYSPNEA

Reduced oxygenation can put passengers at risk for exacerbations of underlying respiratory diseases. Indeed, an estimated 12% of in-flight medical emergencies involve a respiratory complaint.[2] For instance, acute exacerbations of

chronic obstructive pulmonary disease are not uncommon.[35] Furthermore, patients with pulmonary hypertension can have severe hypoxemia as a plane gains altitude.[36]

Clinicians assisting passengers with dyspnea should consider providing supplemental oxygen. In fact, passengers with respiratory illnesses and a resting oxygen saturation lower than 92% at sea level are advised to fly with additional oxygen; permission to travel with additional oxygen can be arranged with the airline with advance notice.[6,37] An albuterol metered-dose inhaler to treat bronchospasm is also available in the medical kit.[3] Cases of pneumothorax have been reported.[38-40] Suspicion of pneumothorax in a patient who is in unstable condition may require the clinician to perform a needle thoracostomy, using the on-board equipment or even improvised (i.e., nonmedical) equipment if the patient is in an extremely unstable condition and the appropriate medical equipment is not available. Descending to a lower altitude may also be beneficial, because cabin pressure is inversely proportional to the altitude of the aircraft.

ACUTE INFECTIONS

If a potentially contagious disease is suspected, the clinician should make an effort to isolate the patient.[41,42] Simply preventing movement of the patient around the cabin and relocating neighboring passengers can reduce the risk of transmission.[6,41] Isolation of body fluids should be adhered to when an acute infection is suspected; gloves are available in the medical kit. Using the bag-valve mask (or performing compression-only CPR) eliminates the need for mouth-to-mouth resuscitation. Finally, when a communicable disease is suspected, the volunteer clinician should have a discussion with both ground-based medical services and the flight crew about potential quarantine and government reporting requirements.[43]

PSYCHIATRIC EMERGENCIES

Psychiatric issues constitute 3.5% of in-flight medical emergencies.[44] Potential stressors include a lengthy check-in process, enhanced security measures, delayed flights, cramped cabins, and alcohol consumption.[45] Acutely agitated passengers pose considerable safety concerns.[29,45]

When faced with a passenger who is having an acute psychiatric issue, clinicians must determine whether an organic cause, such as hypoglycemia, may be responsible. Because the medical kit does not contain sedatives, the use of improvised physical restraints might be necessary to ensure the safety of other passengers if attempts at deescalating the situation and calming the passenger are unsuccessful.

CONCLUSIONS

In-flight medical emergencies occur with relative frequency. Air travel can exacerbate passengers' underlying diseases, and new conditions may manifest during flight. Physicians should be prepared to render care while traveling; physicians must also be aware of the medically austere environment, its related limitations on prudent practice, and the associated liabilities surrounding the delivery of in-flight medical care.

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