Is There a Doctor Onboard? Medical Emergencies at 40,000 Feet

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• Wilderness medicine • In-flight medical emergencies • Flight attendants • FAA

INTRODUCTION

It is estimated 2.75 billion people travel aboard commercial airlines every year and 44,000 in-flight medical emergencies occur worldwide each year.[1] Wilderness medicine requires a commonsense and improvisational approach to medical issues. A sudden call for assistance in the austere and unfamiliar surroundings of an airliner cabin may present the responding medical professional with a “wilderness medicine” experience. From resource management to equipment, this article sheds light on the unique conditions, challenges, and constraints of the flight environment.

THE FLIGHT ENVIRONMENT

Modern commercial aircraft fly at the interface between the troposphere and stratosphere, roughly equivalent to a cruising altitude of 32,000 to 45,000 feet. Above the troposphere, planes fly more smoothly and experience less turbulence and inclement weather. The height of the troposphere varies with altitude and season. Passengers are protected from high-altitude atmospheric conditions by a pressurized cabin environment that potentially creates its own medical ramifications.

CABIN ALTITUDE

The ambient atmospheric pressure at cruising altitude (30,000–40,000 feet) is about 200 to 300 hPa (roughly 0.2–0.3 atm). To allow passengers to survive and operate in this environment, the cabin must be pressurized. Despite pressurization, the internal cabin altitude is generally not maintained at sea level pressure because the aircraft structure required to maintain a sea level pressure would make the plane unacceptably heavy and expensive to build and operate. Thus, a compromise is made that is the most efficient for weight/strength/expense, while preventing passengers from

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becoming hypoxic. The aircraft cabin is typically pressurized between 6000 and 8000 feet above sea level. Newer aircraft, such as the Airbus A380 and Boeing 787 Dreamliner, can pressurize the cabin to lower altitudes, equal to about 6000 feet, even in the upper flight levels. In the United States, Federal Aviation Administration (FAA) requirements allow a maximum cabin altitude of 8000 feet.

Many people with heart and lung disease travel by commercial aircraft, and are unaware of the risk that is incurred. The fractional oxygen content of the air in the cabin is the same as that at sea level, approximately 21%. What changes with increasing cabin altitude is the atmospheric pressure. At a typical cruising altitude, the atmospheric pressure in the cabin is decreased by about 25% to 30% and results in a similar decrease in the partial pressure of inspired oxygen. The lower partial pressure of oxygen in the aircraft cabin results in slight hypoxemia, with a corresponding decrease in oxygen saturation and a mild compensatory hyperventilation and tachycardia. Medical personnel responding to onboard medical events should not be surprised by decreases in arterial oxygen saturation in the range of 3% to 5%, even in healthy individuals.

PRESSURE AND DYSBARISM

Boyle's law states that in a perfect gas where mass and temperature are kept constant, the volume of the gas varies inversely with the absolute pressure.

$$(P \times V = P' \times V')$$

Reduction in aircraft cabin pressure can lead to volume expansion of closed gas-containing compartments in the human body.

Middle Ear

Expanding volumes of air in the paranasal and frontal sinuses may produce symptoms, but the most common manifestation of dysbarism associated with the flight environment is barotitis media resulting in ear pain. Barotitis media is commonly related to eustachian tube congestion secondary to upper respiratory infections, middle ear infections, chronic effusions, or allergies. Mild barotrauma may occur as either pressure increase caused by expansion of gases as the aircraft ascends, or by decreased pressure in the middle ear as the aircraft descends. Although mild discomfort is the typical presentation, in rare cases, the changes in pressure can produce rupture of the tympanic membrane.

The most simple and commonly used method to open the eustachian tube is to swallow. Chewing gum or sucking on hard candy may facilitate this process. Infants should be given a bottle or pacifier to suck on to facilitate swallowing, especially during descent.

Older children and adults may benefit from performing a Valsalva maneuver. This is achieved by pinching the nostrils and attempting exhalation through the nose. This maneuver is familiar to most scuba divers, because the same technique is used for equalizing ears during descent. Another useful technique is to have the patient swallow while pinching the nostrils closed. Other pressure equalization techniques[2] include the following:

- Voluntary tubal opening: Attempt to yawn or wiggle the jaw
- Valsalva maneuver: Pinch your nostrils, and gently blow through your nose
- Toynbee maneuver: Pinch your nostrils and swallow (good technique if equalization is needed during ascent)
- Frenzel maneuver: Pinch your nostrils while contracting your throat muscles, and make the sound of the letter "k"