Coffee, Tea, or MD?
Management of In-Flight Medical Emergencies

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Disclosures

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Learning Objectives

• Explain the physiologic changes that occur during commercial air travel.
• Use the emergency medical kit and other resources to treat a passenger who becomes sick.
• Understand how factors such as hypoxia, dim lighting, and limited space can limit the physician’s ability to provide safe care.
PV = nRT

Temperature, pressure, volume affect gases
Each gas in a mixture exerts a pressure proportional to its concentration.

Total pressure of mixture is the sum of the *partial pressures*.
Respiratory Physiology

- \( \text{PaO}_2 \) in healthy population: 100 mmHg
- \( \text{PaO}_2 \) decreases with lung disease
  - Asthma
  - COPD
Cabin Environment

- Pressure altitude: 8,000 feet
- $\text{PaO}_2$ (healthy passengers): 56 mmHg
- Low humidity (Less than 10%)
Hemoglobin Physiology

![Graph showing oxygen saturation and concentration at different altitudes.]

- **2,500-17,500 Feet**
- **24,000-43,000 Feet**
- **6,000-8,000 Feet**
Adaptation to Hypoxemia

**Respiration**
- Increased tidal volume
- Increased respiratory rate
- Begins at 4,000 ft, maximal at 22,000 ft

**Cardiovascular system**
- Increased cardiac output
- Increased blood pressure
Boyle’s Law

- Pressure, volume inversely related
- Gas-filled cavities expand
- Ruptured bronchogenic cyst

Closon et al. Anesthesiology 2004;101:539-42
Altitude: Pressure Effects

- Barotitis, barosinusitis
  - Otoscopic changes in 10% adults, 20% children
  - Negative ear pressure in 20% adults, 40% children
  

- Severe pain, loss of hearing

- Abdominal pain
Henry’s Law

- Dissolved gas proportional to partial pressure
- Decompression sickness: $\text{N}_2$ emboli
- Dives within 24 hours, sudden decompression
- Life-threatening
SaO2 required before flight:
- 93% without O2
- 95% with O2

SpO2 during six-minute walk test correlates with SpO2 during flight

Pulmonary Disease

- 6 minute walk test or hypoxia inhalation test
- Contraindications:
  - Unstable pulmonary condition
  - e.g. Severe or poorly controlled asthma
  - Class III or IV pulmonary hypertension
  - Active pneumothorax

Contraindications

- Recent CABG
- Unstable angina
- Symptomatic valvular heart disease
- Decompensated CHF
- Uncomplicated MI (2-3 weeks)
- Complicated MI (6 weeks)

Who Gets Sick?

- Air Canada and telemedicine databases
- 5 year retrospective analysis
- 5368 events, 220 diversions
  - Cardiac (26.4%)
  - Neurologic (19.5%)
  - Gastrointestinal (11.4%)
  - Syncope (10.0%)

Two measles clusters

- Flight attendant who traveled to area with low vaccination rate
- Two passengers who traveled from Amsterdam to London

Secondary infections: Vaccinated and unvaccinated family and healthcare workers

Who Volunteers?

- Hong Kong airline
- Medical emergencies 2003-2008
- 4068 emergencies, 46 diversions, 30 deaths
- 3 most common: GI, neurologic, surgical
- Physician volunteers in 36% of cases
Who Volunteers?

- Train cabin crew in stroke screening
- Tablet-based cognitive aids for volunteers
- Training for medical students

Resources: Medical Kit

- Stethoscope, BP cuff
- Airway management equipment
- Automated external defibrillator
- IV start kit, normal saline, dextrose
- Medications, including cardiac drugs
Consulting Services
What Do I Do?

- Identify yourself, state qualifications
- History, physical examination
  - Request an interpreter
  - Get consent?
- Begin treatment
- Goal: Stabilize patient until aircraft lands
What Do I Do?

- Scene safety first priority
  - Flight crew has ultimate authority
- Inform flight crew
- Ask for consultation
- Request diversion if appropriate
- Document findings, communication, plan
- Do no harm!
Unresponsive passenger

- Apply AED
  - Cabin crew trained in use of AED
- Begin CPR if indicated
  - Better to treat patient in seat
- Start IV, administer 50% glucose
- Ask for diversion if no response
AED Use on Commercial Flights

- Self-reported AED use on 3 US airlines
- 169 AED applications, 40 cardiac arrests
- Mean age 58 years
- 14 defibrillations
- Rest NSR, A Fib / A Flutter / Heart block
- Most common use: In-flight monitoring

Deep Venous Thrombosis

- Long periods of inactivity, cramped seating
- Dehydration
- Venous stasis
- Nothing unique about flying
DVT: Incidence

- Asymptomatic DVT study:
  - 131 random passengers, 8 hour flight
  - 10% incidence (no stockings), none with stockings


- DVT Meta-analysis: No increased risk due to flying

DVT: Prevention

- Get up!
- Wear support hose
- Drink lots of fluids (nonalcoholic)
- Consider aspirin before the flight
Symptoms:
- Chest pain
- Shortness of breath
- May complain of DVT symptoms

Administer oxygen
Consider diversion
Disruptive Passenger

- Tokyo Convention of 1963
- Written for in-flight psychiatric illness
- Passengers may take any action necessary to prevent injury to others
Nothing in this subpart is intended to require certificate holders or its agents to provide emergency medical care or to establish a standard of care for the provision of emergency medical care.

*FAR 121.801*
Medical liability

- No litigation against physicians... yet
- Airlines liable for neglect, willful misconduct
- Obligation to assist
  - Not required in U.S., U.K., and Canada
  - Required in Australia, EU countries
- U.S. Aviation Medical Assistance Act
  - Limited protection to medically qualified passenger
You Do Not Want to Be The Case Report!
**Boeing 787 Dreamliner**

- New technology for stronger construction
- Cabin pressure altitude 6,000 feet
- Higher relative humidity
- New, improved batteries!
Medical Tourism

- Over 500,000 international trips in 2006
  - India, Thailand probably most common
- Cosmetic surgery, dentistry
- Joint replacement, CABG, valve replacement
- [www.healthcaretrip.org](http://www.healthcaretrip.org)

The Personal Spaceflight Federation (PSF) is the industry association of leading businesses and organizations working to make commercial human spaceflight a reality.

The mission of the PSF is to promote the development of commercial human spaceflight, pursue ever higher levels of safety, and share best practices and expertise throughout the industry.

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Hyatt Regency San Francisco, 5 Embarcadero Center

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November 2-6, 2015  |  Kauai, Hawaii
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