There is a good chance you will be asked to serve

- 50% of physicians have responded to a medical emergency on an airplane
- 10% have responded to more than one
- I just had my first airplane emergency last February

Itinerary

1. Epidemiology of airplane emergencies
2. Pathophysiology of commercial flight
3. Equipment and interventions on the plane
4. Common midair emergencies
5. Anticipatory guidance to fly safely
The incidence of inflight emergencies is unknown

- There is no centralized reporting system
- Minor in-flight emergencies may not be called in for ground-based support

How many In-Flight Medical Emergencies are there?

- 4 billion passengers board commercial airplanes each year
- 1 / 40,000 passengers has a medical emergency
- 250 to 1000 events per day
- 1/600 flights

Your probability of encountering an emergency is increasing

- Airplanes are larger
- Flights are longer
- Population is aging

How serious are in-flight emergencies?

- 5% of travelers have a chronic illness
  - Represent 2/3 of medical emergencies
- Vasovagal syncope most common problem for healthy passengers
- 7-13% of medical emergencies result in aircraft diversion
- ~3% of events are fatal
The partial pressure of oxygen decreases with altitude.

Hypobaric hypoxia’s effect on oxygen saturation.
Gases expand during flight

- **Boyle’s Law**: $p_1V_1 = p_2V_2$
- HEENT $\Rightarrow$ barotalgia, barodontalgia, barosinusitis
- Lungs $\Rightarrow$ Pneumothorax
- GI $\Rightarrow$ Wound dehiscence, bowel perforation, flatulence
- CV $\Rightarrow$ Decompression sickness
- Medical equipment $\Rightarrow$ air embolism, rupture, compartment syndrome, or local trauma

Air quality can affect passengers

- **Infection**
  - Transmitted through close proximity, not air recirculation
  - Most common influenza and parainfluenza
- **Low Humidity**
  - COPD or asthma exacerbations
  - Epistaxis
  - Thick mucous $\Rightarrow$ tracheostomy plugging
  - Insensible fluid loss

Economy Class Syndrome

- Prolonged sitting $\Rightarrow$ stasis $\Rightarrow$ deep venous thrombosis $\Rightarrow$ pulmonary embolism
- Drink, walk, wear compression stockings
- Those with pre-existing risks may need aspirin or heparin
Travel Considerations

- Physical and mental stress → MI, psychiatric emergencies
- Disrupted circadian rhythms → decrease seizure threshold
- Medication noncompliance from forgetfulness, time changes, flight delays, checked drugs
- Decreased access to food → hypoglycemia

In-Flight Environment

- Turbulence → motion sickness or traumatic injury
- Falling luggage
- Food allergies and poisoning

Equipment and Interventions

History of Equipment and Regulations

- 1986 - Emergency medical kits (EMKs) required on large aircraft
- 1994 - Protective gloves mandated
- 2001 - AED and enhanced medical kit
### What equipment is in the EMK?

<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th>Contents and Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic</td>
<td>1 Sphygmomanometer</td>
</tr>
<tr>
<td></td>
<td>1 Stethoscope</td>
</tr>
<tr>
<td>Airway management</td>
<td>Oropharyngeal airways: 1 pediatric, 1 small adult, 1 large adult</td>
</tr>
<tr>
<td></td>
<td>1 Self-inflating manual resuscitation device</td>
</tr>
<tr>
<td></td>
<td>Cardiopulmonary resuscitation mask: 1 pediatric, 1 small adult, 1 large adult</td>
</tr>
<tr>
<td>Intravenous administration set</td>
<td>1 Tubing set with 2 Y connectors</td>
</tr>
<tr>
<td></td>
<td>2 Alcohol sponges</td>
</tr>
<tr>
<td></td>
<td>1 Roll of 1-inch adhesive tape</td>
</tr>
<tr>
<td></td>
<td>1 Pair of tape scissors</td>
</tr>
<tr>
<td></td>
<td>1 Tourniquet</td>
</tr>
<tr>
<td></td>
<td>1 500 cc bag saline solution</td>
</tr>
<tr>
<td>Medication administration</td>
<td>Needles: 2-18 gauge, 2-20 gauge, 2-22 gauge, or other sizes necessary to administer medications</td>
</tr>
<tr>
<td></td>
<td>Syringes: 1-5 cc, 2-10 cc, or sizes necessary to administer medications</td>
</tr>
<tr>
<td>Protective equipment</td>
<td>Nonpermeable gloves: 1 pair</td>
</tr>
</tbody>
</table>

### What drugs are in the EMK?

<table>
<thead>
<tr>
<th>Category</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analgesics</td>
<td>Nonnarcotic analgesic tablets, 325 mg: 4</td>
</tr>
<tr>
<td></td>
<td>Aspirin tablets, 325 mg: 4</td>
</tr>
<tr>
<td>Antihistamines and bronchospasm</td>
<td>Antihistamine tablets, 25 mg: 4</td>
</tr>
<tr>
<td></td>
<td>Antihistamine injectable, 50 mg (single dose): 2 amphioues</td>
</tr>
<tr>
<td></td>
<td>Metered dose bronchodilator inhaler: 1</td>
</tr>
<tr>
<td>Resuscitation</td>
<td>Atropine, 0.5 mg, 5 cc (single dose): 2</td>
</tr>
<tr>
<td></td>
<td>Dextrose, 50% / 50 cc injectable, (single dose): 1</td>
</tr>
<tr>
<td></td>
<td>Epinephrine 1:1000, 1 cc, injectable (single dose): 2</td>
</tr>
<tr>
<td></td>
<td>Epinephrine 1:10,000, 2 cc, injectable (single dose): 2</td>
</tr>
<tr>
<td></td>
<td>Lidocaine, 5 cc, 20 mg/ml, injectable (single dose): 2</td>
</tr>
<tr>
<td>Heart disease</td>
<td>Nitroglycerin tablets, 0.4 mg: 10</td>
</tr>
</tbody>
</table>

Adapted from Federal Aviation Regulation 14 CFR 121-803, Appendix A (Public Domain).
The Aerospace Medical Association has a larger recommend EMK

What drugs are not in the kit

- **Drugs**
  - Narcotics
  - Naloxone
  - Insulin
  - Antibiotics
  - ACLS drugs

- **Equipment**
  - Glucometer
  - Intubation equipment

The EMK has limitations

- Multiple doses are not always available
- Kits not always maintained
- Contents vary among airlines and countries
The EMK has pediatric limitations

- Liquid or suppository medications not available
- High concentration of IV medications
- Small gauge IVs
- Infant sized masks and airways not usually available
- Beta agonist delivery

Remember there are other resources available

- Other passengers and flight crew
  - Oxygen
    - Available by facemask at 2-4 L/min
  - AED
    - Can be used as monitor

You are not always alone up there

- Many airlines partner with ground-based physician support services
- Offer medical consultation
- Multilingual
- Maintain a list of intermediate airports and medical capabilities

There are options to divert the plane

- May request diversion, expedited landing, or emergency personnel to meet on arrival
- Under ideal conditions, it takes 20 minutes to land the aircraft
- Flying at a lower altitude may improve oxygenation
- $15,000-$890,000 to divert a plane

Common Emergencies

Approaching a Midair Patient

- Identify yourself and level of training
- ABCs, CPR, AED
- Request EMK and oxygen if needed
- Find space
- Obtain medical history and physical exam
- Get help from the ground-based consultation and other passengers
- Consider diversion or altitude reduction
- Document

Unresponsiveness

- ABCs
- AED
- O2
- Fluid
- Dextrose
- ±Naloxone

Adapted from: Peterson DC et al. NEJM. 2013; 368:2075-2083
Cardiac Arrest
- ABCs
- AED
- CPR
- ACLS
  - Epinephrine
  - Atropine
  - Lidocaine

CPR Refresher
- Chest compression : breaths = 30:2
  - Exception: If child (<8) and 2 rescuers 15:2
- Should see chest rise with breaths
- Chest compression depth
  - Adult: 2 inches (5.5 cm)
  - Child: 1/3 AP diameter of chest
- Rate 100-120 bpm
  - “Stayin’ Alive….” – Bee Gees (1977)

Chest Pain
- ABCs, oxygen
- Cardiac monitor or AED
- Morphine
- Oxygen
- Nitroglycerin
- Aspirin
- Beta blocker
- Consider diversion or altitude reduction

Respiratory
- ABCs
- Oxygen
- Lower altitude
- Bronchodilators
- Steroids
- Epinephrine
- Bag valve masks
Psychiatric

- Panic attacks, anxiety, phobias
- Ask other passengers for medications, offer PO anxiolyis
- May have IM benzodiazepine
- Question intoxication or hypoglycemia/hypoxemia
- Physical restraint
  - 4-5 people
  - Constant reassessment

Obstetric

- Gather supplies
  - Towels
  - Blankets
  - Suture material or ties
  - Bulb suction
- EMK
  - Oxytocin?
  - Umbilical clamps?
  - No neonatal resuscitation equipment

Pneumothorax

- www.exchange.Nottingham.ac.uk

Pneumothorax
Anticipatory Guidance

Can I be Sued?
- Aviation Medical Assistance Act of 1998
  - Protects volunteer physician from malpractice if:
    - Is medically qualified
    - Acts voluntarily for no monetary compensation
    - Acts in good faith and does not engage in gross negligence or willful misconduct
  - No physician has ever been successfully sued in US for rendering medical care

Can I be Sued?
- International laws differ among countries
  - U.S., Canada, and UK have similar Good Samaritan laws
  - Much of the European Union, Australia, and New Zealand obligate the physician to respond

Doctor’s can prepare themselves for an inflight medical emergency
- Carry onboard your MD license
  - Also, consider code cards and stethoscope
- Stay current in BLS, ALS, PALS
- Be aware of alcohol, anxiolytics, and sleep aids
- Act to the best of your ability within your training
Doctors can prepare patients to fly safely

- Provide guidance around scheduling medications
- Recommend extra carry-on medications
- Avoid flying after recent surgeries, recent casting, and scuba diving

How do we do?

- When asked, health care worker responded to 75% of emergencies
- High correlation of in-flight and hospital diagnosis
- 60% of cases improved with help from health care provider

I was driving home from the airport alone on the road when I see....

Priorities in managing a motor vehicle accident (MVC)

1. Scene safety
2. Call for help
3. Cervical spine
4. Airway
5. Breathing
6. Circulation
Scene safety is your #1 priority

- Do not approach if fire, gas leak or precipitous balance
- Careful for sharp or hot objects
- Gloves and mask if possible
- Call for help ASAP
- LCES mnemonic
  - Lookout – Person (or flares)
  - Communication
  - Escape Route
  - Safety zones

Important principles in MVC management

- Consider whether you may do more harm than good
- If no problems with scene safety, airway, breathing, or circulation just hold c-spine and wait
  - Use this time to obtain a medical history
  - Keep a child in their car seat
- Consider conditions that led to the accident
- Ask for help without putting yourself in danger
- Stay engaged until EMS arrives

Cervical spine

- If patient ambulatory, encourage them to lie down and maintain cervical spine
- If ABC stable but patient trapped, just hold c-spine
  - May need to be from below or behind
- If needs CPR or airway maneuver, attempt to extract with one person maintaining c-spine
- If alone, attempt to grab and pull from under shoulders using forearms to maintain c-spine

CPR Refresher #2

- In trauma perform jaw thrust to open airway, do not move the neck
Items to have in your car

Summary

- Medical emergencies on airplanes are increasing
- Physiologic changes of flight are generally well tolerated - except in those with predisposing conditions
- Most in-flight emergencies are not serious and are handled adequately by flight crew
- Equipment and drugs on board airplanes can be extensive, but are variable
- In MVCs, scene safety and cervical spine are top priorities
- If you do the best you can within your training you are protected under the law

Questions and Stories?

References

References


There are general guidelines on safety to fly

<table>
<thead>
<tr>
<th>Category</th>
<th>Condition</th>
<th>Source or Further Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low priority</td>
<td>Bacterial meningitis, pneumococcal pneumonia</td>
<td>AMA*</td>
</tr>
<tr>
<td>Cardiac</td>
<td>Myocardial infarction within 3 min</td>
<td>Federation of State Medical Boards of the United States</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>Pneumonecrosis, acute respiratory distress syndrome</td>
<td>AMA*</td>
</tr>
<tr>
<td>Neurologic</td>
<td>Cerebrovascular accidents within 30 min</td>
<td>AMA*</td>
</tr>
<tr>
<td>Infectious</td>
<td>Acute respiratory distress</td>
<td>AMA*</td>
</tr>
<tr>
<td>Drug abuse</td>
<td>Physiological stress</td>
<td>AMA*</td>
</tr>
<tr>
<td>Radiation exposure</td>
<td>Radiation exposure</td>
<td>AMA*</td>
</tr>
<tr>
<td>High priority</td>
<td>Asphyxia, hypothermia, hyperthermia</td>
<td>AMA*</td>
</tr>
</tbody>
</table>

*Adapted from guidelines of the Aeromedical Assessment (AMA) with the permission of the publisher: AMA (American Medical Association).

In-flight oxygen must be arranged ahead of time
Indications for in-flight oxygen

- Use of oxygen at baseline altitude
- CHF NYHA class III–IV or baseline PaO2 less than 70 mm Hg
- Angina CCS class III–IV (14)
- Cyanotic congenital heart disease
- Primary pulmonary hypertension
- Other cardiovascular diseases with known baseline hypoxemia

Recommendations for VTE prophylaxis

<table>
<thead>
<tr>
<th>Risk category</th>
<th>Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Risk:</td>
<td>- Mobilization - Hydration, - Support tights or non-elasticated long socks</td>
</tr>
<tr>
<td>Age over 40</td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td></td>
</tr>
<tr>
<td>Active inflammation</td>
<td></td>
</tr>
<tr>
<td>Recent minor surgery (within last 3 days)</td>
<td></td>
</tr>
<tr>
<td>Moderate Risk:</td>
<td>- Consider aspirin - Graduated compression stockings - Hydration and mobilization</td>
</tr>
<tr>
<td>Varicose veins</td>
<td></td>
</tr>
<tr>
<td>Heart failure (uncontrolled)</td>
<td></td>
</tr>
<tr>
<td>Myocardial infarction (recent)</td>
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<tr>
<td>Hormone therapy (including OCPs)</td>
<td></td>
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<tr>
<td>Pregnancy/postnatal</td>
<td></td>
</tr>
<tr>
<td>Lower limb paralysis</td>
<td></td>
</tr>
<tr>
<td>Lower limb trauma (within 6 weeks)</td>
<td></td>
</tr>
<tr>
<td>Polycythemia</td>
<td></td>
</tr>
<tr>
<td>High Risk:</td>
<td>As above but may recommend low molecular weight heparin instead of aspirin</td>
</tr>
<tr>
<td>Previous VTE</td>
<td></td>
</tr>
<tr>
<td>Thrombophilia</td>
<td></td>
</tr>
<tr>
<td>Major surgery (within 6 weeks)</td>
<td></td>
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<tr>
<td>CVA</td>
<td></td>
</tr>
<tr>
<td>Malignancy</td>
<td></td>
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<tr>
<td>Family History of VTE</td>
<td></td>
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</tbody>
</table>