Aviation Medicine Seminar Series

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- Aviation Medical Examiner (AME)
(1) How to Ace the Medical Exam

- December 13, 2003
- AME training
- How to find a Medical Examiner
- What the exam involves
- The 15 disqualifying conditions…
(2) Spatial Disorientation - January 10, 2004

- **Vestibular** based disorientation: What it is, How to deal with it
- **Vision** based disorientation: What it is, How to deal with it
(3) Common Aeromedical Problems -
  • February 14, 2004
  • Motion Sickness
  • Hyperventilation
  • Hypoxia
  • Carbon Monoxide
  • Trapped gas
(4) Advanced Topics
March 13, 2004
- Self imposed stress
- Hypoxia/Oxygen use and abuse
- Altitude induced decompression sickness
- Trapped gas
- Cabin pressurization
Self Imposed Stress

Introduction

• Definition of Stress
  • Stress is the sum of biological reactions to any adverse stimulus - be it physical, mental, emotional, internal or external - that tend to disturb the “Body’s Natural Balance”

• Although difficult to determine the full effect of stress on the pilot, it is important to be aware of the stresses we can control
Self Imposed Stress

Introduction

- Self imposed stresses have adverse effects on pilots and therefore can affect the safety of flight
- Each stress can deteriorate your piloting skills and these stresses are cumulative
Self Imposed Stress

- Alcohol consumption
- Self medication
- Drug use
- Tobacco use
Self Imposed Stress

Self Imposed Stresses

- Inadequate diet and nutrition
- Psychological stress
- Fatigue
- Poor physical fitness
Alcohol

- Alcohol is a depressant, hypnotic, and addicting drug that in any quantity will have adverse effects on your flying ability
Alcohol and the FARs

• FAR 91.17
  • No person may operate or attempt to operate an aircraft:
    • within 8 hours of consuming alcohol
      ➢ within 24 hours if intoxication or IFR flying is involved (recommendation only)
    • while under the influence of alcohol
    • with a blood-alcohol content of 0.04% or greater
Alcohol as a Drug

- Alcohol is a drug
  - Depressant
    - Blocks impulses from the brain and decreases the ability of the brain to use oxygen
    - Majority of adverse effects are to brain, eyes and middle ear: Crucial organs for pilots
Effects of Alcohol

- Alcohol:
  - slows reaction time
  - impairs judgement
  - impairs memory
  - impairs vision
  - impairs hearing
  - increases fatigue
  - synergistic effects with medications
**BAC and Impairment**

- **0.02% - 0.07%**: significant performance decrements
- **0.04%**: markedly impaired performance (3 standard alcoholic drinks for the average person)
Elimination of Alcohol

Approximately 1/3 oz/hour

Hours to Clear Alcohol

Number of Drinks

Beer

Cocktail

Double

Martini

Approximately 1/3 oz/hour
Hangover Effects

• After acute effects of alcohol intoxication
• May last up to 48-72 hours after drinking alcohol
• May be just as dangerous as intoxication itself
• Includes: impaired judgement, fatigue, irritability, headache, dizziness, dry mouth, stuffy nose, upset stomach, sensitivity to light.
Alcohol and Aircraft Accidents

- Approximately 6 to 9% of GA accidents are caused by alcohol each year.
- 0.04% (40mg/dl) FAA limit.
- 0.02% (20mg/dl) detectable & reported by CAMI.
Self Imposed Stress

Alcohol

- Impairments In;
  - Reaction time
  - Reasoning
  - Judgment
  - Memory
  - Brain oxygen utilization
    a. Hypemic Hypoxia
Self Imposed Stress

Alcohol

Visual Impairments
- Eye muscle imbalance
- Double vision
- Difficulty in focusing

Inner Ear Effects
- Dizziness
- Decreased hearing
Our body is capable of eliminating one third of an ounce of alcohol an hour.

The after effects of alcohol consumption:
- Headache
- Dizziness
- Dry mouth
- Stuffy nose
Alcohol

Self Imposed Stress

The after effects of alcohol consumption

- Fatigue
- Upset stomach
- Irritability
- Impaired judgment
- Increased sensitivity to bright light
The use of alcohol and drugs is regulated FAR 91.17

- Persons may not operate, or attempt to operate, an aircraft when they are currently under the influence of alcohol
- Have consumed alcohol within the past 8 hours
Alcohol

• The use of alcohol and drugs is regulated FAR 91.17
  - Have a blood alcohol content of .04% or greater
  - Are using any drug that adversely affects flight
Self Imposed Stress

Over-The-Counter Medications

- You should be aware that over-the-counter medications as well as prescription medications can affect the safe operation of your aircraft.
Over-The-Counter Medications

- Some drugs effects can be intensified when taken to altitude
- Consult your local Aviation Medical Examiner that a medication might have on you as a pilot
A balanced meal consist of
- Carbohydrates (50-55%)
  a. Breaks down to glucose
- Proteins (15-20%)
  a. Basic building block of all cells
- Fats (30%)
  a. Concentrated source of energy
Self Imposed Stress

Diet

Hypoglycemia (Low Blood Sugars)
- Weakness
- Headache
- Irritability
- Nervousness
- Trembling
- Fainting
Self Imposed Stress

Psychological Stress

- Psychological stresses involve physiological mental, and emotional responses to sociocultural, family and job related situations
Self Imposed Stress

*Psychological Stress*

Personal life changes that cause stress

- Death of a spouse
- Divorce
- Moving or changing jobs
- Marriage
- Being fired
- Changes in health
Self Imposed Stress

**Flying as a Stress**

Examples of flying events that can be a direct cause of stress

- Flying in bad weather
- Night operations
- Performing an instrument approach to minimums
- Flying in high density traffic area
- Flying in to unfamiliar airports
Examples of flying events that can be a direct cause of stress

- Becoming temporarily lost in flight
- Equipment malfunctions
- Conflicts with other crewmembers or ATC
- Being subject to flight checks
Self Imposed Stress

Signs and Symptoms of Stress

• Anxiety
• Irritability
• Impulsiveness
• Aggressiveness
Signs and Symptoms of Stress

- Emotional or physical isolation
- Problems concentrating
- Confusion
- Difficulty remembering important things
Self Imposed Stress

Signs and Symptoms of Stress

- Increased self doubt
- Nightmares
- Trembling
- Weakness
Self Imposed Stress

Signs and Symptoms of Stress

• Diarrhea
• Indigestion
• Frequent urination
• Migraines
Self Imposed Stress

Signs and Symptoms of Stress

- Grinding teeth
- Cold sweat
- Increased smoking or over-eating
- Alcohol and drug use or abuse
Self Imposed Stress

How To Deal with Stress

- Define the source of stress
- Evaluate available resources
- Explore possible solutions
- Take action
Self Imposed Stress

How To Deal with Stress

- Evaluate outcome
- Make corrections or changes
- Try again
Flying High

- PHYSICS OF THE ATMOSPHERE
- RESPIRATION & CIRCULATION
- HYPOXIA
- HYPERVENTILATION
- TRAPPED GAS
- DECOMPRESSION SICKNESS
- SELF-IMPOSED STRESS
- OXYGEN EQUIPMENT
The atmosphere is the gaseous envelope which surrounds the earth.

- It extends from the earth to approximately 1,000 nautical miles out with most flights below 50,000 feet (approx 8.2 nm).
Composition

NITROGEN 78.08%
OXYGEN 20.95%
<table>
<thead>
<tr>
<th>Trace Gases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argon</td>
<td>.93%</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>.03%</td>
</tr>
<tr>
<td>Helium</td>
<td>.00052%</td>
</tr>
<tr>
<td>Methane</td>
<td>.00052%</td>
</tr>
<tr>
<td>Krypton</td>
<td>.00011%</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>.00005%</td>
</tr>
<tr>
<td>Carbon Monoxide (variable)</td>
<td>.00001%</td>
</tr>
<tr>
<td>Xenon</td>
<td>.00001%</td>
</tr>
</tbody>
</table>
The combined weight of all the atmospheric gases creating a force upon the surface of the earth.

The force is caused by gravity pulling molecules earthward and can be measured at any specific altitude.
If you were to expose a vacuum tube with mercury in it to sea level pressure under standard atmospheric conditions, it would rise 29.92 inches of mercury.

**Equivalents**
- 29.92 inHg
- 760 mmHg
- 14.7 PSI
Troposphere

• Temperature
• Water Vapor
• Turbulence
• Temperature lapse rate
Stratosphere

- Relatively Constant
- Little Water Vapor
- Little Turbulence
- Jet Stream

50,000 feet to 50 miles
PHYSIOLOGICAL EFFICIENT ZONE
S.L. TO 12,500 feet

PHYSIOLOGICAL DEFICIENT ZONE
12,500 to 50,000 feet

SPACE EQUIVALENT ZONE
50,000 feet and beyond
Places O2/CO2 are Exchanged in the Body

- External respiration - atmosphere / lungs
- Internal respiration - lungs / blood
- Cellular respiration - blood / body cells
Decrease of Atmospheric Pressure

- Decrease of Partial Pressure
- Hypoxia

- Decrease of Total Pressure
- Trapped Gas
- Evolved Gas Disorder
Term refers to the absence of an adequate supply of oxygen to the tissues, whether in quantity or molecular concentration.

**INSIDIOUS NATURE**
Types of Hypoxia

- Hypoxic hypoxia: (lung level) ALTITUDE HYPOXIA
- Stagnant/Circulatory hypoxia: (transport level) G FORCES
- Hypemic hypoxia: (blood level) CABON MONOXIDE
- Histotoxic hypoxia: (cell level) ALCOHOL
Causes of Hypoxia in Flight

- Ascent to altitude without supplementary Oxygen
- Aircraft decompression at altitude
- Pilot does not know how to operate equipment
- Failure of oxygen supply equipment
Factors Affecting Individual Tolerance to Hypoxia

Operational Factors
- Altitude
- Duration of Exposure
- Rate of Ascent

Individual Factors
- Fatigue
- Alcohol and Drug use
- Smoking
- Physical Fitness
- Disease and Illness
- Natural Adaptation
- Age
TUC = Time of Useful Consciousness

or

EPT = Effective Performance Time

The time in which a person can efficiently and effectively perform their flying duties in an environment of inadequate oxygen.
<table>
<thead>
<tr>
<th>ALTITUDE</th>
<th>TUC/EPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>18,000’</td>
<td>20-30 Minutes</td>
</tr>
<tr>
<td>25,000’</td>
<td>3-5 Minutes</td>
</tr>
<tr>
<td>30,000</td>
<td>1-2 Minutes</td>
</tr>
<tr>
<td>35,000</td>
<td>30-60 Seconds</td>
</tr>
<tr>
<td>40,000</td>
<td>15-20 Seconds</td>
</tr>
<tr>
<td>43,000</td>
<td>9 to 12 Seconds</td>
</tr>
<tr>
<td>ALTITUDE</td>
<td>TUC/EPT</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------</td>
</tr>
<tr>
<td>18,000’</td>
<td>10-15 Minutes</td>
</tr>
<tr>
<td>25,000’</td>
<td>1.5 - 2.5 Minutes</td>
</tr>
<tr>
<td>30,000</td>
<td>30 - 60 Seconds</td>
</tr>
<tr>
<td>35,000</td>
<td>15-30 Seconds</td>
</tr>
<tr>
<td>40,000</td>
<td>7.5-10 Seconds</td>
</tr>
<tr>
<td>43,000</td>
<td>3 - 5 Seconds</td>
</tr>
</tbody>
</table>

Rapid Decompression = 1/2 - 1/2 OFF
Signs

- Increased breathing rate
- Dazed or confused look
- Lethargic
- Loss of Coordination
- Anything out of the ordinary
• Breathlessness
• Dizziness
• Headache
• Poor Judgment
• Lightheadedness
• Reaction Time Delayed
• Tingling
• Fatigue, Drowsiness
• Warm Sensation
• Loss of Peripheral/Reduced Vision
• Euphoria
Prevention

• Know your Oxygen Equipment
• Know how to use the equipment
• Preflight Oxygen Equipment
• Climb/Level Off and Ops Checks
  - Cabin Pressure
  - Oxygen
• Know your symptoms!!!
A condition in which the respiratory ventilation is abnormally increased.

- Results in excessive loss of CO2.
- Brings on symptoms similar to Hypoxia
Causes

- Anxiety
- Excitement
- Stress
- Fear
- Pressure Breathing
• Be aware of times and conditions that can set you up for hyperventilation.
• Try to keep “cool”.
• Monitor rate and depth of breathing.
<table>
<thead>
<tr>
<th>Onset of symptoms</th>
<th>HYPOXIA: Rapid (altitude dependent)</th>
<th>HYPERVENTILATION: Gradual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle activity</td>
<td>HYPOXIA: Flaccid</td>
<td>HYPERVENTILATION: Spasm</td>
</tr>
<tr>
<td>Appearance</td>
<td>HYPOXIA: Cyanosis</td>
<td>HYPERVENTILATION: Pale, Clammy</td>
</tr>
<tr>
<td>Tetany</td>
<td>HYPOXIA: Absent</td>
<td>HYPERVENTILATION: Present</td>
</tr>
</tbody>
</table>
1. Don Mask - 100% O2
2. Check regulator - On, connections are secure
3. Maintain normal rate and depth of breathing until symptoms clear
4. Descend below 10,000 feet
Preventative Actions

- ADHERE TO 91.211 (Supplemental Oxygen)
- OR, FLY AT AN ALTITUDE WHERE OXYGEN ISN'T REQUIRED

- CAMIs RECOMMENDATION
  - 10,000 feet/day
  - 5,000 feet/night
DON’T hold your breath on ascent
Henry’s Law

The amount of gas in a solution varies directly with the partial pressure of that gas over the solution.
“Oh, great! Now there goes my hat!”
Skin Bends

Chokes

Neurologic

(Skin disturbances)

Types

Bends

(Central nervous system)
Bends

SYMPTOMS

1. Pain in the joints
2. Mild pain at onset
3. Pain becomes deep & penetrating
4. Eventually intolerable in severity
Skin Bends

SYMPTOMS

1. Sensation of tiny insects crawling over the skin
2. Mottled and diffuse rash
3. Itching
4. Swelling of the skin
1. Headache
2. Flashing/flickering lights
3. Blind spots
4. Confusion or memory loss
5. Tunnel or blurry vision
6. Vertigo
7. Extreme fatigue or behavior changes
SYMPTOMS

1. Burning deep chest pain
2. Pain is aggravated by breathing
3. Shortness of breath
4. Dry constant cough
Decompression Sickness Factors

**OPERATIONAL**
- Rate of Ascent
- Altitude
- Time at Altitude

**PERSONAL**
- Body Fat
- Activity
- Dehydration
- Age
Scuba Diving

12 hours no decom. stop
24 hours decom. stop
Treatment of Decompression Sickness

1. Oxygen regulator to 100% oxygen
2. Immobilize effected area (if possible)
3. Descend as soon as practical
4. Report to Aviation Medical Examiner for best qualified medical assistance
5. Compression chamber therapy (if required)
Signs of a Decompression

- NOISE
- TEMPERATURE
- FOG
- WIND BLAST
- FLYING DEBRIS
Physiological Signs of a Decompression

- Hypoxia
- Hyperventilation
- Decompression Sickness
- Trapped Gas
- Hypothermia
Oxyhemoglobin Dissociation Curve
Safe Use of Oxygen
Ideas for Future Seminars

- Aviation Physiology Lab
  - Barany Chair
  - Physiological changes with stress
  - Use of Qxygen equipment
Thank You!

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