Review of Acceleration
Atelectasis

An Old Problem in New Settings
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OVERVIEW

• History
• Physiology
• OBOGS Oxygen Delivery
• Hawk T-2 Subjective Data
• Moving Forward
1962 – Institute of Aviation Medicine

• “An Investigation into Post Flight Chest Pain in Fighter Pilots”
  – B.F. Burgess, Cdr, USN
  – I.D. Green, Flt Lt, RAF

• First Reports – 1949
• Made Popular - 1955
HUNTER LUNG

• 4 - 6 +Gz Capable
• Unreliable Regulator
  – Fly with 100% Oxygen
CLASSIC TRIAD

• Dry Cough
• Dyspnea
• Substernal Chest Pain
SINE QUA NON *

• 100% Oxygen
• G-Suit
• Moderate G Exposure (+3Gz)

• * F-22 – Counter-Pressure Vest Only- Dr. Balldin
PHYSIOLOGY

• +Gz
  – Increased Perfusion to Lung Bases
  – Airways Close – Ventilation Decreases

• Nitrogen
  – Non-absorbed Gas – Provides Structure to Alveoli
  – Oxygen – Near Complete Absorption
    • Regulator 100%

• G-Suit
  – Prevents Diaphragm Drop
  – Airways Constricted in Lung Base
ALVEOLAR COLLAPSE

- FVC – Decreased
- Hypoxemia
- Increased Respiratory Rate
Further Research

• Positive Pressure Breathing
  – RAF, Glaister – 1964
    • 30mm Hg – No Counter Pressure

• Effect of Posture and Additional Gear
  – USN, York – 1965
    • FVC Decreased Sitting in Cockpit with Gear

• Counter Pressure Garment and 100% Oxygen
  – USAF SAM, Balldin
CURE

- Nitrogen > 40% Breathing Gas
  - Time (10-15 minutes rest)
  - Deep Breath
  - Cough
  - Yawn
  - Posture Change
  - Exercise
    - Decreased Exercise Tolerance for up to 24 Hrs
- Lasting Impairments
  - None Observed
LEGACY OXYGEN SYSTEMS

• 100% Oxygen Immediately Available
• Diluter – CRU-73/A
  – 30% at Ground Level
  – 45% at 15,000’
• Sustained G
  – 10K’ to 15K’
OBOGS

• Approach 94% Oxygen – Max
• Delivery Schedule
  – Up to 75% Oxygen at Medium Altitude
• Capable of G at Altitudes >20K’

• Human Systems Integration
  – Unintended Consequences
OBOGS OXYGEN DELIVERY

O2 System Comparison, Source O2 Concentration to Mask

- JSSG
- CRU-73 Minimum
- CRU-73 Maximum
- CRU-98 Minimum
- CRU-98 Maximum
- F-22
- F-22 Max

Transition to MAX at 11K Cabin Altitude

- F-22 OBOGS MAX
- F-22 OBOGS AUTO
- F-15E MSOGS
- F-16 OBOGS
RAF HAWK T-2

• MOLECULAR SIEVE
  – Unknown Schedule
• Jacket / Survival Waistcoat
• 5 Bladder G-Suit
T-2 SURVEY RESULTS

• 28/32 Significant Symptoms
  • Cough / Chest Tightness
  • Worse Post Flight
  • Persist 5-10 min
    – Sometimes Hours 3/32
    – Exercise Intolerance 5/32

  – “Feels like I need to reinflate my lungs.”
  – “Bottom 1/5 of lungs feel collapsed until getting out of jet.”
MOVING FORWARD

• How Do You Measure the Level of Atelectasis?
  – Burgess and Green – CXR and Spirometry
• Role of Posture and Aircrew Equipment?
• Does it Matter?
  – How does hypoxemia affect follow on G tolerance?
• Hawk T-1 Research
  – Variable Nitrox Mix
“USAF adamant combat vest is cause of Raptor Maladies” . . .

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