Hyperbaric Oxygen Therapy

• Definitions
  – Hyperbaric oxygen (HBO) therapy is the therapeutic use of oxygen at pressures greater than ____ atmosphere
  – Pressures during HBO therapy are usually expressed in multiples of atmospheric pressure absolute (ATA)
  – 1 ATA = ________ mmHg – most HBO therapy is at between ____ and ___ ATA (1520-2280 mmHg)

• Physiological effects
  – Bubble reduction
    • HBO exerts a physical effect on air or nitrogen bubbles trapped in the blood or tissues as seen in air embolism or decompression sickness
    • The pressure __________ the size of the bubbles, lessening the harm they might cause
    • Since pressure is crucial in these cases, HBO may be at 6 ATA or more
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- Physiological effects
  - Hyperoxygenation of blood & tissues
    - On room air, only about 0.3 ml/dl of O₂ dissolves in the blood, at 3 ATA, plasma contains almost _____ ml/dl dissolved O₂

- Enhanced immune function
  - A tissue PO₂ of at least _____ mmHg is needed for normal cellular function
  - Lower PO₂s are often found in damaged or infected tissue e.g. decubitus ulcers
  - HBO increases the PO₂ to help restore normal WBC and antimicrobial function

- Vasoconstriction
  - HBO causes a general vasoconstriction and a small drop in ____________________
  - While this may decrease blood flow to a region, it is more than compensated by the _________ in oxygen content
  - This may be useful in such conditions as burns, cerebral edema and crushing injuries, helping to decrease edema and tissue swelling, while maintaining tissue oxygenation
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- Physiological effects
  - Neovascularization
    - The hyperoxia from HBO helps form _______ capillary beds
    - The exact mechanism is unknown
    - Neovascularization is an essential component of tissue repair, especially in radiation-induced injuries

- Methods of administration
  - Multiplace chambers
    - Can hold up to _______ people
    - Have airlocks and an outer chamber so entering and leaving do not affect the pressure
    - Chamber is filled with air, only patient is on ________% O2
    - Multiplace chambers can achieve pressures up to _______ ATA and are ideal for decompression sickness and air emboli

HBO Multiplace Chamber

[Diagram of HBO Multiplace Chamber]

Tank
Patient Chamber
Control Panel
Entrance/Exit (Outer Air Lock)
Inner Air Lock
Hyperbaric Oxygen Therapy
• Methods of administration
  – Monoplace chambers
    • Hold only the patient
    • Have 1 airlock
    • Entire chamber is hyperbaric and at _____% O$_2$
    • No electronic equipment can be placed inside and some equipment must be modified

HBO Monoplace Chamber

Hyperbaric Oxygen Therapy
• Indications
  – Decompression sickness
  – Air or gas embolism
  – CO or cyanide poisoning
  – Acute traumatic ischemias
  – Clostridial gangrene
  – Necrotizing soft-tissue infection
  – Ischemic skin grafts
  – Exceptional blood loss
  – Non-healing wounds
  – Refractory osteomyelitis
  – Radiation necrosis
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• Indications (most common)
  – Air embolism
    • Can occur postoperatively during cardiovascular surgery, during lung biopsies, hemodialysis, central line placement, IV changes and medication injection through an IV
    • Air bubbles eventually occludes a vessel
    • If air bubbles reach the cerebral or cardiac circulation they can cause severe neurological symptoms or sudden death

• Indications (most common)
  – Air embolism
    • HBO __________ the size or volume of the air bubble and helps oxygenate local tissue
    • Typical HBO treatment involves immediate pressurization to 6 ATA for _____ minutes, followed by decompression to 2.8 ATA with prolonged O₂ treatment

• Indications (most common)
  – Carbon monoxide poisoning
    • Accounts for _____% of all poisoning deaths in U.S.
    • HBO is the ______ way to remove CO from blood
    • Half-life of carboxyhemoglobin (COHb) breathing room air is ______ hours
    • Half-life of COHb breathing 100% O₂ is _____ min.
    • Half-life of COHb under HBO at 3 ATA is _______ min.
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- Indications (most common)
  - Carbon monoxide poisoning
    - Criteria for selecting patients for HBO therapy
      - History of __________________________
      - Presence of neuropsychiatric abnormality
      - Presence of cardiac instability or ischemia
      - COHb level ________% (lower for children and pregnant women)

- Complications and hazards
  - Barotrauma
    - Sinus trauma
    - Tympanic membrane rupture
    - Pneumothorax
    - Air embolism
  - Oxygen toxicity
    - CNS toxic reaction
    - Pulmonary toxicity
  - Other
    - Fire
    - Sudden decompression
    - Reversible vision changes
    - Claustrophobia