Hyperbaric Oxygen Therapy at the Military Hospital “Queen Astrid”

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The Military Hospital “Queen Astrid”
Oxygen as a drug

• When given at inspired pressures higher than 1 atmosphere, oxygen has true pharmacological properties.

• In order to administer oxygen at “hyperbaric” pressure (HBO), the patient must be exposed to this same pressure → hyperbaric chamber (so-called “caisson”)

![Image of a scuba diver making the 'OK' sign underwater]
Types of HBO chambers

• Monoplace
  – Cheaper, less complicated to operate
  – Limited possibilities
    • Medical monitoring and treatment (limited space! \(O_2\) filled environment!)
    • Claustrophobia, supine position
  – Less suited for anything other than fully conscient and stable patients
Types of hyperbaric chambers

• Multiplace
  – Possibility to treat multiple patients at once
  – Inside attendant (treatment, surveillance of patients)
  – Possibilities of full medical (even ICU) management
    • Medical competency depends mostly on equipment and personnel training!
  – Suited for treating all categories of patients
  – Importance of multi-disciplinary, competent team
Physical & physiological basis

- **Law of Boyle & Mariotte** (pressure vs. volume)
- **Law of Dalton** (partial pressure of gas = % of gas in the mix)
- **Law of Henry** (solution of gases in liquid depends on the – partial – pressure of the gas)
- **Diffusion** distance of O₂ from capillaries to tissue cells depends only on capillary oxygen pressure
Effects of HBOT

- Possible **relief of ischemia** in case of:
  - Vascular insufficiency
  - Oedema (swelling of tissue)
  - Insufficient hemoglobin

- **Restore oxygen dependent functions** of cells:
  - White blood cells (PMN): bacterial “killing” capacity is fully oxygen dependent
  - Antibiotic efficiency is greatly reduced in hypoxic environment
  - Anaerobic bacteria: bacteriostatic effect
  - Wound healing: collagen synthesis and cross-linking is mostly oxygen dependent
History of HBO

• Hyperbaric “caissons” have been used since the 1800’s (diving and tunneling work accident treatments)

• Medical HBO only since 1963
  – Experiments and use in cardiac surgery (Boerema “Life without blood” paper 1959)

• Evidence base
  – Difficult to establish in “RCT” modus
  – Indirect (& lots of animal) evidence → “Consensus Method of Recommendations”
Accepted indications of HBO

• European Committee for Hyperbaric Medicine (ECHM)
  [www.echm.org](http://www.echm.org)

• Updated 2016

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>A</th>
<th>B</th>
<th>C</th>
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</thead>
<tbody>
<tr>
<td><strong>Type I</strong></td>
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<tr>
<td>CO intoxication</td>
<td>X</td>
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<tr>
<td>Crush Syndrome</td>
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<tr>
<td>Prevention of Osteoradionecrosis (dental extraction)</td>
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<td>Osteoradionecrosis (mandible)</td>
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<td>Soft Tissue Radionecrosis (cystitis)</td>
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<tr>
<td>Decompression Accident</td>
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<tr>
<td>Gas Embolism</td>
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<tr>
<td>Anaerobic or Mixed Bacterial Anaerobic Infections</td>
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<tr>
<td><strong>Type II</strong></td>
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<tr>
<td>Diabetic Foot Lesion</td>
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<tr>
<td>Compromised Skin Graft and Musculocutaneous Flap</td>
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<tr>
<td>Osteoradionecrosis (other bones)</td>
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<tr>
<td>Radio-induced Proctitis / Enteritis</td>
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<tr>
<td>Radio-induced Lesions of Soft Tissues</td>
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<td>Surgery and Implant in Irradiated Tissue (preventive action)</td>
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<td>Sudden Deafness</td>
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<td>Ischemic Ulcer</td>
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<td>Neuroblastoma Stage IV</td>
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<tr>
<td><strong>Type III</strong></td>
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<tr>
<td>Post-anoxic Encephalopathy</td>
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<td>Larynx Radionecrosis</td>
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<td>Radio-induced CNS Lesions</td>
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<td>Post-vascular Procedure Reperfusion Syndrome</td>
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<td>Limb Re-implantation</td>
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<tr>
<td>Burns &gt;20% of Surface Area and 2nd degree</td>
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<tr>
<td>Acute Ischemic Ophthalmologic Disorders</td>
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<tr>
<td>Selected Non-healing Wounds secondary to Inflammatory Processes</td>
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<tr>
<td>Pneumatosis Cystoides Intestinalis</td>
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“Military” indications for HBO

• Acoustic Trauma (noise-induced hearing loss)
• Decompression sickness (diving accidents)
• Anaerobic soft tissue infections (wounds)
• Crush lesions (wounds)
• Thermal burns – Frostbite injuries
• TBI (Traumatic brain injury)
HBO availability in Belgium

• No (real) Social Security reimbursement
  – RIZIV codes date from 1970’s & have never been adapted
  – Maximum reimbursed amount: 72€ (day 1) + 62 € (day 2)

• HBO performed “at a loss” by all hospitals in Belgium
  (actual cost = ± 120 € per session)

• Problem (“no financing”)
  – → savings on personnel (availability and education); equipment (maintenance)
  – Accidents (very rare but ALWAYS related to human error or negligence / ignorance)
HBO availability in Belgium

Multiplace HBO chambers
- Bruges
- Aalst
- Antwerp (2)
- Brussels
- Genk
- Charleroi
- Liège (closed 2016)

Monoplace HBO chambers
- Liège (closed 2016)
- Arlon (closed 2016)
“Civilian” indications for HBO

- Chronic wounds (diabetic & vascular)
- Radionecrosis lesions (hemorragic cystitis, skin, oral)
- Carbon monoxide poisoning (CO-intoxication)
- Sudden deafness
- Sudden visual loss (retinal artery/vein thrombosis)
- Gas gangrene & soft tissue anaerobic infections
- Ischemic grafts and flaps
16 seats
and/or
2 beds
40 m³ space
Intensive Care HBO treatments:
2 patients (4)
Full monitoring and treatment
HBO – Military Hospital

- 3 Hyperbaric Medicine specialists
- 6 Hyperbaric Technicians
- Full ICU HBO capacity, 24/24 & 7/7
- “Aid to the Nation”
  - Integration in EMS (SMUR) services Brussels area
  - Upon medical referral only
  - Free of charge to patients
  - 5000+ treatments per year, 600 patients
HBO – Military Hospital

- Scientific research & new areas
  - Traumatic Brain Injury
  - Tumor suppression & increase of cancer therapy efficiency
  - Sickle Cell Anemia
  - Fibromyalgia
  - Südeck’s Atrophy
  - Severe blood loss anemia
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