

# Um mig

---

- Frá Þýskalandi.
- Flutt til Íslands árið 2009.
- Nám í læknisfræði:
  - Háskóli Aachen (1996-1999),
  - Háskóli Lübeck (1999-2005, læknispróf árið 2005).
- Starf:
  - Sjúkrahús Helmstedt (2005-2007),
  - Fæðingarorlof (2007/2008),
  - Sjúkrahús Moringen (2008),
  - Fæðingarorlof (2009),
  - LSH (2010-).
- Enn að læra íslensku, þess vegna núna á enskú...

# Hyperbaric Oxygen Therapy for Enhancement of Healing in Problem Wounds (Hlutverk súrefniskúts í meðferð langvinnra sára)

---



Ruth Auffenberg, MD  
Súrefnisklefi LSH  
S: 543 1006/1007

# About Hyperbaric Oxygen Therapy

- Hyperbaric oxygen therapy (HBOT):
  - Medical use of oxygen ( $O_2$ ) at a level higher than atmospheric pressure.
  - Performed in a hyperbaric chamber (i. háþrýsti súrefnisklefi).



# HBOT Selected Indications

---

- Air or gas embolism,
- Carbon monoxide poisoning,
- Decompression sickness,
- Crush injury, compartment syndrome, and other acute traumatic ischemias,
- Enhancement of healing in selected problem wounds,
  - Diabetically derived illness, such as diabetic foot.
- Necrotizing soft tissue infections (necrotizing fasciitis),
- Delayed radiation injury (soft tissue and bony necrosis),
- Skin grafts and flaps (compromised),
- Thermal burns,
- Tinnitus (not older than 3 month).

# HBOT Contraindications

---

- Absolute contraindication:
  - Untreated pneumothorax,
  - Taking (or having recently taken) one of the following drugs:
    - Doxorubicin (Adriamycin), Cisplatin.
    - Disulfiram (Antabuse) – Used in the treatment of alcoholism.
    - Mafenide acetate (Sulfamylon) – Suppresses bacterial infections in burn wounds.
  - Certain pacemakers,
  - Patient must be in stable condition.
    - (Hyperbaric chamber in LSH is without monitoring).
- Relative contraindication:
  - Upper respiratory infections – can make it difficult for the patient to clear ears,
  - Emphysema with CO<sub>2</sub> retention – can lead to pneumothorax during HBOT,
  - Middle ear barotrauma,
  - Pregnancy,
  - Asthma (because of breathing dry O<sub>2</sub>).

# HBOT Side Effects

---

- Most common: Middle ear barotrauma (2%)
- Claustrophobia in the chamber.
- Rare: pulmonary barotrauma.
- Rare: spontaneous pneumothorax.
- Rare: progressive myopia
  - (if using hood instead of mask).

# Problem Wounds: (Patho) Physiology

---

- Pathway to non-healing: Interplay between
    - Tissue hypoperfusion,
    - Resulting hypoxia,
    - Infection.
  - HBOT: establish adequate oxygen availability.
    - (within vascularized connective tissue surrounding wound.)
  - Effects:
    - Clearance of infection,
    - Enhanced tissue growth,
    - Angiogenesis.
- ⇒ Healing of hypoxic wounds.

# Problem Wounds: Case Studies (1)

---

- Medical studies give evidence on improved healing due to HBOT, for example:
- Kranke, Bennett, Debus, Roeck-Wiedmann, Schnabel: "Hyperbaric oxygen therapy for chronic wounds", Cochrane Review, in: The Cochrane Library, Issue 2, 2004:
  - Diabetic foot ulcer (4 trials, 147 patients):
    - Pooled data of three trials with 118 patients showed a reduction in the risk of major amputation when adjunctive HBOT was used, compared to the alternative therapy.
    - Healing rates were reported in one trial which showed a significant improvement in the chance of healing 1 year after therapy.
  - Venous ulcer: (1 trial, 16 patients):
    - This trial reported data at six weeks (wound size reduction) and 18 weeks (wound size reduction and healing rate) and suggested a significant benefit of HBOT in terms of reduction in ulcer area only at 6 weeks.



# Problem Wounds: Case Studies (2)

---

- Faglia, Favales, Aldeghi, Calia, Quarantiello, Oriani, Michael, Campagnoli, Morabito: "Adjunctive systemic hyperbaric oxygen therapy in treatment of severe prevalently ischemic diabetic foot ulcer. A randomized study.", in: Diabetes Care, Issue 19, 1996:
  - Diabetic foot ulcer (70 patients, 2 did not complete):
    - All underwent diagnostic-therapeutic protocol.
    - 35 patients received HBOT: three patients (8.6%) underwent major amputation: two below the knee and one above the knee.
    - 33 patients did not receive HBOT: 11 patients (33.3%) underwent major amputation: 7 below the knee and 4 above the knee.
    - The difference is statistically significant.
  - HBOT, in conjunction with a multidisciplinary therapeutic protocol, is effective in decreasing major amputations in diabetic patients with foot ulcers.

# Problem Wounds

## Summary of Studies

---

- Several other studies exist.
- Diabetic foot ulcer: clear benefit of HBOT.
- Other hypoxic wounds: further studies needed.
  - However, HBOT is worth a try:
    - If no improvement of wound healing observed after 30 days of HBOT ⇒ HBOT can be stopped.

# Problem Wounds: Therapy

---

- Before treatment:
  - Consultation and examination,
  - Patient must be in stable condition.
    - (Hyperbaric chamber in LSH is without monitoring).
- Treatment:
  - Breathing  $O_2$  using mask in hyperbaric chamber at 2.5 ATA.
  - One physician inside chamber with patient, one physician outside.
  - First treatments: 130 minutes thereof 90 minutes breathing  $O_2$ .
    - Interrupted every 30 minutes by 5 minute break.
  - Later treatments: 90 minutes thereof 60 minutes breathing  $O_2$ .
    - Interrupted after 30 minutes by 5 minute break.
  - Note: Multiple (>20) treatments are necessary!

# Breathing O<sub>2</sub> Using Mask in Hyperbaric Chamber



Ruth Auffenberg: Súrefnisklefi í meðferð langvinnra sára

Thank you for your attention!  
Any questions?



Ruth Auffenberg, MD  
Súrefnisklefi LSH  
S: 543 1006/1007