

Chapter 3 – MILITARY INDICATIONS*

For each of the following diseases or conditions, the relevant characteristics have been summarized. Diseases and conditions have been listed roughly alphabetically; the order of discussion does not reflect relative importance or frequency of occurrence.

Annex A elaborates for each condition the scientific rationale and available evidence. Because this report does not pretend to be scientifically complete, reference is made to published reviews.

DEFINITIONS USED IN THIS SUMMARY

Vital or Non-Vital Emergency

Determines whether the condition, or its immediate to short-term evolution, may or may not compromise the victim's life. Conditions that may have a severe functional impact (e.g. necessitating major amputations) are – in this military operational setting – NOT CLASSIFIED as “life-threatening” – this is opposed to standard NATO P-classification (see below).

Maximum Delay of Useful HBO Therapy for this Condition

Determines directly the decision to evacuate or not, depending on the local possibilities. If HBO is started beyond this time point, the added benefit of the treatment probably does not outweigh the extra effort or (healthcare or tactical) risks of evacuating the patient.

Condition of Evacuation

Here, NATO classification is adhered to, as far as Priority (NATO Priority – P-factor) and Medical Support needed (NATO Dependency – D-factor). Also, special considerations for transport may be listed.

NATO Priority

P1 Life-threatening: life, limb, eyesight

Aircraft launch < 12 hrs – pt return to Europe < 24 hrs

P2 Priority

Aircraft launch < 24 hrs – pt return 24 – 48 hrs

P3 Routine

Aircraft launch > 24 hrs

NATO Dependency

D1 – Full intensive care support (ICU) needed

D2 – Intermediate care (full monitoring, perfusions, drains, etc.) needs (para)medical care during flight

D3 – Low care (urine catheter, IV, pain meds, etc.) need (para)medical attention

D4 – No care (ambulatory)

* See also Annex A.

MILITARY INDICATIONS

Conditions for HBO Therapy

In this item is determined whether the HBO treatment should be performed (or capable of being performed) with intensive care support (ICU) or not; whether the patient would be mandatorily hospitalized for care or could be ambulatory; and finally an estimate of the expected maximal duration of emergency HBO – after this, the patient either would not need further HBO or could be transferred further, implying an interruption of daily HBO for a number of days.

Minimal Specialized Medicine Needed

As HBO is in many cases an adjunctive treatment, it is important that patients receive proper “classical” medical care as a priority. Whether this “specialized medical care” is needed on site – in the institution/hospital that provides HBO – or not (available for outpatient consultation), is listed in the next item.

Type of Hyperbaric Facility (see CGP)

Reference is made here to the definitions of HBO facilities as described in the European Code of Good Practice (CGT) in HBO, published by ECHM and available for download on www.echm.org. In short, a hyperbaric chamber system consists of the hyperbaric chamber(s) including the support equipment (gas and energy supplies, etc.). A hyperbaric facility consists of the therapeutic hyperbaric system(s) together with associated plant, buildings, staff (both technical and medical), and a specific administrative organization. Two kinds of hyperbaric facilities exist:

- Hospital based; and
- Standalone.

However, in each and every hyperbaric facility there should be an area adequately equipped to receive and care for medical emergencies. A Centre for Hyperbaric Medicine is a medical facility that provides HBO for patients and additional treatments, surveillance and attention to the medical conditions of the patient. The centre for hyperbaric medicine must be physically located in or functionally linked to a hospital.

Recommended HBO Protocol

Although pressure and duration of HBO sessions may vary dependent on the country, local possibilities and personal rationale, it is possible to define a “standard” HBO session as:

- Having a duration of minimum 60 minutes of oxygen breathing at pressure (Note: Commonly used protocols have between 70 – 90 minutes of oxygen breathing).
- At a pressure of minimum 2.4 atmospheres absolute pressure (ATA) (Note: Commonly used protocols vary between 2.4 and 2.5 ATA).
- With a maximum of two “air breaks” during the session (short periods where the oxygen mask or hood is taken off, so that the patient can breathe freely, but breathes air, not oxygen).

For diving emergencies and certain anaerobic infections, different schedules are available, and this is indicated when appropriate. The frequency and duration of HBO, as well as short recommendations for adjunctive treatments that are considered essential are given.

Directions for Future Research

As indicated above, often there is only a limited volume of high-grade scientific evidence for the efficacy of HBO in these (any) conditions. The treatment of military patients presents a unique opportunity to increase the data volume, and contribution of patient data to existing registries should be done whenever possible.

In case no specific data collection exists, it is recommended to document each case as completely as possible, for future pooling and analysis.

3.1 ACOUSTIC TRAUMA

i) Vital or non-vital emergency?

Non-vital.

ii) Maximum delay of useful HBO therapy for this condition?

HBO treatment should be started < 48 hrs.

iii) Condition of evacuation?

- a) P3 (but P2 if already available transport < 48 hrs); and
- b) D4.

iv) Conditions for HBO therapy:

- a) Type of HBO sessions (ICU or non ICU): Non ICU;
- b) Status of patient: Ambulatory; and
- c) Expected duration of emergency HBO: < 10 days.

v) Minimal specialized medicine needed:

ENT.

vi) Specialized medicine needed on site:

None.

vii) Type of hyperbaric facility (see CGP):

Facility.

viii) Recommended HBO protocol:

- a) 1 standard HBO treatment per day; and
- b) Add treatment with high dose cortisone from day 1.

ix) Scientific rationale – see Annex A.

x) Directions for future research:

Inclusion in on-going RCT on AAT (Pilot: Centre for Hyperbaric Oxygen Therapy, Brussels, Belgium – medhyper@mil.be).

3.2 (IATROGENIC) ARTERIAL GAS EMBOLISM

- i) *Vital or non-vital emergency?*
Vital.
- ii) *Maximum delay of useful HBO therapy for this condition?*
HBO treatment should be started ASAP, < 48 hrs.
- iii) *Condition of evacuation?*
 - a) Priority = Life-saving interventions; and
 - b) P2 – D1 Emergency evacuation.
- iv) *Conditions for HBO therapy:*
 - a) Type of HBO sessions (ICU or non ICU): ICU;
 - b) Status of patient: ICU hospitalization; and
 - c) Expected duration of emergency HBO: 2 – 3 days.
- v) *Minimal specialized medicine needed:*
Intensive care.
- vi) *Specialized medicine needed on site:*
Intensive care.
- vii) *Type of hyperbaric facility (see CGP):*
Centre.
- viii) *Recommended HBO protocol:*
USN TT6 or equivalent.
- ix) *Scientific rationale – see Annex A.*
- x) *Directions for future research:*
Collect clinical data in systematic way.

3.3 BURN INJURY – LIFE-THREATENING (HIGH TBSA OR RESPIRATORY BURNS)

i) *Vital or non-vital emergency?*

Vital.

ii) *Maximum delay of useful HBO therapy for this condition?*

HBO treatment should be started within 12 hrs, or not at all (Forward or Tactical Evacuation only).

iii) *Condition of evacuation?*

a) P1/P2 – D1; and

b) Emergency evacuation: prioritization = life-saving, not HBO.

iv) *Conditions for HBO therapy:*

a) Type of HBO sessions (ICU or non ICU): ICU;

b) Status of patient: ICU Burn ward hospitalization; and

c) Expected duration of emergency HBO: 3 – 4 days.

v) *Minimal specialized medicine needed:*

Burn centre.

vi) *Specialized medicine needed on site:*

Burn centre.

vii) *Type of hyperbaric facility (see CGP):*

Centre.

viii) *Recommended HBO protocol:*

2 standard HBO sessions per day for the first 2 – 3 days.

ix) *Scientific rationale – see Annex A.*

x) *Directions for future research:*

a) Collect clinical data in systematic way; and

b) Data collection coordination between participating burn centers (outcome parameters comparison between HBO and non-HBO treated patients).

3.4 BURN INJURY – NON-LIFE-THREATENING

- i) *Vital or non-vital emergency?*
Non-vital.
- ii) *Maximum delay of useful HBO therapy for this condition?*
HBO treatment should be started ASAP, < 5 days.
- iii) *Condition of evacuation?*
 - a) P2 – D2 – D3; and
 - b) Emergency evacuation only if risk of permanent disability (face, hands, perineum).
- iv) *Conditions for HBO therapy:*
 - a) Type of HBO sessions (ICU or non ICU): Non ICU;
 - b) Status of patient: Burn ward hospitalization; and
 - c) Expected duration of emergency HBO: < 7 days.
- v) *Minimal specialized medicine needed:*
Burn specialist.
- vi) *Specialized medicine needed on site:*
None.
- vii) *Type of hyperbaric facility (see CGP):*
Facility.
- viii) *Recommended HBO protocol:*
2 standard HBO sessions / day if possible.
- ix) *Scientific rationale – see Annex A.*
- x) *Directions for future research:*
 - a) Collect clinical data in systematic way; and
 - b) Data collection coordination between participating burn centers (outcome parameters comparison between HBO and non-HBO treated patients).

3.5 CARBON MONOXIDE POISONING (WHERE HBO IS INDICATED – SEE SCIENTIFIC RATIONALE)

i) *Vital or non-vital emergency?*

Vital, in case of evidence of end-organ dysfunction

- a) Impaired consciousness;
- b) Cardiac instability with/without ECG ischemic changes;
- c) Metabolic acidosis; and
- d) Pregnancy (with evidence of foetal distress, or prolonged > 1 hour symptomatic maternal intoxication).

ii) *Maximum delay of useful HBO therapy for this condition?*

6 hrs from diagnosis and initiation of treatment with normobaric oxygen.

iii) *Condition of evacuation?*

Emergency evacuation (Forward and Tactical Evacuation only); and
Provide 100% oxygen as soon as possible and during transfer.

iv) *Conditions for HBO therapy:*

- a) Type of HBO sessions (ICU or non ICU): ICU;
- b) Status of patient: Hospitalized (medium care or ICU); and
- c) Expected duration of emergency HBO: < 2 days.

v) *Minimal specialized medicine needed:*

Emergency medicine.

vi) *Specialized medicine needed on site:*

Emergency medicine.

vii) *Type of hyperbaric facility (see CGP):*

Facility.

viii) *Recommended HBO protocol:*

- a) Standard HBO protocol, 1 or 2 sessions depending on the neurologic recovery. In case a treatment pressure of 3 ATA is possible to achieve, this might be preferred;
- b) Consider combined toxicological exposure (cyanide, alcohol, etc.) and treat accordingly; and
- c) Recommend formal neurologic follow-up for late neurological effects.

ix) *Scientific rationale – see Annex A.*

x) *Directions for future research:*

Collect clinical data in systematic way.

3.6 CRUSH INJURY (COMBINED TRAUMA TO BONES, SOFT TISSUE, VESSELS, OR NERVES)

i) *Vital or non-vital emergency?*

Non-vital.

ii) *Maximum delay of useful HBO therapy for this condition?*

HBO treatment should be started at maximum 48 hrs.

iii) *Condition of evacuation?*

Emergency evacuation only if risk of permanent disability P2 – D2 D3.

iv) *Conditions for HBO therapy:*

a) Type of HBO sessions (ICU or non ICU): Non ICU (but depends on general condition);

b) Status of patient: Hospitalized (surgery ward); and

c) Expected duration of emergency HBO: < 7 days.

v) *Minimal specialized medicine needed:*

Trauma centre.

vi) *Specialized medicine needed on site:*

No, unless life-threatening injury.

vii) *Type of hyperbaric facility (see CGP):*

Depends on the condition of the patient.

viii) *Recommended HBO protocol:*

2 standard HBO treatments / day for 2 – 3 days, then 1 treatment / day.

ix) *Scientific rationale – see Annex A.*

x) *Directions for future research:*

a) Collect clinical data in systematic way;

b) Classify patients according to international trauma scores (Gustilo); and

c) Adding (anonymous) data to German Trauma Net database (Coordinator: Centre for Hyperbaric Oxygen – Military Hospital Ulm, Germany).

3.7 DECOMPRESSION SICKNESS – LIFE-THREATENING

- i) *Vital or non-vital emergency?*
Vital.
- ii) *Maximum delay of useful HBO therapy for this condition?*
HBO treatment should be started ASAP, < 48 hrs.
- iii) *Condition of evacuation?*
 - a) P1 – D1 Emergency evacuation indicated (Forward and Tactical Evacuation); and
 - b) Transfer with 100% oxygen and maximum pressurization (< 1000 ft cabin altitude).
- iv) *Conditions for HBO therapy:*
 - a) Type of HBO sessions (ICU or non ICU): ICU;
 - b) Status of patient: Hospitalized ICU; and
 - c) Expected duration of emergency HBO: < 7 days.
- v) *Minimal specialized medicine needed:*
Intensive care.
- vi) *Specialized medicine needed on site:*
Intensive care.
- vii) *Type of hyperbaric facility (see CGP):*
Centre.
- viii) *Recommended HBO protocol:*
 - a) Follow directions in ADivP 2;
 - b) Minimum treatment pressure 2.8 ATA; and
 - c) Aggressive fluid management needed.
- ix) *Scientific rationale – see Annex A.*
- x) *Directions for future research:*
Collect clinical data in systematic way.

3.8 DECOMPRESSION SICKNESS – NON-LIFE-THREATENING

- i) *Vital or non-vital emergency?*
Non-vital.
- ii) *Maximum delay of useful HBO therapy for this condition?*
HBO treatment should be started ASAP, < 5 days.
- iii) *Condition of evacuation?*
 - a) P2 – 3 – D2 – 3 (Emergency evacuation only if risk of permanent disability); and
 - b) Transfer while breathing 100% oxygen and cabin altitude restriction (< 1500 ft cabin pressure).
- iv) *Conditions for HBO therapy:*
 - a) Type of HBO sessions (ICU or non ICU): Non ICU;
 - b) Status of patient: Preferably in-patient; and
 - c) Expected duration of emergency HBO: < 3 days.
- v) *Minimal specialized medicine needed:*
Medical imaging (chest X-ray) (MS: why? pulm. barotrauma then 2).
- vi) *Specialized medicine needed on site:*
None.
- vii) *Type of hyperbaric facility (see CGP):*
Facility.
- viii) *Recommended HBO protocol:*
 - a) Follow directions in ADivP 2; and
 - b) Minimum treatment pressure 2.8 ATA.
- ix) *Scientific rationale – see Annex A.*
- x) *Directions for future research:*
 - a) Collect clinical data in systematic way; and
 - b) Implement or at least, collect sufficient clinical data, to categorize patients according to different injury severity scoring systems (e.g. the Boussuges scale scoring system for DCS).

3.9 FROSTBITE

- i) *Vital or non-vital emergency?*
Non-vital.
- ii) *Maximum delay of useful HBO therapy for this condition?*
HBO treatment should be started within 2 – 3 days.
- iii) *Condition of evacuation?*
P2 – D2 D3.
- iv) *Conditions for HBO therapy:*
 - a) Type of HBO sessions (ICU or non ICU): non ICU;
 - b) Status of patient: In-patient; and
 - c) Expected duration of emergency HBO: 5 – 7 days.
- v) *Minimal specialized medicine needed:*
Surgery.
- vi) *Specialized medicine needed on site:*
No.
- vii) *Type of hyperbaric facility (see CGP):*
Facility.
- viii) *Recommended HBO protocol:*
2 standard HBO treatments /day for 2 – 3 days, then once daily.
- ix) *Scientific rationale – see Annex A.*
- x) *Directions for future research:*
Collect clinical data in systematic way.

3.10 SOFT TISSUE INFECTIONS – LIFE-THREATENING

- i) *Vital or non-vital emergency?*
Vital.
- ii) *Maximum delay of useful HBO therapy for this condition?*
HBO treatment should be started ASAP, < 48 hrs.
- iii) *Condition of evacuation?*
P1 – D1.
- iv) *Conditions for HBO therapy:*
 - a) Type of HBO sessions (ICU or non ICU): ICU;
 - b) Status of patient: Hospitalized in ICU department; and
 - c) Expected duration of emergency HBO: 7 days.
- v) *Minimal specialized medicine needed:*
 - a) Intensive care with infectious isolation; and
 - b) (Septic) surgery.
- vi) *Specialized medicine needed on site:*
 - a) Intensive care; and
 - b) (Septic) surgery.
- vii) *Type of hyperbaric facility (see CGP):*
Centre.
- viii) *Recommended HBO protocol:*
 - a) Boerema schedule (3 ATA) if gas gangrene suspected and patient in vital compromise for the first session;
 - b) 2 standard HBO treatments / day for 2 – 3 days, then 1 treatment / day; and
 - c) Bacterial culture in order to adapt antibiotic treatment accordingly (anaerobic germs!).
- ix) *Scientific rationale – see Annex A.*
- x) *Directions for future research:*
 - a) Collect clinical data in systematic way; and
 - b) Gram test on wound fluid should be reported.