14 October 2011

Military Hospital Brussels

SYMPOSIUM

20 Years Anniversary

Centre for Hyperbaric Oxygen Therapy

Military Hospital Queen Astrid - Brussels

Hyperbaric Oxygen Therapy in Belgium - Anno 2011

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20 Year Anniversary Symposium

Centre for Hyperbaric Oxygen Therapy
Military Hospital "Queen Astrid" – Brussels

Hyperbaric Oxygen in Belgium - Anno 2011

Friday, 14 October 2011

Final Programme

0830	Introduction – *Med Col P. NEIRINCKX, Dir MHQA*
0845	Short History of the Centre for Hyperbaric Oxygen Therapy – *Adjt NEIRYNCK Y - 1SC MOONS T, CHBO*
0930	Clinical Indications for Hyperbaric Oxygen Therapy in 2011 Part 1 – *Med LtCol P. GERMONPRE, Medical Director CHBO*
1015	Coffee Break
1045	Hyperbaric Oxygen Therapy in Crush Trauma – *Prof Dr D. MATHIEU, CHRU Lille, France*
1130	Clinical Indications for Hyperbaric Oxygen Therapy in 2011 Part 2 – *Med LtCol P. GERMONPRE, Medical Director CHBO*
1215	Ceremony – Official hand-over of the key of the "Yellow Submarine" to the Royal Military Museum – Med MajGen G. LAIRE (Medical Component Commander), Med Col P. NEIRINCKX, Col d'Avi BEM (r) L. Gabriel (RMM), Mr D. HANSON (RMM), ADC R. HOUMAN, Med LtCol P. GERMONPRE
1230	Lunch Break
1400	Carbon Monoxide Intoxication and Smoke Inhalation – *Dr I. DEMEYER, OLVZ Aalst*
1445	Quality Assurance in Hyperbaric Centres – a human approach – *ADC R. HOUMAN, CHBO*
1530	Coffee Break
1600	Diving Accident Management – from the Water's Edge to the Hyperbaric Chamber – *Dr P. LAFERE, CHBO*
1645	ACHOBEL – Coordinating HBO care on a national level – *Dr S. DESGESVES, CHU La Citadelle, Liège*
1730	Conclusion – *Med LtCol P. GERMONPRE, CHBO*

Short History of the Centre for Hyperbaric Oxygen Therapy

Yoerik Neirynck, CHT – Thierry Moons, CHT
Centre for Hyperbaric Oxygen Therapy, Brussels

In 1968, the Belgian Navy installs a complex of hyperbaric chambers in the naval base in Ostend. This marks the start of hyperbaric oxygenation in Belgium. Over the next 6 years, the Ministry of Health executes a programmed introduction of monoplace hyperbaric chambers, donated to 11 strategically chosen hospitals over the national territory. The military expertise is only partially exploited, as multiplace chambers are deemed "too dangerous". Only in 1991, the first Belgian hospital-based multiplace hyperbaric chamber is put into use, and again the Belgian Defense Medical Service is at the forefront.

Preparations start on October 15, 1990: one of two available mobile hyperbaric chambers (used for diver support) of the Military Engineers (Genie) is transferred to the Military Hospital and a series of transformations begins, to adapt it to a new role: clinical hyperbaric oxygen therapy. On February 28, 1991, the first patient is treated: a 48 year old patient with clostridial gas gangrene. Despite a poor initial prognosis, he survives, thanks to a "classical" combination of surgical debridement, antibiotic and HBO.

In 1991, 41 patients receive a total of 324 HBO treatments, a number that increases year after year. In 1998, 2360 treatments are given and the hyperbaric chamber's limited capacity of 4 seats becomes evident. On December 24, 2000, 6 days before the planned "official opening", the first patient is treated in our new hyperbaric chamber, a comatose 14 year old girl with carbon monoxide intoxication. She also survives with no sequelae despite a very high CO level.

Twenty years after the first HBO treatment, some 6760 patients have benefited from HBO therapy. The number of HBO sessions given is more than sixty-thousand. Diving emergencies (1581), carbon monoxide intoxication (2587) and gas gangrene and anaerobic infections (2828) are among the more "spectacular" indications. Yearly, about 350 treatments are given in emergency or intensive care setting. However, HBO is also used in the treatment of chronic wounds and sudden deafness or acoustic trauma – some 4200 HBO sessions are given on an ambulatory basis.

Because of the unique role of the Centre for Hyperbaric Oxygen Therapy, several clinical research programmes and participation in international programmes is performed, both medical as in the context of patient safety and quality control.

The Centre is available for emergencies on a 24hr basis, 7 days a week, 365 days per year. Since 2008, no other hospital in the Brussels' region disposes of a hyperbaric centre – thus, virtually all carbon monoxide victims needing HBO are transferred to the Military Hospital.

A frequent intoxication in Belgium, it is estimated by the National Poison Centre that approximately 10000 cases per year occur. About 10-15 % of cases are serious

and need hospitalization for high-flow oxygen therapy. Not all patients need HBO therapy; international consensus has determined precise criteria. Yearly, between 100 and 130 patients are transferred here for hyperbaric treatment. Data from each patient are encoded into a anonymous local database, allowing for some interesting statistical information. However, long-term follow-up proves difficult as patients are coming from a very large area and are seldom motivated to comply with systematic follow-up.

Statistical data are shared with the National Poison Centre's systematic registration, in order to help increase awareness, and improve primary prevention. An Annual Report on Carbon Monoxide Poisoning is produced yearly by the Poison Centre.

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Clinical Indications for Hyperbaric Oxygen Therapy in 2011

Part 1 – Hyperbaric Oxygen Therapy basics

Dr Peter Germonpre
Centre for Hyperbaric Oxygen Therapy – Military Hospital Brussels

Hyperbaric oxygen therapy (HBO) aims at increasing oxygen delivery to tissues by inhalation of 100% oxygen while the patient is at a higher than atmospheric pressure. Using physical laws of gas dissolution, oxygen can be transported in considerable quantities in the blood plasma, even so much that the normal oxygen transport (via haemoglobin) is not used anymore (at arterial oxygen pressures of over 1800 mmHg, the venous blood is still 100% saturated).

This "hyperbaric hyperoxia" has been shown to have a number of clinical and physiological effects, modulating or improving the course of many disease processes. It is also source of possible complications.

A direct pressure effect reduces the volume of any gas bubble inside the body – this is primarily used in emergency treatment of divers' decompression sickness or gas or air embolism.

Because the delivery of oxygen to the tissue cells is primarily driven by diffusion, increasing capillary oxygen pressure will increase the distance to where oxygen diffuses out of a capillary blood vessel. Ischemic tissues may benefit from this increased distance, as may oedematous (swollen) tissues.

Restoring normal or supra-normal oxygen levels in the tissues will restore or improve anti-infectious defense mechanisms – not only by a direct bacteriostatic effect on anaerobic micro-organisms, but also (and probably more important) an optimalisation of white blood cell (macrophage) function. Finally, it has been shown that many antibiotics have a suboptimal effect in hypoxic environment, and antibiotic effects can be synergistically enhanced by providing extra oxygen.

HBO is basically a simple and logical treatment in many diseases where hypoxia plays a role. To prove its efficacy in a pure Evidence Based Medicine (EBM) manner, is difficult.

EBM consists of evaluating a treatment using the "best available evidence". Over the last decades, the "proof" for HBO has been evaluated in a number of International Consensus Conferences, where experts from both HBO and non-HBO "fields" compiled a shortlist of conditions for which HBO may be useful, and under which conditions.

This list is available on the websites of both the Belgian Advisory Committee for Hyperbaric Oxygen Therapy (www.achobel.be) and the European Committee for Hyperbaric Medicine (www.echm.org). This Accepted Indications list is periodically reviewed and a next update s due in 2014.

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Hyperbaric Oxygen Therapy in Crush Trauma

Professeur Daniel MATHIEU
Service de Réanimation et Médecine hyperbare
Hôpital Calmette – Centre Hospitalier et universitaire
Lille - France

Crush injury and other acute traumatic ischemia are characterized by a vicious circle of ischemia, hypoxia, oedema, disturbed microcirculation, and secondary ischemia in the border area of the tissue affected by the primary trauma.

In hypoxic tissues, mechanisms of infection control and healing are impaired so that the risk on infection and wound healing problems are definitely higher than after other kinds of injuries. Restoration of perfusion can lead to reperfusion injury.

Hyperbaric oxygen ameliorates the effects of acute traumatic ischemia through four mechanisms: hyperoxygenation, vasoconstriction, and influence on reperfusion and host factors.

Besides adequate shock management, direct surgical intervention with debridement and repair of soft tissues and of any damaged vessels and stabilization of bony elements are of paramount importance. Adjuvant hyperbaric oxygen therapy (HBOT) should be administered as soon as possible; when it is given early it can prevent large expanses of ischemic necrosis, minimize the frequency and extent of amputations, reduce oedema, control infection, support healing, and prevent reperfusion injury.

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Clinical Indications for Hyperbaric Oxygen Therapy in 2011

Part 2 – Hyperbaric Oxygen in non-emergency treatments

Dr Peter Germonpre
Centre for Hyperbaric Oxygen Therapy – Military Hospital Brussels

Hyperbaric Oxygen Therapy is not only used to treat emergencies. Periodic restoration of normal oxygen tensions in ischemic tissues is a powerful stimulus for neo-angiogenesis in the context of wound healing.

The use of HBO to enhance healing in patients with chronic wounds has thus been proposed since the late 1970's, and progressively the mechanisms behind its action are being unravelled.

Wound healing is characterised by a number of stages, each of which needs to be (almost) completed before the next can start. This dynamic behaviour has been modelised in concepts such as the TIME(-D) concept and is now well accepted.

Some stages can only be successfully completed if a sufficient oxygen tension is present; for other stages, tissue hypoxia is the main trigger. A chronically hypoxic wound will not heal; a chronically hyperoxic wound neither. Exposing patients once or twice daily to hyperbaric oxygen improves wound cleansing (detersion), provides bacteriostatic protection, improves the quality of wound bed collagen deposition and formation of healthy granulation tissue, and thus wound healing.

Examples of chronic wounds where the simple adding of HBO therapy to the "classical" local treatment has been shown to improve outcome, are diabetic foot wounds, radiotherapy induced wounds (radio-cystitis, osteoradionecrosis, soft tissue radionecrosis) and chronic varicose ulcers refractory to compression treatment alone. Recently, randomised controlled trials, even placebo-controlled, have been published.

In chronic refractory infections, such as osteomyelitis or deep abscesses, the addition of HBO to targeted antibiotics in high dose and adequate drainage, may make the difference between cure and failure. It is evident that randomised controlled trials in these infections are difficult to organise and considered unethical.

Many of the diseases treatable with HBO are so-called "orphan diseases" where no other valid treatment exists. Sudden hearing loss and acute acoustic trauma are two such examples, where even the classical treatment is unproven by EBM standards. Because of the unknown underlying pathophysiological mechanism, even HBO is an empirical treatment. Providing high-level scientific evidence is a time consuming and difficult task. Even so, more and more evidence emerges, providing information on optimal patient selection and treatment schedules.

It has been shown in pharmaco-economic analyses (admittedly with a high range of variability) that addition of HBO to the treatment may result in significant healthcare savings, even if the additional cost of HBO is considered.

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Carbon Monoxide Intoxication and Smoke Inhalation

Dr Ignace DEMEYER
Onze Lieve Vrouw Ziekenhuis Aalst

Carbon Monoxide Intoxication and Smoke Inhalation

Carbon Monoxide (CO) is a product of incomplete combustion of any kind of organic materials. It has a lethal effect on living organisms. CO is a toxic gas, colorless, odorless, tasteless, finally non-irritating and impossible to detect by human beings.

The gas is produced in either domestic (e.g. heating systems) or industrial settings (gasoline powered devices, cars...). Being exposed to as less as 100ppm can harm people's health. Every year a lot of people kill themselves by deliberately inhaling CO. Accidental acute CO inhalation is a common occurrence for the medical world, the effects of chronic exposure are far less known.

Amongst illustrious victims of CO intoxication is for instance Emile Zola, famous French author, but also numerous Jewish prisoners in WW II died in camps after being gassed.

The Belgian population and the (para-)medicals are warned by the authorities on a yearly base. However campaigns by the Anti-Poison Centre, the MetOffice can't prevent numerous victims.

Prevention is a significant public health issue. CO detectors for households, Catalytic converters on cars, strictly controlled heating systems are a few of the potential tools.

In spite of excellent medical schools and continuous medical education programs, the Belgian association of hyperbaric facilities never receive CO related victims from hospitals, either because they fail to recognize or because they underestimate the risks of CO. And still there is an excellent algorithm widely available from the hyperbaric society for the good medical practice in treating CO inhalation.

The treatment of CO inhalation is well known: administering oxygen in high concentrations, if required in hyperbaric conditions. The risks of CO for some are even more dramatic and less known: pregnant women are at risk but their fetus is much more endangered due to its fetal hemoglobin.

Also heart failure patients suffering from CO intoxication get into a life threatening situation much sooner than other victims. The CO molecule's affinity for cardiac myoglobin ends up in cardiac ischemia with increased risks of infarction even with 'normal' coronary arteries.

The risks of chronic exposure to CO are actually known as an increased risk of depression, confusion, memory loss. There is an increasing scientific interest in the risk of smoke inhalation but no studies on human beings are available at the moment.

Control and correct application of legal decisions in prevention of carbon monoxide is a governmental task. The ongoing efforts in educating the medical society resulted in the founding of the Advisory Committee for Hyperbaric Oxygen Therapy in Belgium (ACHOBEL). Thanks to these efforts the battle against the silent killer continues.

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Quality assurance in HBO facilities: a human approach

Rob HOUMAN, CHT
Safety Director
Centre for Hyperbaric Oxygen Therapy, Brussels

Near the end of the 19th Century, the industrial revolution has seen the birth of quality assurance, both as a study subject as an action item. Initially exclusively oriented to product conformity, it shifted focus later to "client satisfaction" in general. With time, techniques and approaches to this objective have evolved, being fine-tuned and enhanced.

Quality Assurance, as will be shown, concerns always two aspects: a technical and a human aspect. "Technical QA" will focus on the delivery of a product or service that responds to the expectations of the intended client, in terms of quality, cost and timing. "Human QA" on the other hand concerns the motivation and implication of the persons working in the enterprise. Methods used will have to develop a true implication of the personnel, allowing recognition of ideas, creativity, and sense of responsibility. In the "services" business, motivation of professionals is essential in order to progress.

In a hospital setting, more than a product, a service is offered. On top of this, this "patient service" is delivered in real-time, this means, without having been verified or even inspected before delivery. The "client" receives the service as it is produced, and quality control will thus need to focus much more on prevention.

At the Centre for Hyperbaric Oxygen Therapy, the objective has been to improve quality by preventing errors thanks to a system of education, information and organization. This pathway to QA is based on five criteria: reliability (the capacity to deliver the correct service), organization, personnel competence (and patient's awareness of this), verification of optimal service delivery, attentivity towards patient expectations. In order to develop this strategy in a coherent, efficient and durable manner, 4 dimensions are needed: a strategic, technical, structural and cultural dimension.

Risk assessment is an integral part of this process. Comprehension of human and technical risks will be elaborated on. Indeed, risks are inherent to life and are present in all human activity; however, it is important to differentiate between voluntary and involuntary risks. Technical risks may be controlled by the application of norms, good practice guidelines, etc.

The author will finally stress the necessity and utility to measure the level of quality attained by the use of a "patient satisfaction questionnaire" specifically adapted and developed for use in a hyperbaric treatment centre.

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Diving Accident Management – from the Water's Edge to the Hyperbaric Chamber

Dr P. LAFERE
Centre for Hyperbaric Oxygen Therapy, Brussels

Decompression sickness (DCS) is best known as a diving disorder and describes a condition arising from dissolved gases coming out of solution as bubbles inside the body on depressurization. Bubbles may form whenever the body experiences a reduction in pressure, but not all bubbles result in DCS. Two principal factors determine the risk of a diver for suffering DCS:

1. the rate and duration of gas absorption under pressure – the deeper or longer the dive, the more gas is absorbed into body tissues (Henry's law);
2. The rate and duration of off-gassing on depressurization – the faster the ascent and the shorter the interval between dives the less time there is for absorbed gas to be offloaded safely.

The formation of bubbles in the skin or joints results in milder symptoms, while large numbers of bubbles in the venous blood can cause lung damage. The most severe types of DCS interrupt — and ultimately damage — spinal cord and cerebral function, leading to paralysis, sensory dysfunction, or death. For many divers, it is not recognizing the symptoms which poses problem, it is to admit it and seek medical help. To admit the possibility that one could have an diving accident is difficult. Statistics compiled by Divers Alert Network (DAN) show that roughly 20% of injured divers continue to dive after having identified their symptoms. "Denial" must thus be regarded by itself as a symptom of DCS.

DCS are true medical emergencies that should receive the benefit of specialized treatment in a dedicated centre as soon as possible. A specialized centre is considered a hospital-based recompression facility with permanent and adequately trained medical and paramedical staff.

- On-site 100%oxygen first aid treatment (Type 1 recommendation, level C)
- On-site fluid administration (Type 1 recommendation, level C). Even if the number of divers who receive O2 and fluids increases, still there remains room for improvement. Indeed, according to our experience, 30 to 70% of the victims do not profit from this essential measure.
- After immediate stabilization and medical evaluation, the victim of a decompression accident should be immediately directed to the closest specialized centre (Type 1 recommendation, level C)
- In-water recompression should never be performed as the initial recompression (Type 1 recommendation, level C)
- Major accidents should be treated with hyperoxygenated recompression tables either at moderate pressure (USN6) or at high pressure (Cx30). Minor decompression accidents (pain only) can be treated with oxygen recompression at 2.8 ATA maximum. (Type 1 recommendation, level C). If treated early, there is a significantly higher chance of successful recovery.

Immediate treatment with 100% oxygen, followed by recompression in a hyperbaric chamber, will in most cases result in no long term effects. However, permanent long-term injury from DCS is possible. Short term and long-term follow-up showed similar results, with 16% having permanent neurological sequelae.

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ACHOBEL – Coordinating HBO care on a national level

Dr S. DESGESVES,
CHU La Citadelle, Liège

The Advisory Committee for Hyperbaric Oxygen Therapy (ACHOBEL) was conceived in 1993, at the start of the technical renewal of hyperbaric centres in various Belgian hospitals. In December 1995, it was officially founded as a not-for-profit organisation, with representatives of all Belgian hospitals that disposed of a hyperbaric chamber, be it mono-or multiplace. Later, the hyperbaric centre of Esch sur Alzette in Luxemburg joined.

Its objectives are to

- promote the value of hyperbaric oxygen therapy as intergrated treatment in emergency and intensive care
- put forward the specific benefits of hospital-based HBO therapy, adapt the financing of the treatment by the Social Security institutions
- Integrate notions of HBO into the specific training and education of paramedical personnel in emergencies and intensive care
- Promote the harmonious development of HBO centres and integration in the EMS services in Belgium

ACHOBEL has adopted and promoted the list of “accepted indications for HBO therapy” as pblished by the European Committee for Hyperbaric Medicine, and updated regularly. Information is compiled and distributed to EMS Services (e.g. Carbon Monoxyde Treatment Algorythm, Patient Satisfaction Questionnaire)

Based on the “Code of Good Practice in Hyperbaric Oxygen Therapy”, (structural and functional) norms have been proposed for hyperbaric centres in Belgium. Regularly, courses for “hyperbaric nurses” are organised, both in French and Dutch, in collaboration with NVKVV.

An adaptation of the reimbursement principles and amounts has been proposed and discussed with the Steering Committee of the Social Security (RIZIV-INAMI)

Furthermore, propositions have been formulated regarding medical surveillance of HBO personnel.

In recent years, closer collaboration between Belgian HBO Centres has been sought in the context of EBM requirements, by developing multicentric databases and perhaps later initiate multicentric prospective studies. These efforts have been seriously hampered by the lack of adequate funding of HBO centres, mainly in regards to the necessary personnel. HBO must not be considered a “side activity” but a complement to EMS, ICU and specific medical care. This vicious circle is difficult to break, and a renewed effort to adapt reimbursement to the reality of HBO in Europe in 2011 is dearly needed.

The Committee’s website can be found at www.achobel.be

Notes:

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