

CONTACT DETAILS FOR THE:

Isle-of-Man
HYPERBARIC MEDICINE FACILITY

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HYPERBARIC OXYGEN THERAPY

Introduction

This facility, operated by the Kevin Gray Memorial Trust, was opened in 1984, following the donation of a chamber after the death of local commercial diver, Kevin Gray, to provide emergency recompression for divers in the Irish sea area.

In 1992 a purpose built unit was opened on the same site. It comprises of two multiplace chambers with equipment for the provision of intensive care, utilising mixed gases and saturation treatments.

The facility, in addition to full time operation, provides a 24-hour, on line, information service for divers, together with training and educational programmes in the application and provision of hyperbaric medicine.

Divers who require emergency treatment may, self refer, or be referred by the emergency services but non-urgent medical referrals must be made via a hospital consultant, or general practitioner.

The Department of Health and Social Security substantially supports the facility but it relies upon additional public funding for its operation.

Objectives of this document

To provide:

- ✓ a brief history of hyperbaric oxygen therapy
- ✓ an explanation of the basic principles of hyperbaric oxygen therapy
- ✓ answers to the questions, which are most frequently asked, relating to hyperbaric oxygen therapy
- ✓ guidance to patients attending hyperbaric treatment sessions

History of hyperbaric oxygen therapy

Hyperbaric chambers have been in use for centuries, as early as 1662. However, hyperbaric oxygen therapy has only been used clinically since the mid 1800's.

Hyperbaric oxygen therapy was tested and developed by the U.S. Military after World War I, and it has been used regularly since the 1930's to help treat deep-sea divers with decompression sickness.

Clinical trials in the 1950's uncovered a number of beneficial mechanisms from exposure to hyperbaric oxygen. These early trials, were the forerunners of contemporary applications of hyperbaric oxygen in the clinical setting.

Today there are a number of increasing indications, approved by the health authorities, as primary or adjunctive treatment modalities. Hyperbaric oxygen treatment has proved to be a life and limb saving treatment as well as cost effective. It is therapeutic in a variety of clinical conditions.

Hyperbaric oxygen therapy

Hyperbaric oxygen therapy (HBO) is defined as breathing 100% oxygen while in an enclosed system pressurised to greater than one atmosphere (sea level). Breathing 100% oxygen at atmospheric pressure or applying topical oxygen without enclosing the entire patient in a pressurised chamber does not produce the same effects and is not recognized as hyperbaric oxygen therapy.

Many health professionals may be astonished, at the reaction of some doctors to the word 'hyperbaric', The public continue to find some referring physicians, dismissive and some even openly hostile. The primary reason for this is that the teaching about oxygen in our medical schools was, until recent years, inadequate, particularly in the following areas:

- The importance of barometric pressure in determining oxygen dosage.
- Understanding that the plasma concentration alone determines the rate of transport of oxygen into tissue.
- The most essential function of blood flow is to transport oxygen.
- Oxygen not only acts in relation to metabolism it also acts as a modulator of many cellular functions.
- That most diseases affect not only the cells of a tissue but also the blood supply.
- That both a decrease and an increase in blood supply can cause hypoxia, defined as a deficiency in the level of oxygen required for normal function.

- That an adequate level of oxygen is essential to recovery in disease.

Epictatus in the third century BC postulated that:

"It is impossible to learn something that we think we already know".

Effectiveness of hyperbaric oxygen

Hyperbaric oxygen therapy delivers oxygen quickly, and in high concentrations, to injured areas systemically. The increased pressure changes the normal cellular respiration process and causes oxygen to dissolve in the plasma. This results in a substantial increase in tissue oxygenation.

Hyperbaric oxygen is also used in the treatment of certain critical care acute disorders such as carbon monoxide poisoning, gas gangrene, necrotizing infections, gas embolism and decompression sickness.

Hyperbaric oxygen is beneficial because it:

- ◆ stimulates the growth of new blood vessels
- ◆ increases oxygenation that can arrest certain types of infections
- ◆ enhances wound healing

The mechanisms associated with the action of hyperbaric oxygen

The following beneficial mechanisms have been identified that serve to enhance the healing of treatment conditions.

Hyperoxygenation.

The elevated pressure (1.5 to 3.0 atmospheres) increases the amount of oxygen present in the bloodstream and available to tissues, 10 to 13 times over normal conditions. Hyperbaric oxygen provides immediate support to compromised tissue areas with marginal blood flow. Elevated levels of oxygen can also purge toxins, including carbon monoxide, from the body.

Direct Pressure.

Hyperbaric oxygen shrinks the size of gas bubbles so that they may be reabsorbed. Hyperbaric oxygen is important in the treatment of arterial gas embolism and decompression sickness.

Vasoconstriction.

Elevated levels of oxygen cause vasoconstriction that leads to a reduced blood flow without significantly affecting tissue oxygenation. Hyperbaric oxygen is used to control compartment pressures in crush injuries and to treat thermal burns.

Bactericidal/Bacteriostatic.

Super oxygen saturation of tissue stops the spread of certain toxins and enhances the killing of bacteria. This is important in the treatment of gas gangrene and necrotizing tissue infection.

Angiogenesis and Neovascularization.

Hyperbaric oxygen promotes the growth of new blood vessels by enriching the area with oxygen-carrying blood. Although decreased oxygen tensions stimulate angiogenesis; for it to be effective, there must be an underlying scaffolding of collagen to support it. Overall, therefore, hyperoxygenation stimulates useful angiogenesis.

Answers to frequently asked questions relating to hyperbaric oxygen therapy

Are there any side effects?

The risks associated with hyperbaric oxygen are minimal. However, some patients may experience a few side effects. The most common complications include:

- ◆ sinus squeeze
- ◆ temporary changes in vision
- ◆ fatigue

What does a patient experience during treatment?

The first stage of treatment is compression, in which the pressure inside the system is gradually increased. The temperature increases but is later adjusted to a comfortable level. The patient will feel a fullness in the ears. Instructions are provided to help clear the pressure and relieve any temporary discomfort

Inside the chamber, the patient may sleep, watch TV or videotape, listen to music, read or just relax. When the treatment is completed, normal pressure is restored slowly.

What are some of the different kinds of chambers?

Monoplace chambers accommodate one patient and are pressurized with 100% oxygen that the patient breathes directly. The chamber is capable of providing biomedical monitoring, fluid resuscitation and ventrally support as required.

Dualplace chambers accommodate two seated patients, or one supine patient and an attendant and are pressurized with air. Patients breathe oxygen through a built-in-breathing system. A dualplace offers the advantage of a separate entry lock chamber, which allows the attendant, or physician to have access to the patient at all times.

Multiplace chambers accommodate between four and twenty-four patients and can be designed to specification based on anticipated patient load. The systems are pressurized with air and patients breathe oxygen through a built-in-breathing system.

These systems are large enough to allow for wheelchairs, critical care patients and accompanying medical staff.

How often is hyperbaric oxygen administered?

A variety of factors determine treatment protocol. Acute conditions may require a treatment period of ten days or less, while chronic conditions may require therapy over a few months. Although treatment schedules will vary, most treatments will be administered during one to two hour sessions, once or twice a day, several times a week.

Does hyperbaric oxygen therapy require hospitalization?

No, hyperbaric oxygen therapy can be administered on an outpatient basis. All referrals must be made by a medical practitioner

What are the currently accepted primary indications for hyperbaric oxygen?

- · Air/Gas Embolisms
- · Carbon Monoxide Poisoning and Smoke Inhalation
- · Decompression Sickness
- · Adjunctive Hyperbaric Oxygen in Intracranial Abscess
- · Gas Gangrene
- · Crush Injuries
- · Necrotizing Soft Tissue Infection
- · Enhanced Healing of Selected Wounds
- · Exceptional Blood Loss
- · Osteomyelitis
- · Radiation Tissue Damage
- · Skin Grafts and Flaps
- · Thermal Burns

What are some of the adjunctive indications for hyperbaric oxygen?

Hyperbaric oxygen therapy is performed in certain instances that are life and/or limb threatening, but that are still considered experimental:

- · Carbon Tetrachloride Poisoning (Acute)
- · Cerebrovascular Accident (Acute-Thrombotic or Embolic)
- · Head Injury (Cerebral Edema)
- · Fracture Healing and Bone Grafting
- · Hydrogen Sulphide Poisoning
- · Pyoderma Gangrenosum Retinal (Central) Artery Insufficiency Acute
- · Selected Refractory Mycoses:

- · Mucormycosis, Candidiobolus Coronato
- · Invasive Aspergillosis
- · Sickle Cell Anemia Crises
- · Spider Bite (Brown Recluse, Loxasceles reclusa)
- · Spinal Cord Injury (Acute)
- Multiple Sclerosis
- Bells Palsey

Hyperbaric Treatment Session

➤ Before Treatment

Patients retain their own clothing. To maintain the chamber's cleanliness outdoor shoes should be removed or covered. This of course does not apply to wheelchair users. Patients, on entering the chamber, must give assurance that they have divested themselves of all items on the prohibited item list. (See appendix 2.)

Patients are expected to confirm that they are comfortably seated and that they are conversant with the breathing apparatus.

➤ Pressurisation

The operator will communicate with the patients in the chamber to inform them that compression is imminent and that a rise in temperature may ensue. The chamber will be compressed slowly and smoothly and regular inquiries will be made by the operator with reminders to continually clear the ears and to ensure that no patient is in discomfort.

➤ Treatment

When the recommended treatment pressure is attained compression is stopped and the patients will be instructed to put on their masks or hoods. During the treatment period adjustments may be needed to the chamber pressure owing to adiabatic contraction, alteration in temperature, or patient mask leakage. Patients are always informed, prior to any adjustments or alterations, and any necessary manoeuvres will be made in a smooth and controlled manner.

Patients during treatment may read or listen to the output of the available audio entertainment.

➤ Decompression

Patients will be advised when the prescribed treatment period has elapsed and that the chamber is about to be decompressed. Inexperienced patients will be warned of impending alteration in pressure and the possibility of water vapour manifesting itself as mist.

➤ **Post Treatment**

Patients should pay particular attention to balance and any pressure related disorder before leaving the facility. In the unlikely event of such a problem, the operator should be informed and medical advice will be obtained.

Summary

For several decades hyperbaric medicine has steadily evolved and is gaining momentum. Acceptance is growing throughout the world, At the moment, the comprehensive information and experience derived from many years of clinical experience and trials have prompted major developments. The advancements in diagnostic medicine is partially responsible for the elevation of hyperbaric medicine; for example magnetic resonance imaging, which constantly points to hypoxia and the increased tissue water content of oedema as critical components in many diseases - from the exotic territory of the brain to the mundane problem of varicose ulceration.

The applications of hyperbaric oxygen for a wide range of suitable conditions, are proving a cost effective and a satisfactory form of treatment in the twenty-first century.

David P Downie FIMT CHT

Appendix 1

EAR CLEARING

When the chamber is being compressed you should begin clearing your ears as soon as the pressure begins to change (by the Valsalva manoeuvre, jaw movements, swallowing, or holding your nose with your mouth closed and blowing).

You should immediately report any discomfort to the chamber operator. The chamber operator when alerted to the problem can act swiftly to overcome it, by halting the compression or by rapidly reducing pressure by a small amount.

If the problem is solved then the operator will continue as normal or may halt the pressurisation for a few minutes during which time the patient can breathe oxygen to relieve any inflammation in the ear.

Please remember that if you have any congestion you should use Sudafed, half an hour or so before therapy, to clear your sinuses.

If after a number of treatments you still find it difficult to clear your ears you could try using the earplugs designed for air travel, which are available at Boots and other high street chemists.

If, all of the above fail to relieve the discomfort, the treatment will have to be abandoned. Do not worry about this, it is usually because of a cold and the problem will be resolved in a couple of days and treatment may be resumed.

If you experience any discomfort in the ears or sinus - do not suffer in silence - let the chamber operator know.

Appendix 2

Items and materials not allowed in the chamber

The following comprise a reasonably comprehensive list of items and materials that should not be allowed into the chamber. The letter(s) following each item indicates the general reason for prohibiting it; the coding is shown below.

- **C** possibility of damaging the fabric of the chamber
- **D** contamination of the environment
- **E** explosion risk
- **F** fire source or a combustible substance
- **L** could be broken or damaged by pressure
- **M** will possibly cause a mess
- **P** affect ability of diver

Listing

- a) Adhesive **F**.
- b) Aerosols **D, E, F**
- c) Aftershave and cosmetics **D, F**
- d) Alcohol **D, F, P**.
- e) Batteries with unprotected leads or those containing mercury **C, D, E, F**.
- f) Chemical cleaners e.g. trichloroethylene, 'Freon', etc **D**
- g) Cigarettes, cigars. tobacco of all kinds **F, M**.
- h) Cleansing powder **C, F, P**
- i) Volatile drugs **F, P**.
- j) Electrical equipment including tape recorders, radios, etc **F**
- k) Explosives, thermal nuclear devices **E**.
- l) Glass thermometers **C, D, P**.
- m) Ink pens **M**.
- n) Lighters **F**
- o) Matches **F**
- p) Non-diving watches **L, M**.
- q) Petroleum based lubricants, greases or fluids **F**
- r) Sugar and fine powder or other flammable foodstuffs **E, F**.
- s) Thermos flasks **L, P**.
- t) Non-fire-retardant, bedding including blankets, sheets, pillows, mattresses, etc. except 100* cotton or treated materials **F**

Appendix 3

ISLE OF MAN FIRE AND RESCUE SERVICE

HEALTH AND SAFETY GUIDANCE NOTES FOR: PATIENTS AND VISITORS TO THE HYPERBARIC MEDICINE FACILITY

The drill ground encompassing the Fire Service Headquarters is used daily for training, and for the cleaning and testing of fire-fighting appliances and equipment. The area of the drill ground in use will be cordoned off but whenever possible vehicle access to the chamber will be maintained.

When the Fire Service is using the entire drill area, access is available only along the footpath.

Wheelchair users, finding it difficult or who are unable to negotiate the path, despite assistance from their carers and members of the hyperbaric staff, are assured that the Fire Service crew will make every effort to provide a suitable access, as soon as practically possible. If the barriers are in position you must not, under any circumstances, attempt to cross the drill area.

Parking spaces for two disabled drivers cars are available, one on the ramp, and the other on the hard-standing immediately to the right of the chamber entrance. Able-bodied car users, when visiting the chamber, are reminded that they must use the main car park.

Car drivers can drop and pick up patients but are requested not to stop in a position likely to cause an obstruction.

Appendix 4

THE KEVIN GRAY MEMORIAL TRUST



Registered Charity Number: 32462

CHAIRMAN:

MR J. LIVERSEY

HON. TREASURER:

MR I. BANKROFT

HON. SECRETARY:

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