Outline of the Hyperbaric Service

Hyperbaric Service Staff

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The Alfred Hyperbaric Service

The Alfred Hospital Hyperbaric Unit has been in operation since 1987, and is equipped with one of the world's most advanced hyperbaric facilities, providing Victoria's State Service in Hyperbaric Medicine.

The Alfred Hyperbaric Unit consists of three pressurisable hyperbaric rooms, the largest of which measures 3.1 x 5.8 metres. This provides adequate space for treating the sickest intensive care (ICU) patients with Hyperbaric Oxygen Therapy (HBOT) when necessary as well as providing comfortable room for up to ten outpatients receiving routine daily treatments.

The Alfred Hyperbaric Service provides HBOT to patients Monday – Friday, 0730hrs-1600hrs, and is available 24 hours a day for the treatment of emergencies.

For Non-Urgent Referrals:
All patients wishing to be referred for Hyperbaric Oxygen Therapy are required to visit their General Practitioner or Specialist, and obtain a referral letter, which the medical practitioner can send via post or fax (03) 9076 3052 to The Alfred Hyperbaric Service.

For Urgent Referrals:
Medical practitioners should contact the Hyperbaric Registrar at The Alfred Hyperbaric Service on 9076 2269 between 0730hrs and 1600hrs Monday to Friday.
After these hours, please contact The Alfred’s Switchboard on 9076 2000 and ask for the duty hyperbaric medical officer.

**Referral Contents:**
Please ensure the referral has the following details:
- Patient name
- Patient contact details and address
- Referring doctor contact details
- Patient diagnosis
- Rationale for referral
- Relevant medical history and medications
- Results of any relevant tests/examinations

**Contact**
Hyperbaric Service phone number (03) 90762269
Hyperbaric Service fax number is (03) 9076 3052
Hyperbaric Service email address is hyperbaric@alfred.org.au

The Alfred Hyperbaric Service is staffed by specially-trained Medical, Nursing and Technical staff.

**Director of Intensive Care and Hyperbaric Medicine**
Prof Carlos Scheinkestel

**Deputy Director, Head of Hyperbaric & Quality**
Dr Tim Leong

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- Dr Ian Millar
- Dr Andrew Fock
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- Shelly Black
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- Dwayne Cananzi
- Lester Smith
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**Hyperbaric Service Secretary/Receptionist:**
ElMarie Celestiale
What is Hyperbaric Oxygen Therapy?

Hyperbaric Oxygen Therapy is the administration of 100% oxygen at a pressure greater than atmospheric pressure. As the air we breathe contains only 21% oxygen, breathing 100% oxygen at high pressure results in much more oxygen being dissolved in the body.

Hyperbaric oxygen has been used for many years to treat decompression illness (‘the bends’) in divers. Hyperbaric Oxygen Therapy (HBOT) is now also used in the treatment of a multitude of illnesses, such as necrotising soft tissue infections, certain cases of severe trauma and problem non-healing wounds.

The Hyperbaric Chamber:

The Chamber is pressurised with air and you will breathe 100% oxygen through a mask or hood. You will be able to have a break from the oxygen during the treatment at set times. The main chamber may accommodate up to 10 people, so there may be other patients with you. A registered nurse will also stay inside with you.

How Does Hyperbaric Oxygen Therapy Help?

Hyperbaric oxygen helps the body in several ways:

- **Vasoconstriction and reducing oedema (swelling)**
  Hyperbaric oxygen has the unique property of constricting blood vessels thereby reducing oedema, whilst simultaneously increasing the oxygen supply to an area.

- **Promotes tissue growth**
  Collagen is necessary to make scar tissue and stabilises skin while growing over wounds. High oxygen levels promote the growth of collagen. Tissue such as skin, muscles and other soft tissues grow faster in an oxygen rich area.

- **Stimulates white blood cell (WBC) action**
  Some white blood cells kill bacteria by using special enzymes and toxic substances incorporating oxygen. In areas of the body where oxygen levels are low, WBC loses the oxygen dependent killing systems. HBO restores this function, enhancing the killing of bacteria.

- **Promotes angiogenesis (blood vessel growth)**
  Hyperbaric oxygen stimulates the growth of new blood vessels into poorly perfused tissues. It also ‘supports’ at risk tissues until the new blood vessels grow.

- **Improves antibiotic action**
  Certain antibiotics have enhanced action in an oxygen rich environment. Some bacteria are also restricted in their growth in oxygen rich tissues.

Before You Undergo Hyperbaric Oxygen Therapy:

There are several procedures that you must do before each treatment:

- **Medical Assessment**
  Before you are accepted for treatment you will be examined by a Hyperbaric physician, to assess your suitability to undergo hyperbaric oxygen therapy. As well as the examination, several tests may be ordered, these may include:
    - Chest X-Ray
    - Lung function tests
    - Hearing tests
• Blood tests
• Skin oxygen levels

**Admission Process**
Each day, you will be admitted as a hospital day patient. This is done in the Hyperbaric Service. One of the nurses that are conducting the treatment will assist you in signing the appropriate forms. You will be notified of your treatment time the following day by the nurse. Check that you are "fit" enough to go into the chamber. Dental surgery and pregnancy may be contraindications to treatment. Check with your nurse prior to treatment.

We ask you to be in the Hyperbaric Unit 30 minutes before the treatment begins to be seen by the medical or nursing staff.

If you cannot come in for any reason (cold, hay fever, or transport problems) please telephone us as soon as possible on (03)2762269.

A light breakfast or lunch is recommended prior to your treatment.

As the Hyperbaric Chamber has a high oxygen concentration there is a slight risk of fire. As a safety precaution, we will ask you to wear 100% cotton scrubs which we provide. You will also be required to wear 100% cotton underwear. Shoes are not allowed inside the chamber. Please wear footwear outside the chamber so dirt and grease from the floor is not taken inside.

**For safety reasons the following items are prohibited inside the chamber:**

- Radios / iPods
- Cigarettes /matches/ lighters
- Make up /lipstick /hairsprays
- Lanolin/ ointments
- Mobile phones
- Synthetic fabrics
- Watches
- Hard contact lenses
- Alcohol

You may like to bring something to read during your treatment- don't forget your glasses!

A nurse with Hyperbaric qualifications will always accompany you inside the chamber.
Outside the chamber are a hyperbaric nurse and hyperbaric technician who are specially trained to operate the chamber. They observe the chamber interior constantly via a video and intercom. A doctor is readily available.

Treatments are painless; however please let us know if you do not like enclosed spaces.

**Hyperbaric Oxygen Treatment Program:**

Hyperbaric oxygen is frequently used as part of a total treatment program. It is very important that you follow the advice of the medical officer which may include:

- Regularly taking prescribed medications, e.g. antibiotics, diuretics
- Eating a nutritious diet, to help wound healing
- Stop smoking. Smoking will decrease the effectiveness of your treatment by reducing the amount of oxygen available to the tissues. If you find it impossible to "give up" smoking during this time, please do not smoke 2 hours before and after your treatment.
- Minimal alcohol intake.
You will require more than one treatment. Divers may receive 3-5 treatments, whereas patients with non-healing wounds may require multiple treatments (20-30) to achieve a satisfactory result. If the area has been exposed to radiotherapy, then the number of treatments will be increased. The first treatment for divers is usually about 5 hours. Treatments for all other categories of patients will usually be of about 2 hours duration.

**During The Hyperbaric Treatment:**

As the pressure in the chamber increases, you will develop a feeling of fullness in your ears. You will be taught how to 'equalise' or 'clear your ears'. This may involve swallowing, yawning, or performing a Valsalva maneuver.

You should expect a popping sensation in your ears. If the build up of pressure in your ears is becoming uncomfortable, please tell the nurse so that pressurisation can be stopped until your ears have cleared. You may not be able to equalise if you have a cold, flu or sinusitis.

You will notice that the chamber will become warmer during pressurisation. This is normal. Please let us know if you get too hot, we can give you a wet face washer. There is a basic overhead fan in the chamber which the nurse may be able to increase.

You may find that the treatments are time consuming; however, it is important that you continue the treatments on a regular basis. Interruptions will interfere with the healing process.

**Risks and Side Effects of Hyperbaric Oxygen Therapy:**

Although hyperbaric Oxygen therapy is generally a very safe and well tolerated form of medical treatment, there are some important risks and side effects of which you should be aware. This information sheet summarises the most common and important issues but is not intended to replace the discussions our doctors and nurses have with you.

It is important to let us know any health issues applying in your case, including all medications you are taking, so that we can best advise you about your treatment. You should feel free to ask any member of our team questions at any time. The most common issues are:

**Barotrauma**

Barotrauma is a medical term for injury caused by pressure change if you are unable to equalise a gas containing part of the body. Ears are the most common problem area and we will help you get used to “clearing your ears” in the chamber.

It is important to report any discomfort or difficult clearing your ears immediately to avoid injury or at worst limit it to minor bruising only (which should heal within a few days). If you develop a cold, hay fever or blocked nose etc. during treatment, please let us know - it may be necessary to halt treatment for a few days in such cases.

A risk of barotrauma to other parts of the body is very small but please let us know if you have any problems with your sinuses, recent dental work or lung or bowel problems.
Oxygen Toxicity
Hyperbaric oxygen therapy provides its effects by creating a very high level of oxygen inside the body. Like everything else, oxygen can become toxic if the levels become too high and if this occurs, a patient can briefly lose consciousness, similar to what occurs when someone “faints” or has an epileptic fit.

The risk of this happening is very low but not totally avoidable. We will discuss the level of risk that applies in your situation with you.

Vision Changes
Hyperbaric oxygen can cause changes to vision, especially in older patients, diabetics and those with pre-existing eye disease. Please let us know if you have any pre-existing eye problems and do not arrange changes to your spectacles or contact lens prescription without discussing this with us. The usual problem is temporary myopia (short sightedness) which develops slowly during long courses of hyperbaric oxygen therapy.

This makes it easier to read by my result in distance vision being out of focus. Vision should return towards what is normal for you over the weeks following treatment. If you think you are noticing any changes during the course of treatment, let us know so that we can discuss the appropriateness of continuing treatment.

Anxiety & Claustrophobia
Whilst everyone has some anxiety about new experiences, most patients cope well once they are used to hyperbaric therapy. Some patients can, however, find the experience of being inside the hyperbaric chamber or the sensation of breathing from a mask or a hood uncomfortable or even distressing. Let us know if you have any concerns before or during your treatment.

Fire Risk
Fire risk is increased when oxygen is used under pressure and it is vital that no matches, lighters, mobile phones or other electronic devices are taken into the chamber. We have a very high capacity fire sprinkler system but we don’t want to have to use it.

Smoking
Smoking reduces the oxygen levels in your body and impairs circulation - directly opposing the benefits we are trying to achieve for you. Please be honest and tell us if you are a smoker or, even better, let us help you stop.
Conditions Treated
The Alfred Hyperbaric Service provides Hyperbaric Oxygen Treatment the following approved medical conditions:

- Decompression Illness
- Arterial Gas Embolism
- Gas Gangrene
- Necrotising Soft Tissue Infections
- Acute Ischaemia and Crush Injuries
- Selected ischaemic problem wounds (including non-healing diabetic wounds)
- Osteoradionecrosis
- Delayed Radiation Injury to Bone and Soft Tissue
- Osteomyelitis (chronic refractory or acute)

What is Decompression Illness (DCI)?
Decompression illness (DCI) is a term to encompass all bubble-related problems arising from decompression, including both decompression sickness and arterial gas embolism.

Decompression sickness (DCS) is a general term for all problems resulting from nitrogen leaving the body when ambient pressure is lowered. It can be divided into Type I (musculoskeletal and/or skin manifestations only) or the more serious Type II (neurologic, cardiac, and/or pulmonary manifestations).

Arterial gas embolism (AGE) is the condition characterized by bubble(s) of air from a ruptured lung segment under pressure; the bubbles enter the pulmonary circulation and travel to the arterial circulation, where they may cause a stroke.

What are the Symptoms of DCI?
There are a variety of signs and symptoms associated with DCS and AGE.

DCS:
- Signs
  - Skin rash
  - Paralysis, muscle weakness
  - Difficulty urinating
  - Confusion, personality change
  - Loss of memory, tremors
  - Staggering
  - Collapse or unconsciousness
- Symptoms
  - Fatigue
  - Skin itch
  - Pain in joints or muscles
  - Dizziness, vertigo, ringing in ears
  - Numbness, tingling and paralysis
  - Shortness of breath

AGE:
- Signs
  - Bloody froth from mouth or nose
  - Paralysis or weakness
  - Convulsions
  - Unconsciousness or not breathing
  - Death
- Symptoms
  - Dizziness
  - Blurring of vision
  - Areas of decreased sensation
What should I do if I think I have DCI?

If have been diving recently and you believe you may have signs and symptoms of DCI, then please call us on (03) 9076 2269 and speak to one of our medical staff. The service is open for emergencies 24 hours, 7 days a week.

Please be aware that we may require you to present to the Alfred’s Emergency Department for further assessment/s that cannot be performed over the phone.

What is Osteoradionecrosis (ORN)?

Osteoradionecrosis (ORN) is bone necrosis secondary to irradiation and superimposed infection. It occurs because radiation inevitably destroys normal cells and blood vessels, as well as tumor cells. Damage to the small arteries reduces circulation to the area, depriving it of oxygen and other necessary nutrients. The process is gradual and may take months or years for signs or symptoms to appear.

**Sub acute period:**
Radiation and surgery are coupled close together (non healing wounds)
Ulceration of hypovascular tissue over radionecrotic bone e.g. mandible

**Chronic clinical period (> 1 yr. post radiation):**
Superficial ulceration over areas of deep fibrosis leading to painful ulcers penetrating into underlying tissues

If you require surgery to a radiotherapy affected area, the wound may not heal. Hyperbaric oxygen therapy has been proven to improve prognosis and surgical outcomes.

Reason for Treating with HBOT
There are two rationales for giving HBOT to patients who have had radiotherapy:
- To prevent ORN
- To repair damage from established ORN

What is Radiation Tissue Injury?

Radiation tissue injury is a complication of radiotherapy treatment for malignancy or tumour. It occurs because radiation inevitably destroys normal cells and blood vessels, as well as tumor cells. Damage to the small arteries reduces circulation to the area, depriving it of oxygen and other necessary nutrients.

If you require surgery to a radiotherapy affected area, the wound may not heal. Hyperbaric oxygen therapy has been proven to improve prognosis and surgical outcomes.

Indications for HBOT
The following types of radiation tissue injury can be treated by hyperbaric:
- Soft tissue damage over treated tumour area
- Radiation cystitis
- Radiation proctitis
- Surgical wound in irradiated field
• Dental clearance/surgery for patients who have had head and neck surgery
• Irradiated tissue surgery

What Types of Wounds are Treated with HBOT?
• Non-healing chronic wounds
• Ulcers (Venous, arterial or mixed)
• Diabetic or neuropathic ulcers
• Pressure ulcers
• Post-surgical wounds
• Compromised flaps or grafts
• Traumatic wounds
• Radiation induced wounds

What is a Chronic Wound?
A chronic wound is one that has failed to heal in the expected or usual timeframe the way most wounds do; wounds that do not heal within three months are often considered chronic. Chronic wounds seem to be delayed in one or more of the phases of wound healing.

What are the Phases of Wound Healing?
Wound healing can be divided into three main phases. However it is important to understand that they often overlap to some extent.

Inflammatory phase:
Immediate to 2-5 days

Proliferative phase:
2 days to 3 weeks

Maturation and remodeling phase:
3 weeks to 2 years

What is a Compartment Syndrome?
Compartment syndrome is a condition in which there is swelling and an increase in pressure within a limited space (a compartment) that presses on and compromises blood vessels, nerves, and/or tendons that run through that compartment. Hence, the function of tissue within that compartment is compromised.

Compartment syndromes usually involve the leg but can also occur in the forearm, arm, thigh, shoulder, and buttock.

Some of the causes of increased pressure in compartment syndromes are trauma (e.g. a fracture), too-tight wound dressings or casts, hemorrhage (bleeding) into the compartment, or inflammation.

Research
The Alfred Hyperbaric Service is currently conducting and participating in multiple research trials into Hyperbaric Oxygen Therapy

The HOLLT Study:
Hyperbaric Oxygen in Lower Limb Trauma
HOLLT is an international multi-centre randomised clinical trial aimed at assessing the impact of hyperbaric oxygen therapy (HBO) on acute complication rates and long term outcomes following severe musculoskeletal trauma. It is being led by a team at The Alfred and Monash University Department of Epidemiology and Preventive Medicine, with the latter department undertaking the study coordination and data management, funded by a TAC (formerly the Victorian Trauma Foundation) grant and a NHMRC Grant. The Chief Investigators are Dr Ian Millar of The Alfred Hyperbaric Service and Monash University’s Professor Peter Cameron and Mr Owen Williamson. It has Alfred Ethics approval 206/04. Other Hospitals committed to involvement include the Karolinska Hospital in Stockholm, University of Graz, Austria.,

The study aims to enrol 250 patients over a 2-3 year period with 10-15 per annum expected from the Alfred site. Eligible patients will be randomised to either receive 12 sessions of HBO or to not receive HBO during the acute phase of care. There will be no “sham” or control HBO treatment provided. There are no constraints or protocols regarding any other aspect of trauma management and orthopaedic, plastic surgery and if needed vascular management should be provided as per normal. Enrolled subjects will be followed up for 2 years with radiological, clinical and quality of life measures.

Entry criteria:
• Acute fracture of the tibia with significant soft tissue injury of Gustilo Grade 3
• Minimum age 18 years
• Ability to commence HBO therapy within 48 hours of injury
• Permission to enrol patient granted by trauma team managing patient
• Valid Consent possible
• Follow up likely to be possible (for a two year period)

Blinding and Outcomes
The surgeons initially operating will be kept unaware of study group allocation for the duration of the first operating session. Randomisation will occur as soon as consent is obtained to enable early HBO post operatively. The primary acute outcome is incidence of acute wound complications in the first two weeks post injury. Primary complications include soft tissue necrosis needing debridement, development of secondary compartment syndrome requiring fasciotomy or development of infection.

Review will occur at 3,6,9,12,18 & 24 months including clinical information, procedures undertaken and the functional status of the limb and the patient. Digitised X-rays will be scored in a blinded fashion. Quality of life assessments will be undertaken at the 12 and 24 month review.

Diver Information Nights:
The Alfred Hyperbaric Service hosts a monthly diver's information night to inform and educate divers in our community about the risks of decompression illness (DCI). In addition, inform the group on the process if requiring hyperbaric treatment for their DCI.

Are you an active diver?
Would you like to enhance your knowledge of diving safety and DCI?
Or would you just like to come and see the Chamber?
For further information on Diver Information Nights, please:
Phone:  9076 2323
Email: hypertechs@alfred.org.au

Useful Links

Divers Alert Network (DAN)
(http://www.diversalertnetwork.org/)
South Pacific Underwater Medicine Society (SPUMS)
(http://www.spums.org.au)
The Undersea and Hyperbaric Medical Society (UHMS)
(http://uhms.org)
Australian Wound Management Association (AWMA)
(http://www.awma.com.au)
Royal Hobart Hospital Hyperbaric & Diving Medicine Unit, Hobart
Fremantle Hospital Hyperbaric Medicine Department, Perth
Wesley Centre for Hyperbaric Medicine, Brisbane
(http://hyperbaric.wesley.com.au)
Hyperbaric Technicians and Nurses Association
(http://www.htna.com.au/)