Hyperbaric Oxygen Therapy

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Prepared by :**Dr Norzakiah Mohd Tahir**
Review by :**Dr Sivalal Sadasivan**

1. INTRODUCTION.

Hyperbaric oxygen therapy (HBOT) has been used in Malaysia since 1996. It is currently available at the Institute of Underwater and Hyperbaric Medicine (IUHM), Armed Forces Hospital Lumut, where there is a 3-compartment 17-man vessel equipment. While it is recognized as the treatment of choice for diving-related decompression sickness and carbon monoxide poisoning, HBOT is being increasingly used as adjuvant therapy for other chronic, non-emergency medical conditions.

2. OBJECTIVE

To assess the safety, clinical effectiveness, and cost implications, of hyperbaric oxygen therapy for medical conditions.

3. TECHNICAL FEATURES.

HBOT involves administering pure oxygen to a patient inside a hyperbaric chamber that is pressurized to greater than 1 atmospheric pressure (atm) This causes both mechanical and physiologic effects, by inducing a state of increased pressure and hyperoxia. The specific cellular and biochemical effects of HBOT differ for the various conditions treated. It is typically administered at 1 to 3 atm. for 90 to 120 minutes. However, the duration, frequency, and cumulative number of sessions have not been standardized.

HBOT can be administered using either a mono-place or a multi-place chamber. The mono-place chamber is the less-costly option for initial set-up and operation, but provides less opportunity for patient inter-action while in the chamber. Multi-place chambers, on the other hand, allow medical personnel to work in the chamber and care for acute patients to some extent. Since the entire multi-place chamber is pressurized, medical personnel may require controlled decompression, depending on the duration of exposure.

4. METHODOLOGY

A literature search was carried out using the MEDLINE database. The search included studies in all languages, and limited to studies on human subjects in the last 10 years of publication. The keywords used in the search were hyperbaric oxygen therapy AND (effectiveness OR effective OR efficacy), where 244 abstracts were obtained; hyperbaric oxygen AND (cost OR cost effectiveness OR budget) with 12 abstracts; hyperbaric oxygen AND safe* with 129 abstracts; barotrauma AND hyperbaric oxygen had 30 abstracts; hyperbaric oxygen AND (toxicity OR seizure) produced 541 abstracts. In addition, HTA databases were also searched- AHFMR, AETMIS and STEER, from which 2 HTA reports and 8 literature reviews were obtained. Apart from this, related links were also searched- UHMS and a committee report were obtained. A general search was also conducted using Google.

5. RESULTS AND DISCUSSION

5.1 Safety

5.1.1 Contraindications

Craig and David (1998) reported that the major absolute contraindication is pneumothorax. In addition, several drugs have also been reported as absolute contraindication. Other relative contraindications are upper respiratory infections and chronic sinusitis, obstructive lung disease, seizure disorders, emphysema with CO2 retention, previous ear surgery or injury, claustrophobia, high fever, viral infections, congenital spherocytosis, as well as history of spontaneous pneumothorax, surgery like thoracic surgery, otosclerosis. Keenan et al. (1998) suggest extra care when delivering HBO to critically ill, ventilated patients, since a review of 32 children treated with HBO while being mechanically ventilated, found hypotension, bronchospasm, haemotympanium, progressive hypoxaemia, and accidental extubation (during transport). There was also a case report of a death of a patient with pre-existing pulmonary disease after HBO therapy, due to air embolism to the lungs, heart and brain (Wolf, 1990). Weaver and Churchill (2001) advise caution in the use of HBOT in patients with heart failure or in patients with reduced cardiac ejection fraction based on pulmonary oedema developing in 3 patients with cardiac disease and reduced left ventricular ejection fractions, associated with HBOT, including one fatality. It can be concluded that most of the contraindications and caution in use of HBO is based on limited evidence.

5.1.2 Complications

Middle ear barotrauma

Plafki (2000) in his prospective review of 782 patients treated with HBO; found patients experienced ear pain or discomfort as an expression of problems in equalizing the middle ear pressure, and reported that most common complication is middle ear barotrauma. A retrospective study by Fitzpatrick et al. (1999) reported an overall rate of 3.05 cases of barotraumas per 100 treatments, the most frequently affected areas being the ears, with female patients and patients less than 40 years old age being at greater risk . In attempts to identify prophylactic measures, Carlson et al. (1992) conducted a prospective, parallel, double-blind, RCT trial on topical nasal decongestant and found it no to be effective in preventing middle ear barotrauma during HBOT. Presswood et al (1994) from a retrospective study concluded that patients with an artificial airway receiving HBO therapy are at greater risk of developing tympanic membrane and middle ear complications. However, Blanshard et al. (1996) in a prospective study found that that despite use of ventilation tubes, some patients sustained significant barotrauma. A survey of hospital-based HBO centers in the United States showed great variation in clinical practice regarding middle ear barotrauma prophylaxis, with many centers using unproven therapies like topical nasal decongestants (Capes, 1996).

Other complications

The other reported complication is oxygen toxicity usually presenting as seizure attacks (CNS toxicity) or pulmonary toxicity. Smerz (2004) reported the incidence of oxygen toxic events to be 7/100 recompressions, while pulmonary toxicity was 5/100 recompressions, and CNS events 2/100 recompressions, with an overall seizure rate of 0.6/100 recompressions. However, Yildiz et al. (2004) reported a much lower seizure incidence i.e. 2.4 per 100,000 treatments. A literature review of in-vitro, in-vivo and clinical studies found little basis that HBO enhances malignant growth or metastases (Feldmeier, 2003). It can be concluded that the complications of HBOT therapy include barotraumas and oxygen toxicity, although these are not common. There is no evidence that HBO promotes malignant growth or its recurrence.

5.1.3 Safety measures

The CETS report (2003) indicates that more than 61% of the accidents occurred under hyperbaric conditions, and 31% of the accidents were due to support system defects, with fire in 67% of cases, pressure in 22%. The UHMS Safety Committee report (1997) indicates 77 fatalities during hyperbaric treatment with fires in diving bells, recompression (or decompression) chambers, and clinical hyperbaric chambers. It has been reported that chamber fires before 1980 were principally caused by electrical ignition, whereas since then these have been primarily caused by prohibited sources of ignition carried by the occupant inside the chamber, e.g. titanium-framed glasses (Hink and Jansen, 2003). In conclusion, safety measures to avoid preventable accidents like fire and pressure –related accidents should be taken on the equipment and its maintenance, the conditions for operating the chamber, and the training of both the technical team and the patients.

5.2 Effectiveness

5.2.1 Arterial gas embolism

An HTA report by Craig and David (1998), recommends HBOT as standard care for air embolism, based on theoretical considerations, physiological evidence and widespread clinical use worldwide. The CETS report (2003) also concluded that HBOT is effective in the treatment of air embolism although the evidence was not of a high level. It also points out that the time to treatment is significant. A similar report by Benson et al. (2003) showed that iatrogenic cerebral arterial gas embolism patients improved with HBO therapy, and that this improvement for some continued for several months. In conclusion, although strong evidence supporting the effectiveness of HBO in the treatment of this condition is not available, it is accepted as the standard of care in clinical practice.

5.2.2 Decompression sickness

A randomized controlled trial (RCT) by Keller et al. (1995) of 31 subjects comparing HBO and dexamethasone found earlier improvement in the Lake Louise score, clinical score and AMS-C score with HBO. However, the numbers of subjects were small, it was not a blinded study, and the time of administration of HBO was not considered.

While it may be difficult to carry out RCT for decompression sickness, evidence from observational studies and clinical experience, as well as basic physics, has made HBO the treatment of choice.

5.2.3 Carbon monoxide poisoning

A few clinical trials reviewed in the CETS report (2003) support the use of HBO in this condition, although there was no evidence of decreased mortality rates. In addition, the Underwater and Hyperbaric Medical Society (UHMS) regards HBOT as the treatment of choice. However, a systematic review by Juurlink et al. (2005) concluded that existing RCTs do not establish a reduction in the incidence of adverse neurologic outcomes with the administration of HBO to patients with carbon monoxide poisoning. Apart from this, two good studies with high level of evidence reviewed in the AHFMR report (1998), found no significant difference between HBO and normobaric oxygen treatment. In conclusion, while the scientific evidence is inconclusive, clinical results as well as experimental data support the use of HBO in the treatment of carbon monoxide poisoning.

5.2.4 Gas gangrene

The evidence suggests significant reductions in mortality and morbidity when HBOT is part of the treatment, compared to surgery and antibiotic treatment. There is no high level of evidence, but most studies reported positive results, with further reduction in mortality and morbidity when HBOT is initiated rapidly (Hailey D, 1998; CETS 2003). Here too, it can be concluded that theoretical data and experimental reports support the efficacy of HBO as an adjuvant treatment in gas gangrene.

5.2.5 Post-radiation therapy tissue necrosis

Osteoradionecrosis

Both AHFMR (1998) and CETS (2003) reports support the use of HBO since it is as an accelerating factor in the healing of osteoradionecrosis (ORN). A retrospective study by David et al. (2001) reported that most patients who had been treated for overt ORN with HBO alone or combined with other treatments showed improvement. A number of case series have also shown that HBO prevents ORN in irradiated facial bones. A literature review by Patterson et al. (2002) also reported that there was limited evidence that HBO may help to prevent mandibular ORN in those who had received oral radiotherapy. In addition, for the UHMS, ORN is one of the indications for HBOT. However, a prospective, multi-centre, randomized, double-blind, placebo-controlled trial by Annane et al (2004) found that patients with overt mandibular ORN did not benefit from HBO. Similarly, a review by Maier et al. (2000) did not recommend HBO for the treatment of ORN.From the overall review of the literature, it can be concluded that HBO is effective in the treatment of ORN.

Other post-radiation tissue necrosis

Many studies support that HBO is an effective tool to treat patients with post-radiation haemorrhagic cystitis and/or proctitis, when conventional treatment has had unsatisfactory results (Bui, 2004; Pasquier, 2004; Corman, 2003; Mayer, 2001; Mathews 1999), although these were not RCTs.

Guello et al. (1999) reported that HBOT provides clinical relief in 2 out of 3 patients with chronic radiation-induced necrosis of the digestive tract, and that it can be a useful alternative to conventional treatment.

With respect to neurology, one study reported that HBOT may prove to be an important adjunct to surgery and steroid therapy, in radiation-induced neurologic deficits in children (Chuba, 1997), but another found only slight improvement in adults (Hulshof, 2002).

Feldmeir et al. (2000) reported an 85% success rate with HBOT of delayed radiation injuries of the extremities, particularly in non-healing necrotic wounds of the extremities within previously irradiated fields, and concluded that it is a useful adjunct, and should be part of the overall management.

In therapy of late sequelae in women receiving radiation after breast-conserving surgery, Carl et al. (2001) showed a significant reduction of pain, edema, and erythema, and concluded that HBOT should be considered a treatment option for patients with persisting symptomatology following breast-conserving therapy.

It can be concluded that HBOT may be indicated for the treatment of post-radiation haemorrhagic cystitis and/or proctitis resistant to conventional treatments, whereas there is insufficient evidence of its role in other conditions.

5.2.6 Diabetic leg ulcers

An RCT by Kessler et al. (2003) found that HBO doubles the mean healing rate of non-ischaemic chronic foot ulcers in selected diabetic patients. HBO has also been reported to enhance the healing of ischaemic, non-healing diabetic leg ulcers, and has been suggested as a valuable adjunct to conventional therapy when reconstructive surgery is not possible (Abidia et al. 2003). Another study of 100 patients with chronic diabetic foot ulcers resistant to treatment, found an 81% cure with simultaneous topical HBO and low energy laser therapy (Landau et al. 2001). Reports by AHFMR (1998) and CETS (2003) both concluded that HBO could be beneficial in healing of diabetic wounds. It was also found to be effective in decreasing the number of major amputation rates and in producing negative cultures in patients with chronic diabetic lesions. (Faglia et al. 1996, 1998; Doctor et al. 1992; Stone et al. 1998). A systematic review by Kranke et al. (2004) pooled data from three trials with 118 patients, showed a reduction in the risk of major amputation when adjunctive HBOT was used. It conclusion, HBOT has been found to be valuable in the treatment of diabetic foot ulcers.

5.2.7 Necrotizing soft tissue infections

A retrospective cohort study of 48 subjects with necrotizing soft tissue infection (NSTI) who underwent HBO reported improved survival rates (Wilkinson and Doolette, 2004). Similar results were obtained by other studies (Riseman et al. 1990; Hoolabaugh et al. 1998). Riseman et al. (1990) reported significantly less debridements in those treated with HBO. However, Shupak (1995) reported increased mortality and higher rates of surgical debridement with HBO. Assessments by AHFMR (1998), CETS (2003) and STEER (2003) found no strong evidence of effectiveness of HBOT as adjunct for the treatment of necrotizing soft tissue infections, most being non-randomised trials and case reports. It can be concluded that HBOT appears to be useful in the management of necrotizing soft tissue infections.

5.2.8 Skin grafts and flaps

The AHFMR assessment (1998) reported insufficient evidence to recommend patients with skin grafts and flaps to undergo HBO as part of the treatment regime. However, there are some studies that conclude that HBO is effective (Saunders, 2000).

5.2.9 Chronic refractory osteomyelitis

A retrospective study by Chen et al. (2003) found that HBOT is effective for the management of chronic refractory osteomyelitis of the femur provided patients had received adequate surgical debridement and appropriate antibiotic treatment. Lawson (2003) reported from his literature review that there is insufficient evidence on the effects of HBO in chronic refractory osteomyelitis. In conclusion, there is insufficient evidence to recommend HBO in patients with chronic refractory osteomyelitis

5.2.10 Acute thermal burns

A small sample double blind RCT found HBO to be effective in decreasing edema and shortening the healing time in burns (Niezgoda, 1997). Other small studies reported significant reductions in healing time and mortality (Hart et al. 1974; Hirn et al. 1993). However, Brannen et al. (1997) did not find any significant difference in mortality, number of operations, and length of stay with HBOT in a randomized prospective trial of 125 patients. A systematic review by Villanueva et al. (2004) found insufficient evidence to support or refute the effectiveness of HBOT for the management of thermal burns. It can be concluded that there is inconclusive evidence on role of HBOT in the treatment of thermal burns.

5.2.11 Acute traumatic peripheral ischaemia (crush injuries, compartment syndrome)

Bouachour et al. (1996) in a double-blind placebo controlled RCT on 36 patients found a significant increase in complete wound healing and reduction in repetitive surgery (including amputation), concluding that HBO is a useful adjunct in the management of severe (grade III) crush injuries of the limbs in patients more than 40 years old. Fitzpatrick (1998) reported a case of compartment syndrome associated with an acute exertional injury, in which after surgical decompression, HBOT reduced the oedema and improved tissue viability. However, a review by Strauss (1994) and the CETS report (2003) concluded that the studies and clinical experience are insufficient for drawing any conclusions. The evidence on HBOT for acute traumatic peripheral ischaemia is inconclusive

5.2.12 Anaemia due to exceptional blood loss

The evidence for the use of HBOT in anemia due to exceptional blood loss to provide support until the red cell mass is replaced, is poor. There is also limited clinical experience in treating such patients with HBO. (AHFMR 1998, CETS 2003).

5.2.13 Ear/hearing disorders

Racic (2003) in his retrospective study comparing patients treated with HBO with those treated with pentoxifylline, found a statistically significant improvement in hearing. In another study on patients who had HBO added on to basic treatment, Topuz (2003) reported hearing improvement. These and other studies (Muninov, 2002; Inci, 2002) recommend HBOT as an addition to conventional treatment. With respect to timing of HBOT, Sano (1998) and Murukawa (2000), suggest that HBOT be provided early to achieve optimal hearing improvement.

On the use of HBO in tinnitus, Delb (1999) found HBO a moderately effective additional treatment after primary hemorheologic therapy, provided administered within a month of onset of the condition. Another study found by a less favorable response in patients who had had tinnitus for more than 3 months before HBO (Kau, 1997)

A systematic review on the effectiveness of HBO for idiopathic sudden sensori-neural hearing loss and tinnitus by Bennett et al. (2005) reported an improvement in hearing, but the effect of HBOT in tinnitus could not be assessed due to poor reporting.

It can be concluded that early HBOT produces improvement in hearing loss, while there is inconclusive evidence on its effectiveness in treating tinnitus.

5.2.14 Cerebral ischaemia
Rusyniak et al (2003) in a prospective, double-blind RCT on 33 patients with acute ischaemic stroke, concluded that HBO does not appear to be beneficial, and may in fact be harmful. A literature review by McDonagh et al. (2003) reported insufficient evidence to determine whether HBOT reduces mortality in stroke patients. In conclusion, there is insufficient evidence on the effectiveness of HBO in ischaemic stroke.

5.2.15 Cerebral palsy
A multi-centre RCT involving 111 children with cerebral palsy by Collet et al. (2001) found that HBO did not improve the condition, although other changes were seen in speech, attention, memory, and functional skills. Papazian et al. (2003) in a literature review also concluded that there was no scientific evidence for the use of HBO in children with cerebral palsy. In conclusion there is insufficient evidence on the role of HBO in this condition.

5.2.16 Migraine
Nilsson et al. (2002) in a double-blind placebo-controlled cross-over study in 16 patients concluded that HBO was not effective in migraine. Another randomized, double blind, placebo-controlled study in 40 patients by Eftedal (2004) did not show significant prophylactic effect on migraine. There were, however, some studies that suggest that HBO reduces migraine (Wilson 1998 and Myers 1995). In conclusion, there is inconclusive evidence on the effectiveness of HBOT to reduce migraine.

5.2.17 Traumatic brain injury
Systematic reviews by Bennett al. (2004) and McDonagh et al. (2004) on the benefits of adjunctive HBOT reported that it did not produce full recovery. There is insufficient evidence on the effectiveness of HBOT for traumatic brain injury.

5.2.18 Myocardial ischaemia
An RCT by Vlahovic et al. (2004) found no benefit of HBOT on left ventricular diastolic filling in patients with acute myocardial infarctions treated with thrombolysis. There is no evidence on the effectiveness of HBOT for traumatic brain injury.

5.2.19 Pain management

Yildiz et al. (2004) in a RCT involving 50 patients with fibromyalgia syndrome, reported a significant reduction in tender points and visual analogue scale (VAS) scores and a significant increase in pain threshold with HBOT. In another RCT involving 71 patients with complex regional pain syndrome, Kiralp et al. (2004) found that HBO effective for decreasing pain and oedema and increasing the range of motion. There is insufficient evidence on the effectiveness of HBOT for pain management.

5.2.20 Exercise-induced muscle soreness

Results from the studies conducted found that HBO was not effective in the treatment of exercise-induced muscle soreness (Webster, 2002; Harrison, 2001; Mekjavic, 2000).

5.2.21 Avascular necrosis

Reis et al. (2003) reported that hyperbaric oxygen is effective in the treatment of stage-I avascular necrosis of the head of the femur. There is insufficient evidence on the effectiveness of HBOT for avascular necrosis.

5.2.22 Fracture healing

A systematic review on HBOT for the treatment of delayed bony healing and established non-union of bony fractures by Bennett et al. (2004) failed to locate any relevant clinical evidence.

5.2.23 Multiple sclerosis

A meta-analysis on the efficacy of HBOT in the treatment of multiple sclerosis by Bennett et al. (2004) found no consistent evidence to confirm a beneficial effect.

5.2.24 Ophthalmologic diseases

For central retinal artery occlusion, Patterson (2002) found no reliable evidence on the effectiveness of HBO.

There were case reports on the usage of HBO in non-arteritic anterior optic neuropathy not responding to prednisone and in macular hole surgery, but no strong conclusion could be made.

5.3 Cost Effectiveness

A literature search by Guo (2003) reported limited evidence on cost effectiveness of HBOT in major application areas. The HTA report by Craig and David (1998) indicates that HBO in osteoradionecrosis, diabetic leg ulcers and gas gangrene provides unknown or minimal cost savings while in decompression sickness, gas embolism and carbon monoxide poisoning, the estimated cost savings is $20,600 - $45,400. The CETS report (2003) quotes a study by Dempsey (1997), reporting that the high cost of a treatment in a hyperbaric chamber in Hamilton, Ontario is largely because of staff salaries and underutilization. Mitton and Hailey (1997) reported that the per-treatment cost in the hyperbaric centre in Edmonton, Alberta is lower due to the utilization being close to full capacity. Mitton and Hailey (1997) reported that a new facility in Canada would incur an annual expenditure of $108,000 with capital costs exceeding $600,000.

Guo (2003) found in a hypothetical cohort study of 1 000 sixty year old patients with severe diabetic foot ulcers that HBOT treatment is cost-effective, particularly on a long-term perspective. An economic analysis of HBOT as an adjunct treatment of thermal burns reported an average decrease in length of stay of 14.8 days, a 39% reduction of surgical procedures and an average saving of $31,600 per case (Gianci, 1990).

In conclusion, there is limited evidence on the cost-effectiveness of HBO for major areas of application. A new facility would incur significant capital and operating expenditure. To ensure optimal use, there should be multi-disciplinary utilisation.

6. CONCLUSION

6.1 Safety

There is sufficient evidence that HBOT is safe with few patients having serious side effects. Most of the contraindications and caution in use of HBO is based on limited evidence. The complications of HBOT therapy include barotraumas and oxygen toxicity, although these are not common. There is no evidence that HBO promotes malignant growth or its recurrence. Safety measures to avoid preventable accidents like fire and pressure–related accidents, should be taken on the equipment and its maintenance, the operating conditions of the chamber, and training of the technical team and patients.

6.2 Effectiveness

- Arterial gas embolism – no strong evidence supporting the effectiveness of HBOT; however, it is accepted as standard care in clinical practice.
- Decompression sickness - evidence from observational studies, clinical experience, and basic physics, has made HBO the treatment of choice.
- Carbon monoxide poisoning - inconclusive evidence, but clinical results and experimental data support the use of HBO.
- Gas gangrene - theoretical data and experimental reports support the efficacy of HBO as adjuvant treatment.
- Post-radiation therapy tissue necrosis – sufficient evidence that HBO is effective in the treatment of osteoradionecrosis; some evidence of efficacy of HBOT in the treatment of post-radiation haemorrhagic cystitis and/or proctitis resistant to conventional treatments, but there is insufficient evidence of its role in other conditions
- Diabetic leg ulcers – good evidence of effectiveness of HBOT.
- Necrotizing soft tissue infections – some evidence that HBOT is effective.
- Skin grafts and flaps – inconclusive evidence of the effectiveness of HBOT
- Chronic refractory osteomyelitis - there is insufficient evidence of the effectiveness of HBO in patients with chronic refractory osteomyelitis
- Acute thermal burns - there is inconclusive evidence on role of HBOT in the treatment of thermal burns.
- Acute traumatic peripheral ischaemia (crush injuries, compartment syndrome) - there is inconclusive evidence on role of HBOT

- Anaemia due to exceptional blood loss – insufficient evidence on the efficacy of HBOT
- Ear/hearing disorders – sufficient evidence that early HBOT produces improvement in hearing loss, but there is inconclusive evidence on its effectiveness in treating tinnitus.
- Cerebral ischaemia - insufficient evidence on the effectiveness of HBO in ischaemic stroke.
- Cerebral palsy - there is insufficient evidence on the role of HBO in this condition.
- Migraine - there is inconclusive evidence on the effectiveness of HBOT in reducing migraine.
- Traumatic brain injury -insufficient evidence on the effectiveness of HBOT for traumatic brain injury.
- Myocardial ischaemia - no evidence on the effectiveness of HBOT.
- Pain management - there is insufficient evidence on the effectiveness of HBOT for pain management.
- Exercise-induced muscle soreness - no evidence on the effectiveness of HBOT.
- Avascular necrosis - there is insufficient evidence on the effectiveness of HBOT in avascular necrosis.
- Fracture healing - no evidence on the effectiveness of HBOT.
- Multiple sclerosis no evidence on the effectiveness of HBOT.
- Ophthalmologic diseases - there is insufficient evidence on the effectiveness of HBOT

Table 1: Evidence of effectiveness of HBOT

There is good evidence to support the use of HBOT for the following conditions: Osteoradionecrosis - mandible Diabetic leg ulcers
There is fair evidence to support the use of HBOT for the following conditions: Arterial gas embolism Decompression sickness Gas gangrene Carbon monoxide poisoning Soft tissue radiation injuries Necrotizing soft tissue infections Idiopathic sudden sensorineural hearing loss (ISSHL)
There is poor evidence to support the use of HBOT for the following conditions: Chronic refractory osteomyelitis Acute thermal burns Compromised skin grafts/ flaps Exceptional blood loss anemia Acute traumatic peripheral ischaemia (crush injury, compartment syndrome) Tinnitus Migraine

Complex regional pain syndrome or fibromyalgia syndrome
There is no evidence to support the use of HBOT for the following conditions: Anaemia due to exceptional blood loss Cerebral ischaemia Cerebral palsy Myocardial ischaemia Traumatic brain injury Fracture healing Pain management Exercise-induced muscle soreness Avascular necrosis Multiple sclerosis Central retinal artery occlusion

6.3 Cost Effectiveness

There is limited evidence on the cost-effectiveness of HBO for major areas of application. A new facility would incur significant capital and operating expenditure. To ensure optimal use, there should be multi-disciplinary utilization.

7. RECOMMENDATION

In view of the lack of strong evidence of the effectiveness of hyperbaric oxygen therapy for many clinical conditions as well as the high capital and operating costs, it is recommended that it be considered only for a centre of excellence or a specialized regional centre.

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