HYPER BARIC OXYGEN THERAPY

R. K. DUTTA * AND RANJT KUMAR †

Summary

Hyper baric oxygen (HBO) therapy is presently used in clinical practice as a primary mode of treatment or as an adjunct to conventional therapy. In recent years, a number of bewildering array of skin disorders are being treated with HBO. HBO is found useful in chronic non healing ulcers, bacterial infections and fungal infections. Contra indications and possible toxic effects of HBO have been described.

KEY WORDS : Hyper baric oxygen and Recompression Chambers.

Hyper baric oxygen (HBO) was introduced in clinical practice in the mid-fifties with the general idea that it could be of immense value in diseases where normal amount of oxygen is not available to the tissues while breathing air at one atmospheric pressure (ATA). The beneficial effect of hyper baric oxygen is well documented in decompression sickness[1], carbon monoxide poisoning[2], anaerobic infections[3], burns[4] and peripheral vascular diseases[5]. At present HBO is used either as a primary mode of therapy or as an adjunct to other modes of treatment.

In recent years a number of bewildering array of dermatological diseases have been treated with HBO with beneficial results. However, due to lack of control studies, proper therapeutic evaluation has not been possible. To gain a worthy place in the therapeutic armamentorium of dermatology HBO therapy must be

(i) Uniquely beneficial and superior to other modes of therapy,

(ii) fully practical in its use, and

(iii) applicable to a resonable number of patients.

The diseases hitherto treated with HBO are classified into different categories according to their effectiveness either as a primary mode of therapy or as an adjunct to routinely prescribed treatment.

Category 1 :- Disorders for which HBO is the primary mode of treatment or at times adjunctive; but without doubt, beneficial.

(i) Carbon monoxide poisoning

(ii) Decompression sickness

(iii) Gangrene

(iv) Air embolism

(v) Tetanus

* Senior Adviser (Derm, STD & Leprosy) Command Hospital, Air Force Bangalore-560007.

† Dept. of High Altitude Physiology and Hyper baric Oxygen Institute of Aviation Medicine Bangalore,

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Category 2 :- Conditions for which results on animal studies and clinical experience are encouraging, but for which controlled studies are lacking.

(i) Burns
(ii) Head and spinal cord injury
(iii) Cardiac surgery
(iv) Ischaemia
(v) Osteomyelitis
(vi) Radionecrosis

Category 3 :- Diseases for which animal studies and clinical experience have shown promising results, but definite evidence that HBO therapy is superior to other forms of therapy is lacking.

(i) Cerebrovascular accidents
(ii) Delayed healing of fractures
(iii) Non healing ulcers
(iv) Trophic ulcers

Category 4 : Disorders for which HBO has been used empirically and found beneficial. In this group a number of diseases are included such as arthritis, malignancy, traumatic shock, vascular injuries, psoriasis, lichen planus, erythema nodosum, scleroderma, Schamburg's diseases, toxic melanoderma, fungal diseases, etc.

Indications for HBO therapy and its scope in dermatological practice are steadily increasing. It has been used in a number of infective disorders like leprosy[6], tuberculosis[6], bacterial infections[4] and fungal diseases[7], when usual forms of therapy failed. Dutta and Ranjit Kumar[8] successfully treated three cases of chronic non healing ulcers with HBO. HBO was given as a component of composite therapy and ulcers which were recalcitrant to routine treatment healed in 3 weeks time. During normal wound healing, oxygen tension in the blood is a critical rate limiting factor. Adequate oxygen supply is needed for mitosis, cell migration, and complete healing of ulcers. The beneficial effect of HBO in quickening the healing process has been fully utilised in treating chronic refractory cases of varicose ulcers[9], osteomyelitis[10], and sepsis[11].

Babayants and Matveeva[12] treated lichen planus, systemic scleroderma, Schamburg's disease, psoriasis and toxic melanoderma with HBO with beneficial effect. There was significant improvement in 69 out of 74 cases. In all these cases treatment was given as a component of composite therapy. The improvement in generalised candidiasis had been reported to be remarkable with HBO[13]. Effect of HBO was studied on 21 different strains of yeasts isolated from humans (8 strains belonged to C. albicans) after 24 hours of exposure to 100% 02 and 95% 02 + 5% Co_2 at 1 and 3 atmospheric pressures. HBO at 3 ATA was particularly sensitive. Indices of kill were found 80 to 100 percent in 17 out of 21 strains with average index of kill as 81%. Hyperoxia at 1 ATA with or without Co_2 was not lethal. Fungicidal activity was due to deprivation of carbondoixide and high oxygen tension at the tissue and cellular level. Toxic effect of HBO on bacterias and yeasts was described as early as 1878. Dutta et at[14] recently treated a case of sporotrichosis (lymphatic cutaneous types) with HBO at 2.5 ATO for 90 minutes daily to a total of 20 exposures as an adjunct to iodide therapy. Culture negativity was obtained in one week and complete cure in 3 weeks. There was no toxic effect or relapse in one year. Bean[15] and Mc Allister et al[16] demonstrated antimicrobial effect of HBO in acutely infected animals and beneficial results obtained were attributed to high bacterial oxygen tension. A number of common human pathogens on horse blood agar and other solid media were examined after exposure to HBO at 2

ATA. The microorganisms comprised of *staph. aureus, strept. viridans, strept. pyogenes, strept. faecalis, pseudomonas pyocyaneus, C. albicans and aspergillus fumigatus.* The results were compared with those of controls incubated in air at 1 ATA. The study revealed that HBO is toxic for aerobic and anaerobic bacteria as well as fungi and it produced inhibition of growth rather than destruction of the organisms.

Besides bactericidal effect on both anaerobic and aerobic flora, HBO has effect on antibiotic sensitivity pattern. With HBO *Ps. pyocyaneus* appeared less sensitive to streptomycin though it showed generalised inhibition of growth over the whole plate. Schreiner[17] observed enhanced antibiotic sensitivity of staphylococci to penicillin. *Staphylococcus aureus* growth retardation by penicillin and HBO was regarded as additive. Bornside[18] and Brown et al[19] conducted intensive studies on antibiotics and observed enhancement of activity of polymyxin B against pyocyaneus organisms under HBO ; but there was a temporary set back and authors feared emergence of unknown or altered pathogenic bacteria. Therapeutic response on experimental animals and patients suffering from aerobic organisms was always good when HBO was used as adjuvant to conventional treatment. A possible mechanism for alteration in bacterial growth was thought to be due to the formation of superoxide ion and oxygen toxicity to bacteria[20]. The treatment with HBO is accomplished in a cylindrical multi or mono place recompression chamber. At present there is no fixed treatment profile for the various types of cutaneous disorders, though certain regimes are available for the treatment of anaerobic infection, decompression sickness and peripheral vascular disorders. Treatment schedule will depend on the clinical condition, response and progress of a case.

Considering the various physiological aspects related to HBO, its scope could be delineated in some of the clinical conditions where hemoglobin is lost or inactivated, to compensate for decreased blood flow in peripheral vascular disease, to effect improvement in anaerobic infections, to promote inhibition of aerobic organisms and for rapid healing of indolent and callous ulcers. Majority of patients with skin disorder respond well when HBO is given for 60 to 90 minutes daily for 20 to 30 exposures at 2 5 ATA. HBO at 2.5 ATA is selected since it can meet the oxygen needs of skin, at the same time avoiding any possible side effects of HBO or oxygen toxicity which are frequently observed above 3 ATA. Neovascularisation, enhanced fibroblastic activity, formation of granulation tissue and epithelialisation produced by HBO are responsible for the beneficial effect on wound healing whereas in infective conditions beneficial effect is attributable to the bacteriostatic and bactericidal effect of HBO.

HBO is not free from toxic effects. Hyperbaric oxygen was introduced in clinical practice through the pioneeing works of Boerema in Holland and Illimgworth and Davidson in UK. In our country, it was first introduced at the Institute of Aviation Medicine, IAF, Bangalore in 1967 and later in Bombay. Each case has to be properly evaluated before HBO therapy is instituted. Lung pathology favouring air trapping is an absolute contraindication, to this mode of treatment. Untreated and metastatic malignancy tends to flare up with HBO therapy. Chronic respiratory diseases with Co_2 retention becomes worse with HBO which not only removes the hypoxic stimulus maintaining the respiration but also favours its retention by interfering with its removal by Hb. HBO is to be avoided in infants where it is likely to cause blindness due to

retrolenticular degeneration. HBO may increase blood pressure in a hypertensive patient by 25–40 mm Hg. Steroid is known to increase oxygen toxicity and is to be avoided during HBO exposures. Patients with epilepsy are not suitable subjects for HBO therapy which may precipitate convulsions in them.

Most common side effect of HBO therapy is parotitis causing earache and even rupture of the ear drum. Slow increase in pressure, instructions in pressure equalisation in the middle ear and in worst cases myringotomy usually solves the problem. Oxygen toxicity may involve CNS and produce severe convulsion when PO2 is higher than 3 ATA. Diazepam helps in these cases to reduce sensitivity of CNS to high PO2. Lung tissues may be damaged if exposures are given for a long time. Short exposures and alternating air breathing guard against lung damage. Molecular oxygen is a potent enzyme inhibitor and can oxidise some of the important nonprotein constituents of the cells into inactive forms thereby producing a state of hyperoxic hypoxia leading to cellular death and disruption. Lastly fire risk in oxygen-rich environment should not be forgotton.

Conclusion

Hyperbaric oxygen is presently considered as an extension or adjunct to conventional therapy. Pressure chambers are at present available in India only at Bangalore and Bombay. It must be clearly understood that the use of HBO in dermatological practice is at present only in a very preliminary state.

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