Symposium on HYPERBARIC MEDICINE

Role of Hyperbaric Oxygen in Chronic Cases

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When the initial clinical experiments in high pressure chamber were started in 1956 by Boerema and associates, their main aim was to determine the value of Hyperbaric Oxygen (HBO) as a supplement in surgery of heart. Their approach was such as to load the body with maximal amount of oxygen before the complete circulatory arrest induced in cardiovascular surgery.

Following this start, there was a sudden lag of interest in HBO till 1961 when it again erupted. During this period quite a lot of over-enthusiasm faded out, and to many an investigator hyperbaric chamber was nothing more than an interesting laboratory tool that provided new possibilities for their experiments.

The present day interest had resulted in an almost complete re-evaluation of all the previous findings on the utility of HBO. Use of HBO has not been in much controversy in cases of acute ischaemia in the limb[5,16] where the blood vessels in the surrounding tissues are healthy and have no pathological changes as found in peripheral arterial diseases. Though a number of workers like Illingworth[5], Schribeman[11], Kidokoro[9] and Koomen[10] have reported clinical improvement in cases of peripheral vascular disease with HBO, Boerema[2] expressed the opinion that daily use of HBO for a few hours should have no part to play in recanalisation, development of collateral circulation and restoration of blood supply in chronic conditions. He is of the opinion that the rest pain and claudication are due to anoxic neuritis, and the temporary improvement during HBO therapy would wear off once the treatment ceases as the basic condition of chronic tissue anoxia can not be altered. It is however, well known that in HBO therapy arterial oxygen tension is increased thus elevating the capillary-tissue oxygen gradient. This means that not only more oxygen is available to the tissue but also the area of surrounding tissues around any one capillary, which is capable of being adequately supplied by that capillary, increases significantly. Therefore, HBO is of value in many pathological conditions in which the ischaemic tissue can benefit from HBO when it cannot be reached by oxygen at normal atmospheric pressure.

In spite of advances in medical science there are still a number of patients with occlusive arterial disorders in whom amputation of the affected limb becomes inevitable to save his life, in spite of other vigorous treatment. This statement is more applicable to thromboangitis obliterans (TAO) which is common in India.

In the treatment of TAO, a beneficial effect of HBO has been reported by many workers, specially Illingworth[5]. Bird et al[1] found a reduction in the blood flow in the normal limbs after exposure to HBO. This may be due to vasospasm in the limbs. Experimental study by Kidokoro et al[9] had also proved

the beneficial effect of HBO in cases of vascular occlusion. For the last 13 years Hyperbaric chamber (RRC) in the IAM Bangalore has been employed for the treatment of chronic peripheral vascular disorders and some other chronic conditions, viz., chronic osteomyelitis, diabetic gangrene, and a few cases of chronic ulcers. But till today the bulk of the cases have been of TAO only.

Material and Methods

This study presents 58 cases of TAO which were treated with HBO at IAM. The cases were diagnosed at different service and civil hospitals and sent to IAM Bangalore for treatment with HBO. These were well established cases with history of 6 months to 5 years duration. Most of the cases had lumbar sympathectomy done 6 months to 1 year earlier and its beneficial effects had mostly worne off by the time they arrived for HBO therapy.

Evaluation in each case was done to assess peripheral pulsation, skin temperature gradient in the limb, claudication time, claudication distance in all cases and femoral angiography in a number of patients before starting the treatment.

Treatment schedule consisted of exposure to HBO at 2.5 ATA for a duration of 90 min a day for a total of 36 exposures. This schedule was found to be safe during earlier trials[9,11,17]. Patients breathed 100% oxygen with the help of a suitable mask while the pressure inside the Hyperbaric chamber was raised with compressed air. This method prevented wastage of oxygen, minimised fire hazard and allowed the medical attendant to breathe air instead of HBO. On completion of 36 exposures each patient was assessed and investigated on the same lines as done before the therapy. They were reviewed again after 6 months.

Results

Out of the 58 cases treated with HBO, 55 showed improvement in different parameters after the therapy. Three cases did not show any appreciable improvement. Their rest pains became more severe and there was no improvement in most of the other parameters.

The initial improvement was sustained in many cases who came for a review.

The angiographic pattern of vessels seen immediately and 6 months after HBO therapy was compared with that before the therapy. Improvement was associated with new collateral formation, neovascularisation in the form of capillaries which were not seen earlier and opening up of blocked vessels. The results obtained in this study confirm the findings of earlier studies conducted at this Institute[4,5,11,17].

Discussion

Oxygen under high pressure produced its effect by 2 important mechanisms namely an increase in volume of dissolved oxygen and a considerable increase in oxygen tension. Both these factors help in the carriage of oxygen through tissue fluids to distant cells which are otherwise deprived of their blood supply due to pathological changes. Most of our patients had already been treated by vasodilators and later on by lumbar sympathectomy. These methods of treatment did not produce any long-term relief of symptoms and many of them had rest pains, claudication, ulcers and some even had gangrenous changes. In an earlier study a control group with placebo treatment did not show any improvement. With HBO, the ulcers healed, claudication distance increased, improvement was noticed in the temperature gradient in the affected limb, and better performance was shown by ergometry test. Arteriograms done at the end of the treatment and at the end of 6 months showed that in a number of cases there was opening up of the collaterals and new capillary formation. Thus, there was not only subjective improvement in most of these cases but a definite reversal of the pathology, though in a limited sense of the term.

Contrary to the view that HBO inhibits new vessel formation, it is possible that in case of chronic tissue hypoxia its magnitude may play an important role in the vascular response. If it is severe and chronic, tissue degeneration, ulceration and gangrene usually result. However, mild hypoxia upto an optimal level should stimulate increased vascularisation as a compensatory mechanism. Administration of hyperbaric oxygen would lower the hypoxia in the chronically ischaemic limb to an optimum level. This modified state of hypoxia in the tissue stimulates formation of new vessels.

Improved radiological findings in a number of cases of this series justify this argument. However, these cases need to be reviewed over much longer period. Again, there were a few cases who showed clinical improvement without any corresponding appreciable radiological improvement. During subsequent reviews of these cases, it would be interesting to observe whether the clinical improvement in these cases was short lived and reverted to pre-treatment state, or improved further. The studies conducted at IAM so far indicate long term benefits of HBO therapy.

All the cases in this series had reported very late for HBO treatment and also when other methods had been tried without benefit. It is, therefore, felt that HBO is likely ro be more beneficial in TAO and peripheral artery disease if started early because there is a possibility that in such situations the pathological changes would be of lesser magnitude and the chances of healing may be expected to be more rewarding.

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