

Hyperbaric Oxygen Therapy in Stroke Cases

Wg Cdr KS Soodan^{*}, Wg Cdr AK Roy^{**}, Surg Lt Cdr PK Singh^{***}, Air Cmde Surjit Singh[†], Gp Capt KP Hegde⁺⁺

Ten stroke cases were selected at random from Command Hospital, Air Force Bangalore who had different manifestations of upper motor neurone syndrome for treatment with hyperbaric Oxygen as an adjunctive therapy. The HBO therapy was given at 2.5 ATA for 90 min, six days a week for 10-25 exposures. The cases treated with HBO therapy showed significant improvement in the spasticity and motor functions as compared to cases who were treated with physiotherapy alone. The improvement in speech and facial nerve palsy was highly significant. The HBO therapy helps early and better rehabilitation of stroke cases by reducing the spasticity and improving the motor functions.

Key Words : Hyperbaric Oxygen, Cerebro Vascular accident.

Stroke in younger population of Armed Forces is a fairly common problem. Approximately 10% of stroke cases in younger Armed Forces Personnel are of athero-thrombotic origin.

The conventional methods in the management of spasticity include physical modalities like heat, cold, vibrations and electrical stimulation. Occasionally, drugs and various orthopaedic procedures have also been used. In spite of all these conventional modalities of treatment, spasticity still remains a disabling and limiting factor in the management and rehabilitation of these patients.

The hyperbaric oxygen therapy has been used in stroke cases of different etiologies and has shown encouraging results in lowering the morbidity, reducing the spasticity and improving the motor functions, thereby facilitating an early and proper rehabilitation of these patients.

The HBO therapy results in :-

(i) Reduction of ischaemic hypoxia of the tissues

- (ii) Improves haemorrhology by decreasing the platelet aggregation and avoiding further clotting.
- (iii) Reduces cerebral oedema by causing cerebral vasoconstriction.
- (iv) Improves the neurone cell metabolism by improving the oxygen supply.
- (v) Improves the oxygen supply of the muscle cells thereby assisting the muscle function improvement.

Material and Methods

Cases and Controls : Ten cases of stroke selected at random with varying degree of spasticity and other manifestations of upper motor neurone syndrome, were subjected to HBO therapy in addition to conventional treatment. The time interval between the onset of stroke and the start of HBO therapy varied from 2 weeks to 5 months. The age of the cases ranged between 27 years to 70 Years. Similar number of cases were taken as controls who were age and sex matched and were treated with the conventional mode of treatment only.

Motor Power and Spasticity : The assessment of motor power and spasticity were made on clinical scale (MRC scale).

Therapy Protocol : The patients were hospitalised during HBO therapy. A detailed clinical examination was done in all cases for assessment of general and systemic status including nervous system and pulmonary functions prior to HBO therapy. The HBO therapy was given in a multiplace chamber as per the standard protocol of 2.5 ATA for 90 minutes in a day.

^{*} Professor (Av Med) and Head, Dept of High Altitude Physiology, Institute of Aerospace Medicine, Vimanapura, Bangalore-560017

^{**} Classified Specialist (Neurology) Command Hospital, Air Force, Bangalore-560007

^{***} Graded Specialist (Av Med) INS Hansa, Dabolim, Goa

⁺⁺ Senior Adviser (Medicine) Command Hospital, Air Force, Bangalore-560007

[†] Formerly Commandant IAM, IAF, Bangalore (Retired)

Results

All the ten cases who were given HBO therapy were of sudden origin. Six parameters were assessed before and after HBO therapy. These parameters were speech, gait, VII nerve function, reflexes, motor power and spasticity. We had two cases in the age group of 25-40 years, four cases each in the age group of 40-60 and above 60 years. There was one female in the age group of 40-60 years.

Table I shows the effect of HBO on the neurological deficits other than the motor power and spasticity. Speech was affected in eight cases out of which four showed remarkable improvement to a clear intelligible level. Eight cases had facial nerve lesion, out of which four showed complete recovery with no residual deficit. The facial nerve was the first lesion to improve and is considered to be a good prognostic sign. Tendon reflexes remained exaggerated in most of the cases signifying persistence of upper motor neurone lesion. The gait improved in all the cases. Most cases were able to walk without any support but with a mild limp.

TABLE I Effect of HBO Therapy on Neurological Deficits

PARAMETER	BEFORE HBOT	AFTER HBOT	
SPEECH	normal	2	6
	affected	8	4
VII NERVE	normal	2	6
	affected	8	4
REFLEXES	normal	2	3
	exaggerated	8	7
GAIT	normal	2	2
	hemiplegic	4	8
	nonambulatory	4	0

Motor power to different grades was affected in nine cases as shown in Table II. Improvement in motor power was seen in five cases which is significant from mobility and rehabilitation point of view.

Table II, Effect of HBO Therapy on Muscle Power

Grade	Before HBOT (No. Cases)	After HBOT (No. Cases)
V	1	2
IV	0	5
III	6	3
II	1	-
I	1	-
0	1	-

Similarly, significant improvement in spasticity was seen, where nine cases showed complete recovery from spasticity and one case had grade I spasticity only (Table III).

TABLE III Effect of HBO Therapy on Spasticity

Grade	Before HBOT	After HBOT
V	0	-
IV	3	-
III	3	-
II	1	-
I	0	1
0	3	9

Two parameters i.e., motor power and spasticity were compared in patients who were treated with physiotherapy alone. The improvement in motor power amongst controls was of the order of Gr 3-4/5 whereas the improvement in spasticity was of the order of Gr 2-3/5. The relief of spasticity was rapid and the recovery in motor functions was lasting amongst patients treated with hyperbaric oxygen therapy. There was overall a sense of well being felt by the patients and no complication of HBOT was noticed. All cases had pulmonary functions well within normal limits.

Discussion

The role of hyperbaric oxygen therapy in cerebral ischaemia has been mentioned as early as in 1961 by Smith G et al¹ and has been confirmed and recommended by many others subsequently. In chronic stroke cases, there are always marginally functioning neurones which can be brought close to normal functioning activity by HBO therapy which helps in revascularisation. HBO therapy leads to vasoconstriction of the cerebral blood vessels but the amount of oxygen

carried by blood circulating through cerebral vessels is much higher in proportion as compared to the reduced blood flow. Significant improvement in regional blood flow during HBO therapy has been reported by Newbauer². Sukoff³ reported reduction in cerebral oedema following HBO therapy in stroke cases.

Although HBO therapy has been used for several years in the management of stroke cases, not much literature is available with regard to its effect on spasticity, speech and facial nerve palsy. Spasticity is a common manifestation in the stroke cases. The cause of spasticity is disputed with multiple explanations. Earlier spasticity was believed to be due to hyperactive gamma efferents but micro graphic study in spastic patients showed lack of any such evidence. However Dilwaide and Young⁴ produced evidence that the spasticity was due to decreased presynaptic inhibition of Ia terminals within the spinal cord. The cases treated at our Institute showed significant improvement in the spasticity. Spasticity improved to grade 0 in nine out of ten cases due to which, the patients could become ambulatory. The improvement in spasticity was rapid and more in cases on HBO therapy as compared to patients treated with other modes of treatment (Physio-therapy). Motor power also improved in these cases. No case reported any recurrence of spasticity in follow up of nine months. KK Jain⁵ in series of 21 cases observed relief of spasticity in all cases and a combination of HBO and physiotherapy produced a lasting relief. The relief in spasticity is most probably due to improvement in the functions of neurones in the penumbra zone of cerebral hemisphere affected by stroke. Kieper⁶ also recorded reduction in the spasticity following HBO therapy in spastic paraplegics.

The other significant finding in our cases was the improvement in speech and VII nerve palsy. Most cases where speech and VII nerve were affected, showed complete recovery. The rapid and complete recovery is possibly due to improvement of the Oxygen status of the ischaemic neurones left with marginal function. Reduction in blood flow due to vasoconstriction in the facial nerve canal there by reducing oedema

could be another possible mechanism aiding facial nerve recovery. It will be worthwhile considering treatment of facial palsy with HBO where decompression of the nerve is indicated.

The deep reflexes remained exaggerated even though there was definitive recovery in other manifestations of upper motor neurone syndrome signifying incomplete recovery from the stroke. But the improvement in the spasticity, the motor functions, speech and facial nerve palsy definitely improved the quality of life of the stroke cases. HBO therapy or recompression is an absolute indication in stroke cases due to cerebral air embolism. HBO therapy in chronic stroke cases is a very useful adjunctive treatment for rapid and better rehabilitation.

Akhinov et al⁷ in a series of 104 cases observed good results in 74 cases, satisfactory in 22 cases and doubtful in 8 cases of CVA. Similary Jia et al⁸ found total recovery in 32%, significant recovery in 31% and no effect in 4% cases.

Although the cases were subjected to HBO therapy after their initial stabilisation, it still remains doubtful that at what stage HBO therapy should be started. Considering the rationale of use of HBO therapy in stroke cases, better results could be achieved by early commencement of the therapy.

References

1. Smith G, Lawson D, Renfrew S. Preservation of cerebral cortical activity by breathing oxygen at 2 ATA of pressure during ischaemia. *Surg gynecol obstet* 1961; 113 : 13-16.
2. Neubaur RA. Regional cerebral blood flow studies of the effect of HBO in acute stroke neuro-logic deficits : 30 cases. Seventh Annual conference on clinical application of HBO Anaheim : June 1982.
3. Suckoff MH, Ragatz RE : HBO for the treatment of acute cerebral oedema, *Neuro surgery* 1982; 10 : 29-38
4. Delwaide PJ, Young RR. Clinical neurophysiology in Spasticity. Amsterdam : Elsevier, 1985.
5. Jain KK. Effect of Hyperbaric Oxygenation on spasticity in stroke patients. *Journal of Hyperbaric Medicine*, 1989; 4(2) : 55-62.
6. Kieper NR. The use of hyperbaric oxygen in the rehabilitation of spinal cord injured patients due to

decompression sickness in Kindwall EP. Proceedings of eighth International Congress on hyperbaric medicine. San Pedro, CA : Best publishing company 1987; 251-254.

7. Akhinov GA, Lobzin VS, Sapov IA et al. Assessment of efficiency of HBO Therapy in the early

forms of CV disorders. Neurosci-Behav-physiology. Journal of Hyperbaric Medicine 1986; 15(1) : 13-17.

8. Jia SJ, Zhang JD, Ou ZK. Experience in clinical use of HBO therapy in cerebral thrombosis. Journal of Hyperbaric Medicine 1986; 3(1).