



Hyperbaric Oxygen Therapy For Sudden Sensorineural Hearing Loss After Failure Intratympanic And Oral Corticosteroid Therapy

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ABSTRACT

Introduction: The current treatment for sudden hearing loss remains controversial. Systemic and intratympanic steroids are usually prescribed; unfortunately, only 61% of patients achieve full recovery. Recently, hyperbaric oxygen therapy emerges as a new possible treatment. **Objective:** To determine the efficacy of Hyperbaric Oxygen therapy (HBOT) after unsuccessful treatment with oral and intratympanic corticosteroids.

Methodology: Case series. Setting: Secondary care center. Patients were included from March 2013 to July 2013. Inclusion criteria: age >18 years, failure to systemic and intratympanic corticosteroids. Intervention: Ten sessions of HBOT were conducted, 60 minutes each, at 2 atmospheres. All patients underwent audiometry before and after treatment. PTA (pure tone average) was defined as the average of the frequencies of 500, 1000, 2000 and 4000 Hz.

Results: We included four female patients, mean age 51 years. The mean time from onset of illness to HBOT was 108.75 days. Initial mean PTA was 55.31 dB, final PTA was 54.6875 dB ($p=0.958$). Mean hearing gain was 0.625 dB. One patient had complete hearing recovery, 2 patients slight improvement (recovery of 3.75 dB), 1 patient worsened; In addition, 2 patients reported subjective improvement of dizziness. Although hearing gain was observed at low frequencies in two patients (25dB and 20 dB), no statistical significance was achieved ($p=0.817$). No complications were reported.

Conclusions: The use of HBOT in patients who fail steroid therapy did not demonstrate a beneficial hearing effect in our patients. However, symptoms like dizziness improved subjectively. More studies are needed to corroborate our results.

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INTRODUCTION

Idiopathic Sudden sensorineural hearing loss (ISSNHL), is defined as a sensorineural hearing loss greater than 30 dB, occurring in at least 3 contiguous frequencies and developing in 72 hours or less. It is a disease with unknown etiology, which can lead to permanent morbidity.¹⁻⁷ Available treatments include steroids, vasodilators, antivirals and immunosuppressants.

To date, the most accepted treatment are corticosteroids, however, there is still no accepted worldwide treatment^{1,2,4,5}. Approximately, 61% of patients experience spontaneous recovery, for those patients without clinical improvement, intratympanic corticosteroids have been widely used. Unfortunately, the latter constitutes an invasive procedure. Associated risks like tympanic perforation, meningitis and otitis media have been reported.¹

HBOT has been shown to provide significant additional effect when used in combination with steroids, however, the therapeutic role of HBOT individually is not well established. The objective of this protocol, is to determine effect of the HBOT for the treatment of ISSNHL refractory to treatment with systemic and intratympanic steroids.^{1,3,5}

We performed a cases series, in patients refractory to systemic and intratympanic corticosteroids with ISSNHL.

METHODS AND MATERIALS

We included 4 patients with diagnosis of Idiopathic Sudden Sensorineural Hearing Loss (ISSNHL) treated at the Otolaryngology department of the Hospital Civil de Culiacán from March 2013 to July 2013.

This study was approved by the Ethics Committee. HBOT was performed by slowly increasing the air pressure to 2 Atm. Breathing 100% oxygen for 60 minutes. A Full course was defined as the HBO once a day for 10 days over a 2 week period. The results were evaluated before and after treatment (audiometry and speech audiometry).

Inclusion Criteria: Patients previously treated with intratympanic and Systemic corticosteroids without clinical improvement in the audiometry test. Patient must be older than 18 years old.

Exclusion criteria: Patients who have not been treated with systemic or intratympanic corticosteroids, patients with associated diseases: serous otitis media, eustachian tube dysfunction, brain trauma, Meniere's disease, ear surgery, vestibular neuronitis, labyrinthitis, migraine, central nervous system involvement. Patient's inability to perform HBOT.

Elimination criteria: tympanic perforation or complication of serous otitis media, increase in dizziness or appearance of neurologic symptoms, revocation of informed consent or lost of follow up. Incomplete HBOT. Patients who didn't perform audiometry test before and after the treatment protocol.

RESULTS

We included four female patients, mean age 51 years. The mean time from onset of illness to HBOT was 108.75 days. Initial mean PTA was 55.31 dB, final PTA was 54.6875 dB ($p=0.958$).

Mean hearing gain was 0.625 dB. One patient had complete hearing recovery, 2 patients slight improvement (recovery of 3.75 dB), 1 patient worsened; In addition, 2 patients reported subjective improvement of dizziness. See Table 1.

Although hearing gain was observed at low frequencies in two patients (25dB and 20 dB), no statistical significance was achieved ($p=0.817$). No complications were reported.



Figure 1. External view of hyperbaric chamber

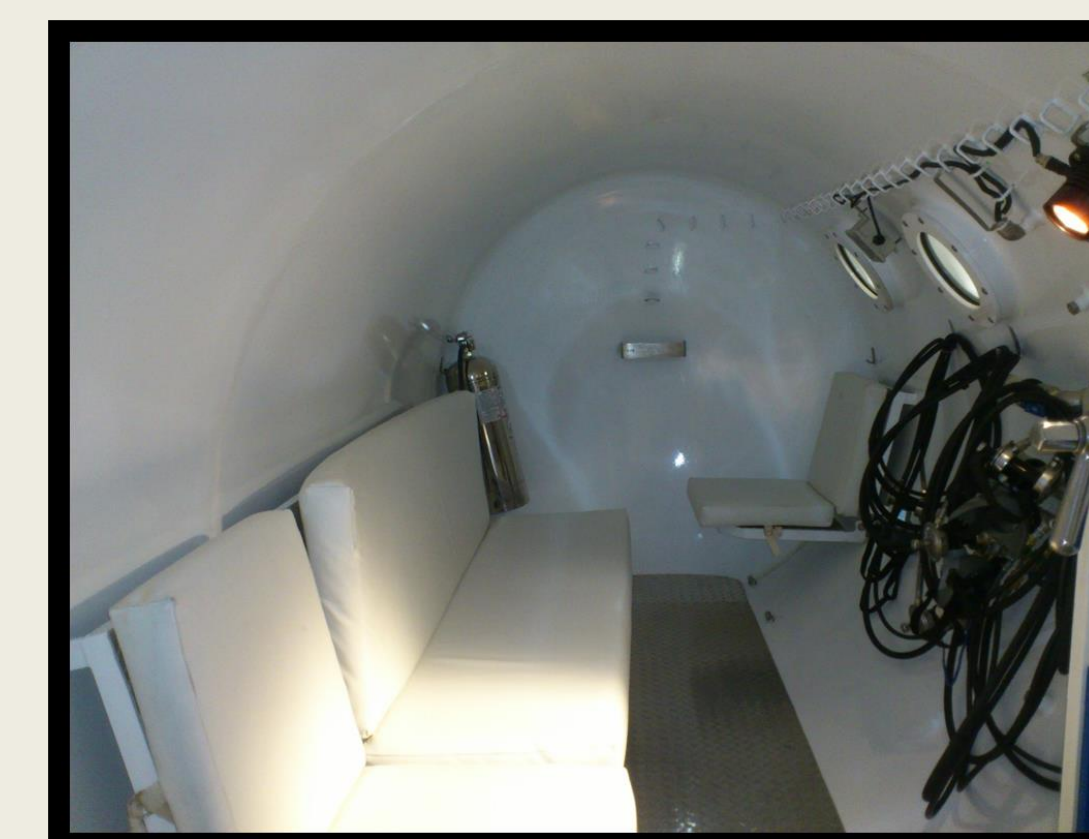


Figure 2. Internal view of hyperbaric chamber

Patient	Age (Years)	Evolution in Days	Side	Pre HBOT	Post HBOT
				PTA4	PTA4
P1	43	155	Left	78.75	75
P2	21	56	Left	32.5	8.75
P3	83	50	Left	42.25	37.5
P4	57	174	Left	68.5	97.5
Mean	51	108.75	Left	55.3	54.6

Table 1. Patient results. PTA4, defined as the mean of the 500 Hz, 1000 Hz, 2000 Hz y 4000 Hz. Evolution in days: from onset of disease to the beginning of the HBOT. Only patient 2 had full recovery.

Author/Year	N	HBOT	Treatment	PTA Pre	PTA Post	Gain dB
Narozny ³ 2004	52	10/ 2.5 atm 60 min/day	Rheotherapy, steroids and HBOT	60	32.63	27.37
Horn ² 2005	9	10/2 atm 90 min/day	Patient failed Corticosteroid Therapy and Famvir	Air: 63.5 Bone: 52.2	Air: 52.4 Bone: 46.4	Air: 11.1 Bone:5.8
Suzuki ¹ 2012	174	10/ 2.5 atm 60 min/ day	Previous HBOT they received hydrocortisone IV(400mg/day)	75.8±19.78	49.6±28.1	26.2±22.8
Imsuwansri ⁴ 2012	1	10/ atm 90 min/day	Patient failed Corticosteroid oral and IT therapy	60	20	40
Yang ⁸ 2013	22	10/2.5 atm 120 min/day	Patient failed Corticosteroid Therapy	86.02	68.63	17.39
Cvorovic ⁹ 2013	25	20/2 atm 60 min/day	Patient failed Corticosteroid Teraphy	73.4	39.6	33.76 Younger than 60 years was 40.22 Older: 21.23
Burgos 2014	4	10/ 2 atm 60 min/day	Patient failed Corticosteroid oral and IT therapy	55.3	54.6	0.63

Table 2. Atm: atmospheres, dB:decibels, HBOT: Hyperbaric oxygen therapy, IT: intratympanic therapy, PTA: pure tone average.

DISCUSSION

Currently, the pathophysiology of SNHL remains unknown. There are many drug therapies based on observational, empirical and experimental studies. Nonetheless, the standard of care is the use of corticosteroids. Hypothetically, most of the treatment options target the inner ear in order to improve blood circulation and restore the oxygen pressure. However, there are many refractory cases, with no evidence based- alternative treatment.

The hyperbaric chamber, used as an adjuvant therapy has proven utility in diverse studies. Furthermore, ISSNHL guidelines by the American academy of otolaryngology have approved its use in ISSNHL patients. The mechanism of action is mainly described as the arterial oxygen diffuses through the capillaries into the inner ear and its membranes, providing oxygen to the sensorineural structures of the cochlea and therefore, increasing inner ear's oxygen saturation. A review of published articles which used hyperbaric chamber as a ISSNHL treatment in the past 10 years was performed. All studies had PTA pre/post measurements (Table 2).

Results showed that most of the articles in the literature reported some hearing improvement. Although diverse treatment combinations were used. This also could be due to a selection bias, being positive results the only ones that were actually published. In our study, being a small sample of patients, no hearing gain was observed (classification according to Hu and Wilson); perhaps due to the clinical characteristics of our patients or longer evolution time. However, a trend in hearing gain at low frequencies was observed. In these patients, previous and post average PTA in low frequencies were 50.3 dB and 47.8 dB, respectively, showing an improvement of 2.5 dB. P value (.817) was not significant. In two patients hearing gain at low frequencies were 20 and 25 dB (frequencies from 125 Hz to 500 Hz, this trend toward low frequencies improvement was also stated in the clinical practice guidelines of Sudden Hearing Loss 2012, by the American academy of otolaryngology, statement 9) Limitations of the study were the small sample of patients, the absence of a control group or randomization and the longer evolution time. Nevertheless, we believe it is useful to report the results in refractory patients (of oral and IT steroids) in both early and late hyperbaric chamber treatment.

CONCLUSIONS

The use of HBOT in patients who fail steroid therapy did not demonstrate a beneficial hearing effect in our patients. However, symptoms like dizziness and tinnitus improved subjectively.

HBOT is still a controversial treatment, still more, on refractory patients with ISSNHL, but, it must be consider as an option. Clinician should individualize treatment and possible response, always explaining the uncertain prognosis to the patient. Must consider age, time of evolution and severity of hearing loss. More studies are needed to corroborate our results.

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