Complete recovery following hyperbaric oxygen therapy in idiopathic sudden sensorineural hearing loss: a report of two cases

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ABSTRACT

Idiopathic sudden sensorineural hearing loss (ISSHL), a common otologic emergency, presents mostly as an abrupt onset unilateral hearing loss, aural fullness, often with vertigo and tinnitus, usually upon awakening in the morning. Its etiopathogenesis is multifactorial, so a number of different therapeutic regimens are in practice, hyperbaric oxygen (HBO_2) therapy being an effective yet underutilized one. Not all cases recover completely even after treatment. Here we describe two cases of ISSHL, diagnosed on the basis of clinical examination and pure-tone audiometry, who had a complete recovery following administration of HBO_2 therapy in addition to medical treatment. These cases are reported to highlight the effectiveness of this modality in a physician's armamentarium.

INTRODUCTION

Idiopathic sudden sensorineural hearing loss (ISSHL), defined as a unilateral sensorineural hearing loss of greater than 30dB in at least three contiguous frequencies over 72 hours, is a disease of unknown etiology [1]. The pathophysiology of this condition is unclear. Several possible etiologies, including viral infections, autoimmune reactions, intracochlear membrane breaks and vascular insults, are suggested [2]. A vascular cause has long been presumed because of the abrupt clinical course and accompanying circumstances.

Idiopathic sudden sensorineural hearing loss (ISSHL) is an audiological emergency, which if left untreated may lead to permanent morbidity. It has been reported that ISSHL spontaneously resolves in 45%-65% of cases [3,4]. Various primary treatments have been proposed, including steroids, vasodilators, antiviral agents, anticoagulants, vitamins, plasma expanders, diuretics and hyperbaric oxygen (HBO_2) therapy, individually or in combination [5]. The empirical use of all drugs is based mainly on improving the blood circulation and restoring the oxygen tension of the inner ear. The use of hyperbaric oxygen in ISSHL is intended to increase the partial oxygen pressure and oxygen concentration in the inner ear and to improve the microcirculation [6].

ISSHL is the newest indication approved by the Undersea and Hyperbaric Medical Society's Hyperbaric Oxygen Therapy Committee [7]. In HBO_2 therapy, a patient breathes 100% oxygen at a pressure level higher than 1 atmosphere absolute (atm abs). The prognosis of ISSHL depends on a number of patient-related and audiovestibular parameters [8], and the effectiveness of the treatment modality used. As a result, each patient may have a variable degree of recovery.

This paper reports two cases of ISSHL. Both had complete recovery after administration of HBO_2 as an adjunctive treatment, and highlights the growing importance of this treatment modality for the disorder.

CASE REPORT 1

A 38-year-old male presented to our outpatient department with sudden onset hearing loss in the left ear for two days, with tinnitus and no other positive history or associated comorbidity. Otoscopic and other physical

KEYWORDS: sudden sensorineural hearing loss, SSNHL, hyperbaric oxygen, complete recovery

examinations were unremarkable. The Rinne test was positive on both sides, the Weber test lateralized to the right, and the absolute bone conduction test decreased on the left side with a 512-Hz tuning fork. All hematological and biochemical investigations were normal. Pure-tone audiometry revealed bone conduction thresholds of 70dB in the left ear and normal hearing sensitivity in the right ear: Hence, we made a diagnosis of left-ear ISSHL.

We administered medical treatment to the patient, including intravenous dexamethasone, plasma expander (Dextran-40 500 ml intravenously once a day), antioxidant ginkgo biloba, nicotinic acid and antiviral agent acyclovir 800 mg five times a day. Also, the patient was treated in a monoplace hyperbaric chamber, where he breathed 100% oxygen at a pressure of 2.5 atm abs for 60 minutes, once daily, planned for a total of 10 sessions. Pure-tone audiometry repeated after five sessions of HBO_2 therapy revealed an improvement in bone conduction thresholds to within 20dB – i.e., a hearing gain of 50dB. The patient had a complete recovery: His hearing level returned to within 20dB at 500-, 1,000- and 2,000 Hz, even before completion of the entire protocol. Tinnitus also resolved. Hence, the last five sessions were believed to be unnecessary and HBO_2 therapy was stopped midway. The patient suffered no side effects from the treatment and remains asymptomatic to this date.

CASE REPORT 2

A 28-year-old male presented to our department with sudden onset hearing loss in the left ear for six days, with accompanying tinnitus and no other positive history. Tuning fork tests indicated a left-sided sensorineural hearing loss. Pure-tone audiometry showed bone conduction thresholds of 80dB in the left ear and normal hearing sensitivity in the right ear. The diagnosis was left-ear ISSHL.

The patient was administered the same conventional medical treatment as outlined above for Case 1, along with HBO_2 therapy. Pure-tone audiometry repeated after five sessions revealed an improvement of bone conduction thresholds to 40dB. Audiometry was repeated after the next three sessions. The patient showed subjective improvement in hearing, an improvement in bone conduction thresholds to within 20dB – i.e., a total hearing gain of 60dB. Thus, the patient achieved complete recovery, as well as resolution of tinnitus, even before completion of the entire protocol. Hence, HBO_2 therapy was withdrawn. The patient suffered no side effects and remains asymptomatic.

DISCUSSION

Idiopathic sudden sensorineural hearing loss presents as an abrupt onset unilateral deafness (generally within three days), of greater than 30dB at three consecutive frequencies. The incidence of five to 20 per 100,000 persons per year [4] is an underestimate, since many who recover quickly never seek medical attention. ISSHL occurs mostly between 43 and 53 years of age, with equal sex distribution [4,9].

Sudden onset hearing loss is virtually always associated with aural fullness, tinnitus and varying degrees of imbalance and vertigo. The etiology of SSHL is unknown: in 85% to 90% of cases, despite thorough evaluation, the underlying cause is unknown or uncertain at the time of presentation. Treatment decisions are generally made without knowledge of the etiology [10,11]. It is thought to be the clinical manifestation of different pathologic processes that include viral infection, vascular occlusion, autoimmunity and intracochlear membrane breaks [2].

A common problem is delay in diagnosis. Evaluation begins with a careful history, followed by physical examination, which includes tuning fork tests and cranial nerve examination. Audiometric testing serves to verify and quantify the degree of hearing loss. Gadolinium-enhanced magnetic resonance imaging of the temporal bone and brain is warranted in selected patients to rule out a retrocochlear abnormality.

Controversy remains surrounding the necessity and options for treating idiopathic SSHL. One of the bases of this ongoing debate is the fact that idiopathic SSHL spontaneously resolves in 45% to 65% of patients [3,4]. Numerous agents have been investigated for the treatment of idiopathic SSHL including steroids, anti-inflammatory agents, antimicrobials, calcium antagonists, vitamins, essential minerals, vasodilators, volume expanders, defibrinogenators,

diuretics, hyperbaric oxygen, and bed rest. The number and variety of treatments results from the ongoing debate over the etiology of idiopathic SSHL, and the relative rarity of the condition [8,10]. However, the main aim is to improve blood flow to aid oxygenation of the cochlea.

The current standard treatment for ISSHL is a tapered course of corticosteroids, which has been the cornerstone of management for many decades. Many studies have shown the benefit of systemic corticosteroid therapy for hearing recovery in ISSHL patients. Wilson, et al. demonstrated a statistically significant benefit of systemic corticosteroids for hearing recovery in patients with ISSHL [12]. Moskowitz, et al. demonstrated better functional hearing levels in patients of ISSHL receiving steroids as compared to placebo [13]. Fetterman, et al. showed that ISSHL patients who were treated with steroids or vasodilators or both were more likely to improve [14]. An initial randomized, placebo-controlled trial involving subjects with ISSHL showed significantly higher rates of improvement among patients receiving oral steroids [15]. Fuse, et al. found that most patients who recovered completely after oral corticosteroid therapy improved within seven to 10 days after starting medication [16]. Lefebvre reported that 100% of sudden hearing loss patients treated with corticosteroids recovered within seven days [17].

Several other treatment modalities targeting mainly the vascular etiology of ISSHL are in practice. However, their exact role in the management has not been established. Wilkins, et al. treated patients with ISSHL with a "shotgun" regimen that included dextran, histamine, hypaque, diuretics, steroids, vasodilators and carbogen inhalation, and suggested that this approach offers no better outcome than is reported in literature for spontaneous recovery [18].

The use of antiviral treatment in the management of ISSHL is anecdotal. However, there is increasing histologic and epidemiologic evidence to support a viral cause in ISSHL. Hughes, et al. have suggested the use of acyclovir in the treatment regimen for ISSHL [19]. Redleaf, et al. used a combination of dextran and diatrozide; the findings were suggestive of beneficial use of the same in ISSHL [20]. Emmett and Shea used a combination of carbogen, intravenous histamine, steroids, diuretics, low-salt diet, and hypaque to treat ISSHL. However, no statistical conclusions were made from this study [21].

The use of HBO_2 therapy in the treatment of ISSHL is intended to increase the partial oxygen pressure in the inner ear and to improve the microcirculation [6]. The usefulness of HBO_2 for ISSHL has been studied for many decades. Pioneer work on the role of HBO_2 therapy in disorders of the inner ear was conducted by Lamm and Klimpel [22] and by Appaix and Demard [23] in 1970. The therapeutic usefulness of HBO_2 in ISSHL has also been confirmed by other authors.

Hyperbaric oxygen therapy improves the results of the conventional treatment of ISSHL, and best results are achieved if the treatment is started early after the onset of deafness. The famous Cochrane trial meta-analysis [24] of several studies also concluded that significantly improved hearing levels are achieved if HBO_2 therapy is begun within two weeks of onset of hearing loss. In both our cases, HBO_2 was initiated in less than a week after the onset of hearing loss, and favorable outcomes were achieved. Aslan, et al. investigated therapeutic effects of addition of HBO_2 to conventional therapy (prednisone, betahistine, stellate ganglion block) and reported that this significantly improved the outcome of ISSHL, especially in patients younger than 50 [25]. Takahashi and Kobayashi also reported that addition of HBO_2 to conventional therapies improved the outcome of ISSHL [26].

In a prospective randomized study conducted by Topuz, et al. in 2003, ISSHL patients received the conventional medical treatment (steroids, plasma expander dextrans, diazepam, pentoxiphylline and salt restriction), with the addition of HBO_2. This study concluded that the addition of HBO_2 to conventional treatment modalities significantly improves the outcome of ISSHL, especially in patients younger than 50 [27]. A study by Narozny concluded that HBO_2 with high doses of glucocorticoids improves the results of conventional ISSHL treatment; best results are achieved if the treatment is started as early as possible [28]. Both our patients too, were administered HBO_2 therapy in addition to the conventional medical treatment, and favorable outcomes were achieved. Also, both patients

were younger than 50 years, and had significantly improved hearing outcomes, as stated by several other studies conducted in the past.

Many [29,30,31,32,33,34] trials have studied the adverse effects of HBO_2 in SSHL patients; these have been found to be negligible. When used in standard protocols of pressures not exceeding 3 atm abs and length of treatment shorter than 120 minutes, hyperbaric oxygen therapy is a safe and a relatively benign intervention. No adverse events during or following HBO_2 therapy were reported in both patients.

The prognosis of ISSHL depends on a number of patient-related and audiovestibular parameters [8] as well as the effectiveness of the treatment modality used. Early estimation of prognosis of this condition is a dilemma. The factors considered important in the prognosis are: severity of hearing loss; duration of symptoms before treatment; presence of vertigo; type of audiogram; age of patient; gender; hearing level in the opposite ear; coexistence of metabolic diseases such as diabetes mellitus, hypertension, thyroid disorders; audiological parameters [4,14]; use of corticosteroids and HBO_2; and number of HBO_2 treatments.

Many trials have studied the impact of these parameters on the outcome of ISSHL. A study conducted by Ceylan, et al. found the following to be poor prognostic factors: female gender; presence of vertigo; initiation of treatment more than seven days after onset of deafness; and >40dB hearing loss on admission [8]. An increased severity of initial hearing loss may be associated with poorer prognosis. It is generally agreed that nearly all patients with >90dB hearing loss will not recover, regardless of therapy [35].

The time from onset of hearing loss to treatment is considered to be one of the most important prognostic factors. Shaia and Sheehy achieved a complete to moderate recovery in 75% of their patients treated within seven days of onset of hearing loss [36]. Vertigo has been considered a poor prognostic factor [4]. Patients with up-sloping audiograms are reported to be more likely to recover [35]. Advanced age is considered a prognostic factor: A better recovery rate was reported in young patients [3,7]. Female gender is considered to be a poor prognostic factor in ISSHL [8]. Systemic diseases such as hypertension, diabetes mellitus and hyperlipidemia may be poor prognostic factors, because of the presence of microvascular disorders [38].

Several studies have demonstrated the efficacy of steroids in the treatment of ISSHL; HBO_2 therapy has been shown to provide a significant additional effect when used in combination with steroids. Because of the additive effect of these factors, each patient may have a variable degree of recovery. In both our cases, the majority of the patient-related and audiovestibular parameters were favorable. Both patients were young males, with no history of vertigo or any associated comorbidities, who presented with <90dB hearing loss within seven days of onset of deafness. In addition, the use of an effective treatment modality i.e., HBO_2 in addition to medical treatment (including steroids) helped these patients to achieve a complete recovery, both audiometrically and subjectively.

ISSHL presents a major public health problem, with a significant impact on patients' quality of life, especially if vertigo and tinnitus are present. This has been studied in several trials [39,40,41].

CONCLUSION

The addition of HBO_2 therapy to conventional treatment modalities significantly improves the outcome of ISSHL, aids in disability reduction in terms of improved hearing levels, and helps patients to improve their quality of life. Hence, the use of hyperbaric oxygen should be encouraged as an adjunctive therapy in ISSHL patients, as it is safe and has shown favorable and promising results. Awareness regarding the use of HBO_2 and the importance of effects of oxygen under hyperbaric conditions should be fostered so that it can be used more routinely. Also, awareness regarding SSHL as an otologic emergency should be increased. This will help ensure that treatment is begun earlier so that more favorable hearing outcomes can be achieved.

Conflict of interest statement

The authors declare that no conflict of interest exists with this submission. ■

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