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Successful treatment of acute sensorineural hearing loss with hyperbaric oxygen therapy

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ABSTRACT

Sudden sensorineural hearing loss (SSNHL) is an important acute clinical condition in children. A specific treatment is still missing. Hyperbaric oxygen (HBO) therapy is one of the recommended treatments for SSNHL in adults. Our knowledge on the use of HBO therapy in children for SSNHL is limited. Herein, we report the successful use of HBO therapy in the management of SSNHL in a 14-year-old child.

1. Introduction

Sudden sensorineural hearing loss (SSNHL) is characterized by a significant hearing loss occurring within 72 h in at least 3 consecutive audiogram frequencies. Although SSNHL is less common in children than in adults, the prognosis is worse^[1,2].

Treatment of SSNHL in both adults and children is usually challenging and a specific treatment for SSNHL is still missing. Hyperbaric oxygen (HBO) therapy, which involves the inhalation of oxygen (> 95%) at elevated atmospheric pressures inside a pressurized chamber, is one of the promising treatments in the management of SSNHL^[3]. The majority of studies assessing the efficacy of HBO therapy on SSNHL have enrolled merely adult patients, and hence our knowledge on the use of HBO in the pediatric population is limited.

Herein, we report the successful use of HBO therapy in the management of SSNHL in a 14-year-old child.

2. Case report

A 14 year-old boy was brought to the Undersea and Hyperbaric Medicine Department for unilateral hearing loss, which had started approximately 25 days ago and failed a course of medical treatment.

The physical examination of external ear canal and ear drum was unremarkable. Audiometric assessment revealed sensorineural hearing loss on the left ear (Figure 1).

Following written informed consent and education regarding ear clearing, HBO therapy was scheduled to be delivered once a day at 2.4 atmospheres absolute. Each HBO session would involve three periods of 30 min oxygen inhalation interspersed with two periods of 5 min air inhalation. The first 6 HBO sessions went uneventful. On Day 7, the patient reported flu like symptoms and otoscopic examination revealed failure to ear clearance, a major risk factor for middle-ear barotrauma. Medical treatment was prescribed and HBO therapy was postponed for 3 days. Following medical management with a systemic decongestant, control otoscopic

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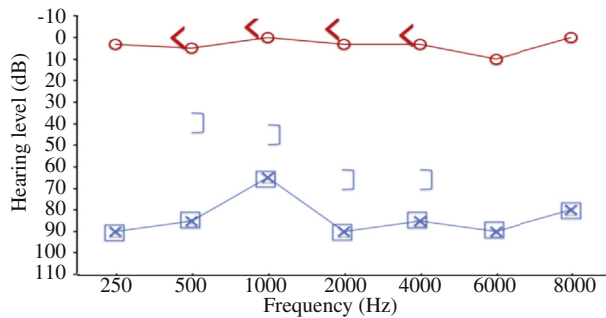


Figure 1. Pure tone audiometry of the patient before HBO therapy. ○: Unmasked air conduction thresholds for the right ear; ×: Unmasked air conduction thresholds for the left ear; □: Masked air conduction thresholds for the left ear; △: Unmasked bone conduction thresholds for the right ear; ▽: Masked bone conduction thresholds for the left ear.

examination revealed persistence in failure to ear clearance and HBO therapy was postponed for 4 more days. After 7 days of interruption, the patient was able to clear his ears and completed a total of 20 HBO sessions. At the completion of treatment, both the symptoms and the audiogram were significantly resolved (Figure 2). On follow up at 6 months, pure tone audiometer revealed complete recovery (Figure 3). Informed consent was obtained from patient and his parents to publish this case report.

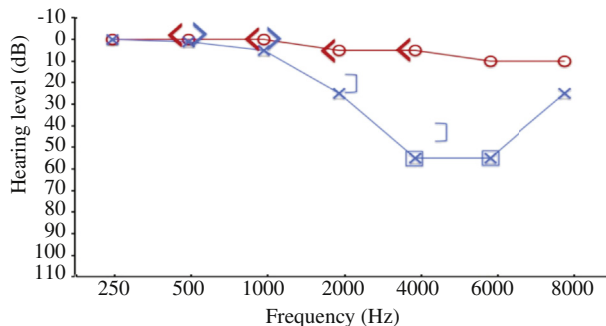


Figure 2. Pure tone audiometry of the patient after HBO therapy. ○: Unmasked air conduction thresholds for the right ear; ×: Unmasked air conduction thresholds for the left ear; □: Masked air conduction thresholds for the left ear; △: Unmasked bone conduction thresholds for the right ear; ▽: Unmasked bone conduction thresholds for the left ear; ▽: Masked bone conduction thresholds for the left ear.

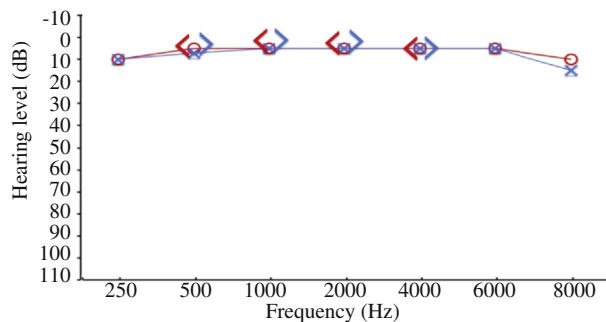


Figure 3. Pure tone audiometry of the patient at 6 months follow-up. ○: Unmasked air conduction thresholds for the right ear; ×: Unmasked air conduction thresholds for the left ear; □: Masked air conduction thresholds for the left ear; △: Unmasked bone conduction thresholds for the right ear; ▽: Unmasked bone conduction thresholds for the left ear.

3. Discussion

SSNHL has a lower prevalence in children than in adults and studies dealing with hearing loss in children are, therefore, rare. Although some studies involve both pediatric and adult patients, they haven't specifically reported on the children's characteristics and treatment outcomes^[4]. Nevertheless, several retrospective studies with small sample sizes are available. Roman *et al.* performed a study on 12 children with SSNHL, while total recovery was reported in 4 (28.5%) children, partial recovery was reported in 4 (28.5%) children, and no recovery in 6 (43%) children^[1]. Roman *et al.* also reported that severe hearing loss, the presence of vertigo and a downward audiometric curve were negative prognostic factors^[1]. Inci *et al.*, conducted a study on 43 children and reported the treatment failure in 23 of the 50 ears (46%)^[5]. Treatment delay and the presence of vertigo were negative prognostic factors. Chen *et al.* reported complete recovery in 8 of 14 (57%) children with SSNHL and partial recovery in 5 (36%)^[6]. A hearing loss greater than 50 dB was a poor prognostic factor^[6].

There is not a specific treatment for SSNHL in children. Several treatment options with varying success rates have been reported. Roman *et al.* used piracetam (50 mg/kg/day), methylprednisolone (1 mg/kg/day) and carbogen inhalation (15 min/day)^[1]. Chen *et al.* used prednisolone at an initial dose of 3 mg/kg/day and tapering gradually^[6]. Inci *et al.* used the combination of HBO therapy and corticosteroids (1 mg/kg/day)^[5].

Herein, we report a child who received HBO therapy for SSNHL, 25 days after the diagnosis. Data on the efficacy of HBO therapy in pediatric patients with SSNHL is limited. Although our patient had several bad prognostic factors, such as severe hearing loss (> 80 dB), failure to thrive medical treatment and delayed HBO therapy, a significant improvement in hearing was achieved following HBO therapy and complete recovery was observed at 6 months follow-up^[1,5-7].

For more than two decades now, HBO therapy has been used in the treatment of SSNHL. Impairment in circulation and a resulting hypoxia in the inner ear organs is one of the most popular theories on the pathophysiology of SSNHL. The rationale behind the use of HBO therapy in SSNHL, in this sense, is the restoration of the oxygen tension in the inner ear to avoid further damage to the cochlear tissue.

HBO therapy by the way of increasing the amount of oxygen dissolved in plasma improves tissue perfusion and sustains hypoxic cells in the endo- and peri-lymph^[7]. While HBO therapy is not yet accepted as a standard of care in patients with SSNHL, the most recent clinical guideline of the American Academy of Otolaryngology-Head and Neck Surgery states HBO therapy as an adjuvant treatment option in the management of SSNHL^[3].

Although it is rare and mild in nature, side effects of HBO therapy, particularly middle-ear barotrauma, in the pediatric population is a major concern with limited data. Middle-ear barotrauma may usually be avoided by comprehensive before-treatment education, routine otoscopic examination prior to each session and high vigilance. Any mass, foreign body or exudate observed on otoscopy within the external ear canal may hamper ear clearance and hence, should be removed before HBO treatment. Otoscopic examination also provides evidence for successful ear clearance, as the physician may witness the ear

drum while the patient performs ear clearing maneuvers. Familiarity with the normal structures of the ear and experience with otoscopes is therefore, a pre-requisite for hyperbaric practitioners. We interrupted HBO therapy in our patient due to flu like symptoms which hampered ear clearing and could put the ear drum at risk for barotrauma. Treatment was continued and terminated uneventfully.

HBO therapy may be considered in pediatric patients with idiopathic SSNHL. However, we cannot rule out spontaneous improvement of hearing in our patient. High vigilance for potential side effects is a prerequisite for HBO treatment in pediatric patients since they may fail to follow instructions properly. Routine otoscopic examination of patients before each HBO session is recommended to avoid middle ear barotrauma. Further studies are required to confirm the effectiveness and safety of HBO therapy in children with SSNHL.

Conflict of interest statement

The authors report no conflict of interest.

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