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# Hyperbaric Treatment of Sensorineural Hearing Loss

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## Continuing Education Activity

Sudden sensorineural hearing loss (SSNHL) is defined as hearing loss of at least 30 decibels occurring over at least three consecutive audiometric frequencies and lasting at least 3 days. A specific etiology is identified only about 10 to 15 percent of the time, and the majority of cases are deemed idiopathic. Patients typically first notice symptoms upon waking and describe a sensation of aural fullness or blockage. They may also experience tinnitus, dizziness, or vertigo. The spontaneous recovery rate is difficult to determine since many patients do not seek medical care but it has been reported to range from 25 to 65 percent. In most controlled trials, the spontaneous recovery in patients receiving placebo therapy is between 35 and 39 percent. More than 60 treatment protocols have been described for SSNHL but the majority of these have not proven effective. The three most promising treatments include corticosteroids, vasodilators, and hyperbaric oxygen therapy. Of these, only hyperbaric oxygen has undergone sufficient randomized controlled trials to show a positive treatment effect in meta-analyses. This activity describes the indications, contraindications, and protocol for hyperbaric oxygen therapy as a therapy for sudden sensorineural hearing loss and highlights the role of the interprofessional team in promptly assisting patients seeking treatment.

## Objectives:

- Identify the indications for hyperbaric oxygen therapy for sudden sensorineural hearing loss.
- Describe the contraindications to hyperbaric oxygen therapy for sudden sensorineural hearing loss.
- Review the complications of hyperbaric oxygen therapy.
- Summarize interprofessional team strategies for enhancing care coordination for patients with sudden sensorineural hearing loss by evaluating their candidacy for hyperbaric oxygen therapy.

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## Introduction

The sudden sensorineural hearing loss is defined as a hearing loss of at least 30 decibels occurring over at least three consecutive frequencies and lasting at least 3 days. A specific etiology is identified only about 10% to 15% of the time, the majority of the time this is deemed idiopathic. Possible etiologies include vascular occlusion, viral infections, labyrinthine membrane breaks, autoimmune, trauma, toxins, cochlear membrane damage, demyelinating disease, stroke, and schwannoma. The patient typically first notices symptoms upon awakening and describes an aural fullness/blockage. They may also experience tinnitus (usual), dizziness, or vertigo. There are approximately 4000 new cases in the United States annually. The spontaneous recovery rate is difficult to determine since many patients do not seek medical care but it has been reported as low as 25% and as high as 65%. In most controlled trials, the spontaneous recovery in patients receiving placebo is between 35% and 39%. Hearing loss can impose heavy social

and economic burdens and significantly impair a patient's quality of life. Adult-onset hearing loss is the most common cause of disability globally and the third leading cause of years of productivity lost due to disability according to the World Health Organization (WHO). Hearing aids are recommended for moderate (41 decibels to 60 decibels) and severe (61 decibels and greater) hearing loss. More than 60 treatment protocols have been described for sudden sensorineural hearing loss, but the majority of these are not efficacious. The three most promising treatments include corticosteroids, vasodilators, and hyperbaric oxygen therapy. Of these, only hyperbaric oxygen has sufficient randomized controlled trials to have a positive meta-analysis Cochrane review.[1][2][3]

## Anatomy and Physiology

Hearing function in the inner ear is maintained by the cochlea which is known to have a high oxygen demand. Cochlear hypoxia is associated with progressive ossification, fibrosis, loss of neurons, endolymphatic hydrops, and hearing loss. Direct blood supply to the organ of Corti is minimal; oxygen must diffuse through the perilymph and cortilymph. The labyrinthine artery (internal auditory artery) is a long, slender branch off of the anterior inferior cerebellar artery (85%) or the basilar artery (15%). It accompanies the vestibulocochlear nerve through the internal acoustic meatus into the inner ear. Animal models of labyrinthine artery occlusion have shown progressive degenerative changes, fibrosis, new bone formation, and hearing loss. Any pathology that results in vascular occlusion of this artery can result in hearing loss.

## Indications

Hyperbaric oxygen can increase perilymph oxygen tension and restore hearing in a significant number of patients with sudden sensorineural hearing loss. Efficacy may depend on many factors including the degree of patency of the labyrinthine artery and the ability to increase oxygen tension in the perilymph. Many prospective randomized controlled trials have proven their benefits over placebo. The best results are found when patients are treated within 14 days of symptoms onset and with concomitant steroids (either systemically or intratympanic). Steroids should be given at an initial dose of 1mg/kg/day and tapered over 2 to 3 weeks unless contraindicated. Patients with moderate to severe hearing loss (more than 40 decibels) should be considered for hyperbaric oxygen therapy. The American Academy of Otolaryngology recommends hyperbaric oxygen be considered as a treatment option for up to 3 months after symptom onset and recommends against the routine use of antivirals, thrombolytics, vasodilators, vasoactive substances, or antioxidants. Patients who have failed an initial course of steroids can still often benefit from a combination of intratympanic steroids and hyperbaric oxygen therapy even as far out as ten weeks after symptom onset. An otolaryngologist and audiologist should evaluate patients with an audiogram, MRI of the brain (to rule out retrocochlear pathology), full autoimmune and vasculitis evaluation, and auditory brainstem response. Follow-up audiograms should be done during (after the first ten treatments) and after (at the completion of 20 treatments) the course of hyperbaric oxygen therapy and at 6 months follow up. Additionally, patients should be educated on the natural history of the condition, the benefits and risks of interventions, and the limitations of the existing evidence regarding efficacy. Patients should be counseled on the possibility of incomplete recovery of hearing and possible benefits of amplification and hearing-assistive technology and other supportive measures.[4][5][6]

## Contraindications

Contraindications to hyperbaric oxygen are relatively few but may include: confinement anxiety, severe congestive heart failure, severe reactive airways disease, untreated pneumothorax, and concomitant doxorubicin or bleomycin therapy. Systemic corticosteroids may be contraindicated in patients with psychiatric illness, diabetes, peptic ulcer disease, breastfeeding, and liver disease. For these patients, intra-tympanic steroids may be a better option.[7][8][9]

## Equipment

Patients may be treated in a monoplace hyperbaric chamber or a multiplace chamber.

## Personnel

For multiplace chamber operation, an inside tender is needed in addition to the outside chamber operator.

## Preparation

Patients should be screened for reversible contraindications such as fever and hypoglycemia before treatment.

## Technique or Treatment

Treatment pressure for hyperbaric oxygen therapy should be 2.0 ATA to 2.5 ATA for 90 minutes daily for 10 to 20 treatments depending on response. Those who have shown no improvement (10 decibels or less) during the first ten treatments are less likely to benefit from further treatment.

## Complications

Middle-ear barotrauma is the most common complication of hyperbaric oxygen therapy. Its incidence is approximately 13%, but the vast majority of these cases resolve with no sequela. The incidence of middle ear barotrauma can be lowered using slower compression rates, coaching proper ear clearing techniques, and oral decongestants. The O'Neill grading scale has shown greater inter-rater reliability and utility than Teed's scale in determining the degree of barotrauma and recommended treatment options.

## Clinical Significance

Moderate to severe hearing loss dramatically affects the quality of life for patients and their families and may impair their ability to work in their chosen careers. Hearing aids cost between \$1500 and \$3000 per pair (US dollars, 2017), requiring replacement every 3 to 5 years, and they don't always give the patient fully functional hearing. A course of 10 hyperbaric oxygen treatments at an outpatient facility ranges between \$2000 and \$5000. For people with an early presentation of sudden sensorineural hearing loss, the application of hyperbaric oxygen therapy significantly improves the prognosis with a number needed to treat of 5.3. For patients with moderate hearing loss hyperbaric oxygen improved hearing an average of 19.3 decibels and for those with severe hearing loss improved an average of 37.7 decibels. This improvement would bring the average patient from needing to wear hearing aids and learn lip reading to a normal to slight impairment range.

## Enhancing Healthcare Team Outcomes

Sensorineural hearing loss is best done with an interprofessional that includes audiology nurses. Over the years HBO has been recommended for the treatment of sensorineural loss but clinicians should be aware that the data are heterogeneous and there still remains some question about its real benefits. When to undertake HBO therapy for sensorineural loss is still being debated but some experts suggest it should be early in the course.

The outcomes-based on small case series seems to suggest that some patients with sensorineural loss do have a positive outcome, but this is not a universal finding.[1] [Level 5]

## Review Questions

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**Disclosure:** Heather Murphy-Lavoie declares no relevant financial relationships with ineligible companies.

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