



Hyperbaric Oxygen Therapy (HBOT) for Sudden Deafness – A Case Report

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ABSTRACT

Introduction: Sudden deafness or sudden sensorineural hearing loss (SSNHL) is defined as sensorineural hearing loss of more than 30 dB at three consecutive frequencies occurring within 3 days. The condition is usually unilateral and often idiopathic. The etiology is still not known. Early diagnosis and prompt treatment are essential to improve hearing recovery. **Case:** A 62-year-old Balinese male presented with sudden decreased hearing for approximately one week accompanied by tinnitus. The patient denied previous history of cough, cold, vomiting, allergies, sinusitis, autoimmune disease, anemia, or other systemic diseases. There was no history of trauma or rhinoplasty. Pure tone audiometry showed severe mixed hearing loss in the right ear and moderate sensorineural hearing loss in the left ear. The patient received combination therapy consisting of methylprednisolone, mecobalamin, and hyperbaric oxygen therapy (HBOT). **Discussion:** HBOT increases oxygen delivery to the inner ear and may enhance cochlear metabolism and microcirculation. Several studies have reported improved outcomes when HBOT therapy is combined with corticosteroid therapy. **Conclusion:** This case demonstrates that HBOT therapy combined with corticosteroids may provide significant hearing improvement in patients with sudden deafness.

Keywords: Audiometry, case report, hyperbaric oxygen therapy, sudden deafness.

ABSTRAK

Pendahuluan: Tuli mendadak atau *sudden sensorineural hearing loss* (SSNHL) didefinisikan sebagai kehilangan pendengaran sensorineural lebih dari 30 dB pada 3 frekuensi berturut-turut yang terjadi dalam waktu 3 hari. Kondisi ini umumnya bersifat unilateral dan sering kali idiopatik. Etiologi pasti dari tuli mendadak masih belum diketahui. Diagnosis dini serta penatalaksanaan yang cepat dan tepat sangat penting untuk meningkatkan kemungkinan pemulihan fungsi pendengaran. **Kasus:** Seorang laki-laki berusia 62 tahun, suku Bali, datang dengan keluhan penurunan pendengaran mendadak sejak kurang lebih 1 minggu yang disertai tinnitus. Pasien menyangkal riwayat batuk, pilek, muntah, alergi, sinusitis, penyakit autoimun, anemia, ataupun penyakit sistemik lainnya. Tidak terdapat riwayat trauma dan tindakan operasi hidung sebelumnya. Pemeriksaan audiometri nada murni menunjukkan tuli campuran berat pada telinga kanan dan tuli sensorineural sedang pada telinga kiri. Pasien mendapatkan terapi kombinasi berupa *methylprednisolone*, *mecobalamin*, serta terapi oksigen hiperbarik (*hyperbaric oxygen therapy*/HBOT). **Pembahasan:** HBOT dapat meningkatkan suplai oksigen ke telinga dalam serta berpotensi meningkatkan metabolisme koklea dan mikrosirkulasi. Beberapa penelitian melaporkan hasil yang lebih baik ketika terapi HBOT dikombinasikan dengan terapi *corticosteroid*. **Simpulan:** Laporan kasus ini menunjukkan bahwa kombinasi terapi HBOT dan *corticosteroid* dapat memberikan perbaikan pendengaran yang bermakna pada pasien dengan tuli mendadak. **Kadek Rina Agustinawati, Komang Krisna Nugraha Wirasatya, Luh Putu Dhena Purwaningsih. Hyperbaric Oxygen Therapy (HBOT) untuk Pasien Tuli Mendadak - Laporan Kasus.**

Kata Kunci: Audiometri, laporan kasus, terapi oksigen hiperbarik, tuli mendadak.

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INTRODUCTION

Sudden deafness or sudden sensorineural hearing loss (SSNHL) is defined as a form of subjective sensation of sensorineural hearing loss in one or both ears that occurs rapidly within a 72 hour period. The audiometric

criterion is a decrease in hearing ≥ 30 dB in at least 3 consecutive frequencies, which indicates an abnormality in the cochlea, auditory nerve, or the center for perception and impulse processing in the brain auditory cortex. If the cause of sudden deafness cannot

be identified after adequate examination, it is called idiopathic sudden sensorineural hearing loss (ISSNHL).¹ Four theories of the cause are viral infections, vascular abnormalities, intracochlear membrane damage, and immunological abnormalities.^{1,2}

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Sudden deafness occurs in 5–30 people out of 100,000 people per year. The distribution of men and women is almost similar, with a peak age of 50–60 year.³

Patients commonly report unilateral hearing loss noticed upon awakening. In most cases it is usually unilateral, only 1%–2% of cases are bilateral. Hearing loss can be sudden, gradually disappear steadily or can occur quickly and progressively. Hearing loss can fluctuate, but most is stable. Sudden deafness is also often accompanied by complaints of a sensation of fullness in the ears with or without tinnitus; can be preceded by tinnitus. In 28%–57% people with sudden deafness, vestibular disorders, such as vertigo or disequilibrium, can be found.³ Sudden deafness has the characteristics of being acute, sensorineural deafness, and unknown etiology (idiopathic). Additional characteristics can include vertigo, tinnitus, without cranial nerve involvement. An in-depth history regarding the process of deafness, accompanying symptoms, and predisposing factors is important for diagnosis. Otoloscopic examination may reveal no abnormalities. An audiology examination may find:

- Tuning test: Rinne is positive, Weber is lateralized to the healthy ear, Schwabach is shortened. Impressions of sensorineural deafness.
- Pure tone audiometry: Mild to severe sensorineural hearing loss.
- Tone decay or fatigue reflex test is negative. The impression is not retrocochlear deafness.
- Speech audiometry: SDS (speech discrimination score) less than 100%. Impressions of sensorineural deafness
- Audiometric impedance: Tympanometry

type A (normal). The ipsilateral stapedius reflex is negative or positive, while the contralateral is positive. Impressions of sensorineural deafness.

- BERA (in children) shows mild to severe sensorineural deafness. ENG examination (electronystagmography) may show canal paresis.⁴

CT scan and MRI with contrast are needed to rule out other diagnoses such as acoustic neuroma and temporal bone malformation. Arteriography examination is performed in cases suspicious for thrombosis. Laboratory examinations are carried out to check for possible viral, bacterial infections, autoimmune diseases, hyperlipidemia, hypothyroidism, hyperfibrinogen, and hemostasis function.^{6,7}

Most causes of sudden sensorineural deafness are idiopathic, sudden deafness must be differentiated from other possible etiologies such as: bacterial infections (meningitis, labyrinthitis, syphilis) and viruses (HIV, mumps, herpes simplex), autoimmune disease (systemic lupus erythematosus); tumors (meningitis carcinomatosa, vestibular Schwannoma).^{8,9}

Management of sudden deafness consist of systemic corticosteroids, intratympanic corticosteroids, and hyperbaric oxygen therapy. The first choice is steroids. Systemic steroid administration did not show satisfactory results, because only 61% of sufferers experienced recovery. Intratympanic steroids shows better results, but because of the side effects such as temporary dizziness, pain at the injection site, and burning sensation, intratympanic steroids is less

desirable.^{10,11} Several studies have proven that hyperbaric oxygen therapy (HBOT) results in hearing improvements. HBOT is also non-invasive, and comfortable for patients. The combination of HBOT and steroids shows better results than HBOT alone or steroids alone.^{5,12}

The Undersea and Hyperbaric Medical Society (UHMS) has determined that sudden idiopathic sensorineural hearing loss is the primary indication for HBOT. This therapy should be given as soon as possible. This therapy has side effects of damage to the ears, sinuses and lungs due to changes in pressure, temporary worsening of myopia, claustrophobia, and oxygen poisoning.¹³

Evaluation of hearing function is carried out every week for one month. Kallinen, et al., (1977) define the hearing improvement response in sudden deafness as follows:¹⁴

- Very good, if the improvement is more than 30 dB on 5 frequencies.
- Recovered, if the improvement in hearing threshold is less than 30 dB at frequencies of 250 Hz, 500 Hz, 1,000 Hz, 2,000 Hz, and below 25 dB at frequencies of 4,000 Hz.
- Good, if the average improvement is 10–30 dB on 5 frequencies.
- No improvement, if there is an improvement of less than 10 dB on 5 frequencies.

If hearing loss does not improve with the above treatment, a hearing aid is considered. Ppsychotherapy can aid the patient to accept the situation.¹⁵

CASE

A male, 62 year-old, Balinese, complained of hearing loss for ± 1 week. Patients also complain of ringing in their ears. History of fever, vomiting, cough, and cold was denied. Patient has never complained of similar complaints. No history of allergies, sinusitis, autoimmune disease, anemia, or other systemic diseases. Any trauma or previous rhinoplasty were also denied. No other family members suffer from a similar disease. The patient is self-employed, history of smoking and drinking alcohol is unknown. Physical examination and general status were within normal limits. ENT status: Nose: within normal limits; throat: within normal limits; left

Table 1. Criteria for diagnosis of sudden sensorineural hearing loss.⁵

Main Symptoms

- Sudden onset of hearing loss (able to say clearly when it appeared)
- Sensorineural hearing loss (usually severe)
- Unknown cause

Accessory Symptoms

- Possibly accompanied by tinnitus
- May be accompanied by vertigo, nausea, or vomiting (without recurrent episodes)
- No cranial nerve symptom other than from eight above

Note: Definitive diagnosis involves all the foregoing criteria; probable diagnosis. centers on the first two.



and right ears: deafness (+/+), no secretion, tumor, corpus alienum, tinnitus, vertigo. Pure Tone Audiometry shows AD : AC 75 dB BC 48.75 dB; AS : AC 40 dB BC 50 dB. The patient was diagnosed with severe mixed AD deafness and moderate AS SNHL.

Management include mecobalamin 2 x 500 mcg, methylprednisolone 1 x 16 mg, hyperbaric consultation for 5 sessions and to get enough rest. No barotrauma complications (ear pain, paranasal sinus pain, or toothache) during HBOT. The audiometry test showed improvement after HBOT, the right ear became normal with an audiometry test result of 20 dB, while the left ear became normal with an audiometry test result of 22.5 dB.

DISCUSSION

A male, 62 year-old, Hindu, Balinese, complained of hearing loss ± 1 week ago. The patient also complained of ringing in the ears. History of fever, vomiting, cough and cold was denied. Patient has never complained of similar complaints. No history of allergies, sinusitis, autoimmune disease, anemia, or other systemic diseases. Any trauma or previous rhinoplasty were also denied.

ENT examination status showed nose and throat were within normal limits. Bilateral deafness was found, and meet the definition of sudden deafness as it occurs within 72 hours. The audiometric findings were a decrease in hearing ≥ 30 dB in at least 3 consecutive frequencies, indicating abnormalities in the cochlea, auditory nerve, and the center for perception and processing of impulses in the

auditory brain cortex. The working diagnosis was severe mixed AD deafness and moderate AS SNHL, based on anamnesis, physical examination and pure tone audiometry.

The treatment was mecobalamin 2 x 500 mcg, methylprednisolone 1 x 16 mg, hyperbaric oxygen therapy for 5 sessions as both agents have been employed in similar cases to address neural repair and inflammation.¹⁰ Mecobalamin, the active form of vitamin B12, plays a crucial role in the maintenance and repair of nerves.¹⁶ Methylprednisolone has anti-inflammatory effects to reduce inflammation and relieve symptoms.^{6,10}

Systemic corticosteroids are considered the first-line treatment for sudden sensorineural hearing loss.^{6,7,10} Hyperbaric oxygen therapy (HBOT) can also improve hearing loss.^{6,10,12} Several studies shows better results after a combination of HBOT and steroids than HBOT alone or steroids alone.^{6,10,13}

This case showed significant hearing improvement after combination of HBOT and corticosteroids (methylprednisolone) therapy. The result supports the findings of other studies that have shown better outcomes with combination therapy.¹ However, we cannot definitively conclude that the improvement was solely due to the combination of HBOT and steroids.

In cases of sudden deafness, inflammation of the cochlea or auditory nerve is thought to play a role in the pathogenesis.¹ Corticosteroids aim to reduce this inflammation, potentially restoring hearing function. Several studies

have demonstrated that corticosteroids may improve cochlear blood flow and reduce inner ear edema, thereby contributing to the recovery of hearing function in cases of sudden sensorineural hearing loss.^{6,10} The patient's prognosis is expected to be good considering that the patient does not have predisposing factors. Audiometry test results showed improvement after the patient underwent HBOT.

CONCLUSION

Sudden deafness is a condition of sensorineural hearing loss of more than 30 dB at 3 consecutive frequencies within 3 days of onset which occurs in 5–30 people out of 100,000 people per year. The diagnosis is made based on anamnesis, physical examination, and supporting examinations in the form of pure tone audiometry. The etiology is still not known.

RECOMMENDATION

Further research can explore the mechanism of action of HBOT, including its effect on neuroprotective and vascular aspects that can influence hearing recovery.

COMPETING INTEREST

The authors declare no competing interests related to the study

AUTHORS' CONTRIBUTION

Kadek Rina Agustinawati – develop research proposal, collect data, data analysis.
Luh Putu Dhena Purwaningsih – develop research proposal, collect data, data analysis.
Komang Krisna Nugraha Wirasatya – data analysis and publication manuscript.

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