



# MANAGEMENT OF BILATERAL ACUTE LOW TONE SENSORINEURAL HEARING LOSS (ALHL)

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## Abstract

**Introduction:** In the ORL-HNS, acute low-tone sensorineural hearing loss (ALHL) is an emergency that needs to be treated right away. The hearing loss in ALHL is restricted to low-tone frequencies, and it has a superior prognosis compared to idiopathic sudden sensorineural hearing loss (ISSNHL). The administration of systemic corticosteroids was said to provide positive outcomes. **Aim:** to ascertain the effects of steroid treatment in patients with ALHL without diuretics. **Case Report:** A 36-year-old lady was identified as having dyslipidemia and bilateral acute low-tone sensorineural hearing loss. Patients had complete bed rest, oxygen treatment, simvastatin, vitamins B and C, and high-dosage oral corticosteroids (tapering off). **Method:** Through the Cochrane database, PubMed, and Google Scholar, evidence-based literature studies on the management of ALHL are available. **Conclusion:** The ORL-HNS department considers ALHL to be an emergency that needs to be treated right away to improve the prognosis. With corticosteroids as the primary treatment and no diuretics in combination, PTA has improved with favorable outcomes. It is essential to assess the effectiveness of therapy throughout both short- and long-term follow-ups.

**Keywords:** Acute low-tone sensorineural hearing loss, corticosteroid, idiopathic, sensorineural.

## INTRODUCTION

With relatively normal hearing retained at higher frequencies of 2, 4, and 8 kHz, the particular hearing impairment of ALHL is mostly restricted to the lower frequencies of 125, 250, and 500 Hz.<sup>1</sup> Because ALHL only affects low-tone frequencies and has a fair prognosis, it differs clinically from sudden sensorineural hearing loss (SSNHL).<sup>2-4</sup> Most medical professionals do not consider ALHL to be a distinct illness from SSNHL.<sup>2</sup> ALHL was first distinguished from idiopathic sudden sensorineural hearing loss (ISSHL) by Abe in 1981 as a type of sensorineural hearing loss confined to low frequencies.<sup>5,6</sup> The possible cause of this condition is the fact that the prognosis for ALHL is far better than idiopathic SSNHL.<sup>2</sup>

ALHL is an emergency in the ORL-HNS that requires immediate treatment.<sup>2-4</sup> The incidence of ALHL is reported to be 42.8-65.8 per 100,000 population in Japan (18% of these patients were diagnosed with SSNHL or ISSNHL).<sup>2</sup> In contrast to SSNHL which is more common in the elderly, ALHL is more common in young patients.<sup>2</sup> The incidence of idiopathic SSNHL was highest in older men, and that of ALHL was highest in younger women.<sup>7</sup>

ALHL is often accompanied by tinnitus, autophony, and/or ear fullness, as well as a weak sensation of dizziness.<sup>1</sup> The pathophysiologic mechanisms of ALHL are similar to those of SSNHL, and the condition has been associated with cochlear hydrops and the early stages of Meniere's disease.<sup>8</sup> ALHL is also assumed to be caused by an autoimmune response of the endolymphatic sac and/or cochlear-specific endolymphatic hydrops.<sup>9</sup> Viral infection, vascular impairment, autoimmune disease, inner ear pathology, and central nervous system anomalies, although the cause in most patients is never identified.<sup>7</sup>

Systemic corticosteroids are the main modalities for the treatment of ALHL. As mentioned by Jung, ALHL patients show that 32-65% of patients are cured without treatment. Patients with ALHL have a better prognosis if compared to SSNHL. Recent research about the incidence of ALHL in Japan reported

that 9-47% of patients who recover experience relapse and as much as 10% of them thrive to Meniere's disease. Therefore, some experts state ALHL is an early sign of Meniere's disease (MD) or a part of endolymphatic hydrops.<sup>2</sup>

## CASE REPORT

The patient, a 36-year-old woman, presented to the RSUP Dr. M. Djamil Padang's ORL-HNS outpatient clinic on April 5th, 2021 with the primary complaint of buzzing in both ears two days prior to admission. The patient said that both of her ears felt full. There was no ear discomfort, no Covid-19 history, no trauma history, no history of ear discharge, no history of exposure to noise, no vertigo, no fever, no cough, and no runny nose. There was no prior history of excruciating headaches. Diabetes mellitus and hypertension were not present. Dyslipidemia's past was unknown. The person receiving care is the patient.

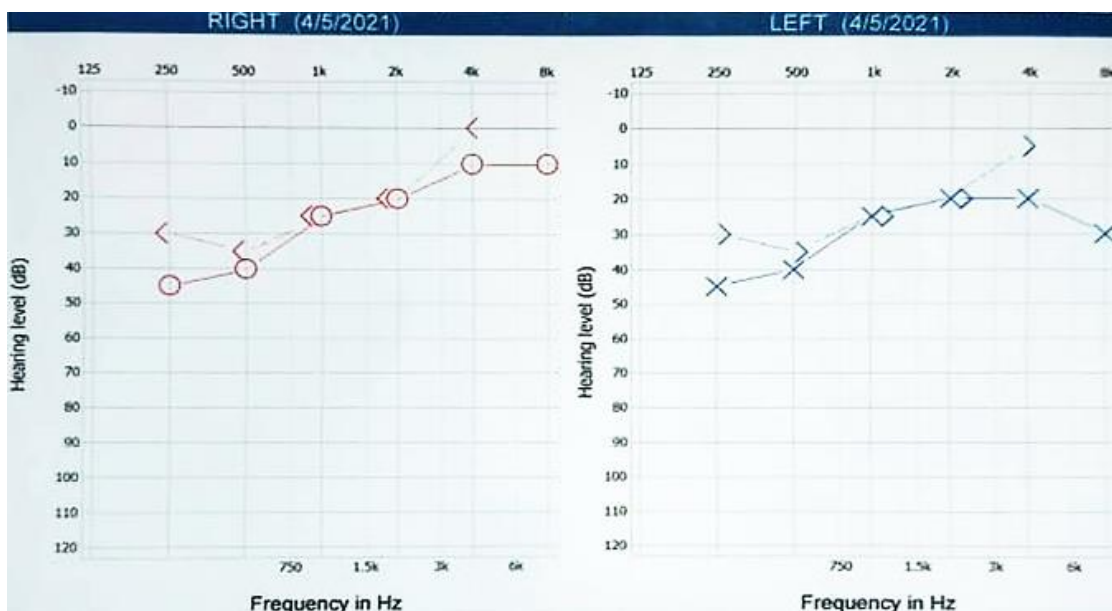
A physical examination revealed a generally unwell yet cooperative patient. The temperature was 36.5°C, the respiration rate was 17x/min, and blood pressure was 120/80mmHg. Right ear otoscopy revealed a large ear canal, an undamaged tympanic membrane, and a cone of light. There were no cicatrix, hyperemia, or edema on the right retroauricular. The tympanic membrane was intact, the ear canal was large, and there was a cone of light in the left ear. Upon left retroauricular inspection, there was no cicatrix, hyperemia, or edema.

When examined, the nose and throat appeared to be within normal limits. Testing with a tuning fork revealed sensorineural hearing loss in both ears (Table 1). Examination of the facial nerve and balance revealed no abnormalities.

On April 5, 2021, a pure tone audiometry test revealed lowered hearing thresholds at low frequencies, with the right ear's pure tone average (PTA) at low frequencies of 42.5 dB and high frequencies of 16.2 dB, and the left ear at low frequencies of 42.5 dB and high frequencies of 23.75 dB (Figure 1).

**Table 1.** Tuning fork examination

F	Rinne		Weber	Schwabach	
	Right	Left		Right	Left
128	Positive	Positive	Lateralization to the left	Shorten	Shorten
256	Positive	Positive		Shorten	Shorten
512	Positive	Positive		Shorten	Shorten
1024	Positive	Positive	No lateralization	Same with examiner	
2048	Positive	Positive			

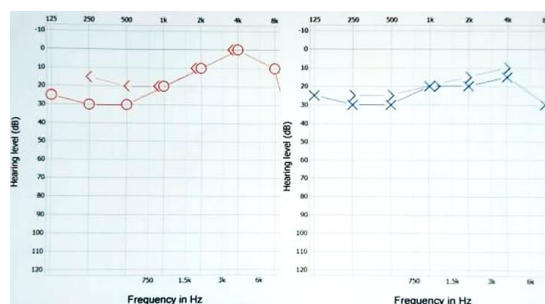


**Figure 1.** Audiogram on the right ear and left ear showed decreased hearing thresholds at low frequencies with PTA right ear low frequencies 42.5dB, high frequencies 16.2dB and left ear low frequencies 42.5dB, high frequencies 23.75dB

The laboratory results displayed Hb 12.5 g/dl, leucocytes 7,210 / mm<sup>3</sup>, platelets 235,000 / mm<sup>3</sup>, hematocrit 38%, PT 10.2", APTT 27.4", fasting blood sugar 69 mg/dl, total cholesterol 217 mg/dl, HDL 139 mg/dl, LDL 66 mg/dl, triglycerides 56 mg/dl, SGOT 18 u / l, SGPT 13 u / l, ureum 24 mg/dl, creatinine 0.6 mg/dl, Na<sup>+</sup> 139 mmol/l, K<sup>+</sup> 3.9 mmol/l, Cl<sup>-</sup> 100 mmol/l. Dyslipidemia was the laboratory’s conclusion.

The patient was identified as having dyslipidemia and bilateral acute low-tone sensorineural hearing loss (ALHL). Treatment for the patient involved absolute bed rest, the intravenous infusion of 4 liters of oxygen for 15 minutes every 6 hours, IVFD RL 500 cc every 8 hours, intravenous injections of vitamins C and B12, and vitamin.

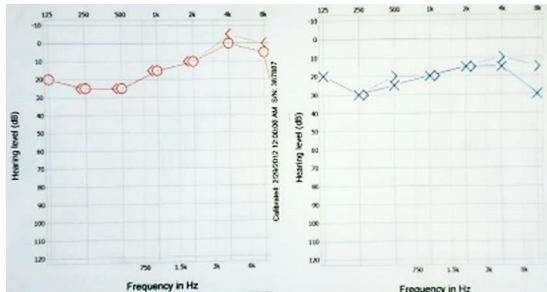
One week after treatment (April 12<sup>th</sup>, 2021), the buzzing sound ear was reduced, and there was no dizziness. Pure tone audiometry showed a decrease in hearing threshold at low frequencies with PTA 28.3 dB on both ears (Figure 2).



**Figure 2.** Audiogram a week after treatment (April 12, 2021) showed a decrease in hearing threshold at low frequencies with PTA 28.3 dB on both ears

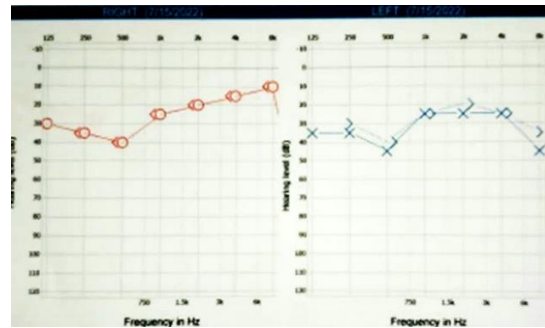
The patient was given medication that included methylprednisolone 1x16mg tablet taken orally for the first three days, vitamin B complex 3x1 tablet taken orally, and vitamin C 2x100mg tablet taken orally. The patient was then permitted to go home. One week later, the patient was advised to visit the ORL-HNS outpatient clinic of RSUP Dr. M. Djamil Padang. The

patient returned for follow-up care on April 19, 2021, two weeks following therapy. No buzzing ears could be heard. Tuning fork analysis revealed typical limits of 128, 256, 512, 1024, and 2048 Hz. With PTA 23.3 dB at the right ear and 25 dB at the left ear, pure tone audiometry testing revealed a reduction in the hearing threshold at low frequencies (Figure 3).



**Figure 3.** An audiogram two weeks after treatment (April 19, 2021) showed a decrease in hearing threshold at low frequencies with PTA 23.3 dB at the right ear and 25 dB at the left ear

One year after completing ALHL therapy, the patient once again complained of ear fullness and buzzing noises. The hearing threshold at low frequencies is reduced on pure tones audiometry test by 35 dB at the right ear and 38.3 dB at the left ear (Figure 4). Although it is suggested that the patient receive ALHL treatment, the patient declines because the complaint does not affect her daily activities.



**Figure 4.** Audiograms on the right ear and left ear showed decreased hearing thresholds at low frequencies in both ears.

In patients with bilateral ALHL, does corticosteroid therapy alone without diuretics increase PTA?

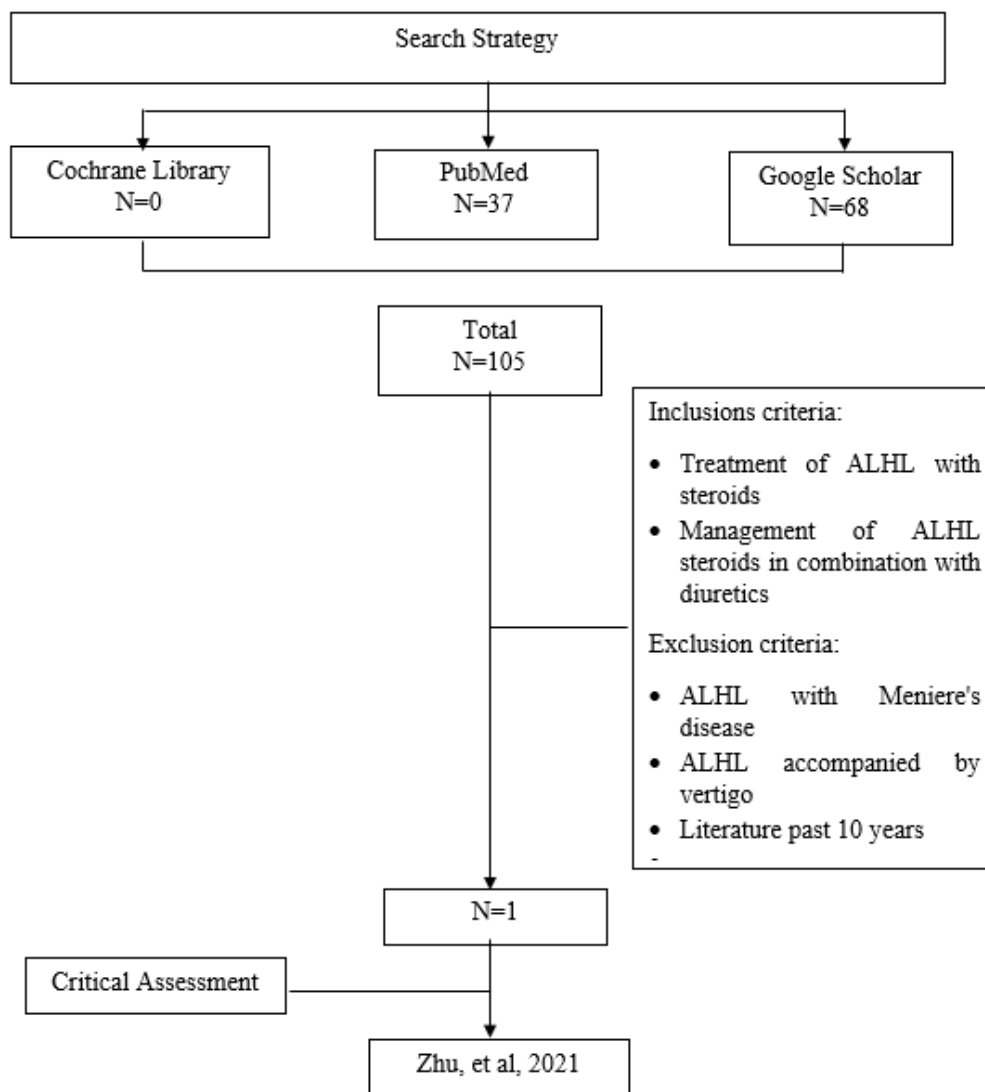
- P : Bilateral ALHL patient
- I : Systemic corticosteroids
- C : Steroids with diuretics
- O : Increase PTA in ALHL cases, and reduce complications

## METHOD

The authors performed a comprehensive literature search Cochrane database, PubMed, and Google Scholar, using the keywords of “Acute low-tone sensorineural hearing loss”, “sensorineural hearing loss”, “corticosteroids” and “diuretics” (Table 2). The search was using inclusion criteria: 1) Treatment of ALHL with steroids, 2) Management of ALHL steroids in combination with diuretics; and exclusion criteria: 1) ALHL with Meniere's disease, 2) ALHL accompanied by vertigo, 3) Literature past 10 years (Figure 5.)

## RESULT

After conducting a literature search on the Cochrane database, PubMed, and Google Scholar, it was obtained 107 articles published in the last 10 years. Selection based on inclusion and exclusion criteria found only 1 study was relevant to the topic. Zhu Y et al, reported that the study design is a meta-analysis. ALHL patients were treated with corticosteroids and patients were given combination diuretic therapy.



**Figure 5.** Literature search strategy and result

From the study conducted by Zhu Y, there was no significant difference between the administration of corticosteroid therapy and the administration of diuretics in ALHL (Table 3)<sup>10</sup>

**Table 2.** Search strategy

Literature	Result	Keywords
PubMed	37	“Acute low-tone sensorineural hearing loss” and “sensorineural hearing loss” and “corticosteroids” and “diuretics”
Cochrane Library	0	
Google Scholar	68	

**Table 3.** Literature review

No	Writer - journal	Patients/ Problem	Intervention	Comparison	Outcome
1	Zhu Y, et al. <i>Ear, Nose &amp; Throat</i> 2021.	ALHL patients	Steroids treatment	Diuretics treatment	Recovery rate of low-tone hearing loss

**DISCUSSION**

We describe a case of a 36-year-old lady who was identified as having dyslipidemia with bilateral acute low-tone sensorineural hearing loss (ALHL). The

history, physical examination, ENT examination, tuning fork, audiometry, and laboratory results are used to make the diagnosis. In this example, complete bed rest, intranasal oxygen therapy, vitamin C, mecobalamin, vitamin B complex, simvastatin, and a high dosage

corticosteroid (Methylprednisolone - tapering down) were used to treat the patient without the use of diuretics.

In the past, ALHL was often confused with ISSNHL, but now it can be made as a separate diagnosis.<sup>10</sup> The patient mostly came with complaints of tinnitus, ear fullness sensation, and decreased hearing in low tones without spinning dizziness. ALHL can be diagnosed by pure tone audiometry examination.<sup>9-12</sup>

In this instance, the patient complained of buzzing in both ears, feeling full in both ears and losing hearing. The patient made no claims of feeling lightheaded. The patient's audiogram revealed a drop in the hearing threshold at frequencies between 250 and 500 Hz, but not at higher frequencies between 4,000 and 16,000 Hz.

The patient in this instance is a lady, age 36. As in other earlier investigations, Yoshida's research revealed a significant incidence of ALHL in young women.<sup>7</sup> According to Kim, most victims are female, with a peak age of 40.<sup>12</sup>

ALHL without vertigo was described by Taki et al. as a unique type of ISSNHL. Despite this, multiple studies have linked cochlear hydrops and ALHL to the early onset of Meniere's illness.<sup>13</sup> Abe as quoted by Sato reported a study of 39 patients with ALHL with unclear causes. All patients experience complete healing without recurrence and symptom fluctuations.<sup>14</sup>

Yoshida asserts that the etiology of ALHL is assumed to be idiopathic, with endolymphatic hydrops limited to the cochlea perhaps playing a major role in the pathophysiology of ALHL.<sup>7</sup>

According to Leong's research, endolymphatic hydrops and autoimmune processes may be responsible for ALHL's genesis. ALHL patients also exhibited abnormalities in the balance of Th1/Th2 cells.<sup>15</sup>

Our patient's test results revealed a rise in total cholesterol. There were no further risk factors identified in the patient. It is thought that this patient's ALHL has an idiopathic etiology. With the results of the ECOG and glycerol tests, several otolaryngologists have attempted to explain the pathophysiology and genesis of ALHL.<sup>10</sup>

Glycerin and electrocochleography (EChoG) tests cannot be carried out on our patients due to the lack of equipment and supporting resources in our department.

Gonzalez et al. found that stress causes pathophysiological mechanisms that cause abrupt hearing loss. Studies done on stressed-out rats have revealed increased red blood cell aggregation, which causes haemoconcentration, and decreased blood flow in the microcirculation. More delicate structures, including the cochlea, are more significantly impacted by the blockage of blood flow in the inner ear. These kinds of modifications, for instance, have a greater impact on the cochlea than the vestibular labyrinth. The exterior and internal hair cells, as well as the stria vascularis, are the crucial components of the cochlea.<sup>16</sup> Shi added that the stria network is the largest and most complicated towards the basal end and is narrower and simpler as it gets closer to the apex.<sup>17</sup> The patient is a medical professional who is under enough stress.

Patients with ALHL are often treated with systemic steroids or a combination of steroids and diuretics.<sup>7</sup>

According to Zhu's study, there was no discernible statistical difference between individuals receiving steroid treatment and those receiving diuretic treatment in terms of how quickly their low-pitched hearing thresholds recovered.<sup>10</sup>

The patient receives therapy (as previously mentioned) for 7 days while being treated in the ORL-HNS department's ward. According to the ORL-HNS department's clinical practice standards, the patient received oxygen treatment for 15 minutes every 6 hours, methylprednisolone, vitamin C, mecobalamin, simvastatin, and neurotropic. Steroids, which aid in the treatment of immunological problems, are the first-line treatment for ALHL, according to Leong et al. in their publication.<sup>15</sup>

Methylprednisolone 40 mg per day on days 1-3, 30 mg on days 4-6, 20 mg on days 7-9, and 10 mg on days 10-12 yield an excellent outcome, according to research by Choi et al. Methylprednisolone 1x48 mg was administered to the patient in this case, tapering off over the course of 14 days (decrease every 3 days). The administration of Vitamin B12 and Adenosine Triphosphate, which work to improve blood flow to the cochlea and shield it from oxidative stress, can be used with treatment, according to Choi as well.<sup>18</sup>

Treatment for ALHL consists of diuretics and a 14-day course of a full dosage of 60 mg of methylprednisolone (sometimes a mix of steroids and diuretics).<sup>11</sup> We do not prescribe diuretics for our patients.

Within a week of experiencing problems, patients got therapy. During the follow-up, the patient's condition improved and her hearing threshold rose. According to Chang et al, the length of time between the onset of symptoms and the start of treatment has a significant impact on how well the hearing threshold improves during the first month. Several earlier trials also showed that starting treatment 1 week after the beginning of symptoms boosted the proportion of hearing improvement.<sup>1</sup> according to the suggested criteria for treatment success put forward by the Japan Ministry of Health, Labor, and Welfare's Study Group for Acute Profound Deafness Research Committee.<sup>10</sup> One week after beginning treatment, the patient underwent audiometry, which revealed an increase in hearing threshold at low frequencies. Hearing loss and ringing in the ear complaints fell as well.

Twenty-five patients (75.7%) had a complete hearing recovery, five patients (15.1%) had partial recovery, two patients (6.0%) had no recovery, and one patient (3.0%) had hearing loss advanced 1 month after starting therapy, according to Roh et al's study. 33 patients were monitored over an extended time (mean 22 months, range 3-79 months). Five patients (15.2%) had acute low-tone hearing loss recurrences. Over the course of the initial 12 months of follow-up, there were no recurrences. The results of the first treatment were connected to the long-term prognosis.<sup>19</sup>

In this instance, the patient complained of ear and ear fullness again a year after receiving earlier therapy. A reduction in hearing threshold at low frequencies is shown on the audiogram in both ears. The patient was recommended to seek treatment, but she

declined since she thought her problem did not affect her day-to-day activities.

## CONCLUSION

ALHL is an emergency in the ORL-HNS department, and it needs to be treated right away in order to have a better prognosis. With corticosteroids as the primary treatment and no diuretics in combination, PTA has improved with favorable outcomes. Short-term and long-term follow-up should be used to evaluate the effectiveness of the therapy.

## REFERENCES

1. Chang J, Yum G, Im HY, Jung JY, Rah YC, Choi J. Short-term outcomes of acute low-tone sensorineural hearing loss according to treatment modality. *J Audiol Otol*. 2016;20(1):47–52.
2. Sari JTY, Munilson J, Rosalinda R. Penatalaksanaan Acute Low-tone Sensorineural Hearing Loss. *Maj Kedokt Andalas*. 2019;42(1):22.
3. Psillas G, Rizou A, Rachovitsas D, Tsiropoulos G, Constantinidis J. Hearing outcome of low-tone compared to high-tone sudden sensorineural hearing loss. *Int Arch Otorhinolaryngol*. 2019;23(1):65–9.
4. Ma Y, Sun Q, Zhang K, Bai L, Du L. High level of IgE in acute low-tone sensorineural hearing loss: A predictor for recurrence and Meniere Disease transformation. *Am J Otolaryngol - Head Neck Med Surg*. 2021;42(2).
5. Yakunina N, Lee WH, Ryu YJ, Nam EC. Sequential versus Combination Treatment Using Steroids and Diuretics for Acute Low-Frequency Sensorineural Hearing Loss: A Noninferiority Trial. *Otol Neurotol*. 2019;40(3):305–11.
6. Young YH. Contemporary review of the causes and differential diagnosis of sudden sensorineural hearing loss. *Int J Audiol*. 2020;59(4):243–53.
7. Yoshida T, Sone M, Kitoh R, Nishio SY, Ogawa K, Kanzaki S, et al. Idiopathic sudden sensorineural hearing loss and acute low-tone sensorineural hearing loss: a comparison of the results of a nationwide epidemiological survey in Japan. *Acta Otolaryngol*. 2017;137:S38–43.
8. Park MJ, Kim SH, Kim SS, Yeo SG. Clinical characteristics and short-term outcomes of acute low-frequency sensorineural hearing loss with Vertigo. *Clin Exp Otorhinolaryngol*. 2018;11(2):96–101.
9. Shin SH, Byun SW, Park S, Kim EH, Kim MW, Lee HY. Optimal First-Line Therapy for Acute Low-Tone Sensorineural Hearing Loss. *J Audiol Otol*. 2021;25(4):209–16.
10. Zhu Y, Li G, Zhuang H, Yang Z, Sun JC, Xiong G, et al. Meta-Analysis Comparing Steroids and Diuretics in the Treatment of Acute Low-Tone Sensorineural Hearing Loss. *Ear, Nose Throat J*. 2021;100(3\_suppl):281S–285S.
11. Im GJ, Kim SK, Choi J, Song JJ, Chae SW, Jung HH. Analysis of audio-vestibular assessment in acute low-tone hearing loss. *Acta Otolaryngol*. 2016;136(7):649–54.
12. Kim H, Lee H, Kim YC, Park E, Choi J, Rah YC, et al. Update on clinical manifestation in acute low-tone hearing loss. *Korean J Otorhinolaryngol Neck Surg*. 2020;63(9):403–8.
13. Taki M, Hasegawa T, Ninoyu Y, Mohri H, Hirano S. Low-Frequency Sensorineural Hearing Loss Associated With Iron-Deficiency Anemia. *J Int Adv Otol*. 2021;17(5):465–7.
14. Sato H, Kuwashima S, Nishio SY, Kitoh R, Fukuda S, Hara A, et al. Epidemiological survey of acute low-tone sensorineural hearing loss. *Acta Otolaryngol*. 2017;137:S34–7.
15. Leong J li, Chen C hao, Huang C yuan, Cheng H lien, Chu Y chia. Combination Therapy and Single-Modality Treatment for Acute Low-Tone Hearing Loss: A Meta-analysis with Trial Sequential Analysis. *MDPI*. 2022;1–12.
16. Lopez-Gonzalez MA, Lopez-Lorente C, Abrante A, Benaixa P, Esteban F. Sudden Deafness Caused by Lifestyle Stress: Pathophysiological Mechanisms and New Therapeutic Perspectives. *Open Otorhinolaryngol J*. 2009;3(1):1–4.
17. Xiaorui S. Physiopathology of the Cochlear Microcirculation. *NIH Public Access Mol Cell Biochem*. 2013;23(1):1–33.
18. Choi HG, Park KH, Seo JH, Kim DK, Yeo SW, Park SN. Clinical and audiologic characteristics of acute low-tone sensorineural hearing loss: Therapeutic response and prognosis. *Korean J Audiol*. 2011;15(1):8–13.
19. Roh KJ, Lee EJ, Park AY, Choi B Il, Son EJ. Long-term outcomes of acute low-tone hearing loss. *Korean J Audiol*. 2015;19(2):74–8.

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