



Recovery Rates by Severity of Hearing Loss in Cases of Acute Low-Tone Sensorineural Hearing Loss

Hiroataka So¹ Masafumi Ueno¹ Yoichiro Sato¹ Ken Kasahara¹ Yoshimitsu Fuse¹ Seiichi Shinden^{1,2}
Naoki Oishi² Hiroyuki Ozawa²

¹ Department of Otorhinolaryngology, Saiseikai Utsunomiya Hospital, Utsunomiya, Tochigi, Japan

² Department of Otorhinolaryngology, Keio University Hospital, Tokyo, Japan

Address for correspondence Hiroataka So, MD, Department of Otolaryngology-Head and Neck Surgery, Keio University School of Medicine, 35 Shinanomachi, Shinjuku-ku, Tokyo 1080073, Japan (e-mail: emptychair71@gmail.com).

Int J Pract Otolaryngol 2025;8:e1–e7.

Abstract

Acute low-tone sensorineural hearing loss (ALHL), first reported in 1982, is characterized by hearing loss (HL), tinnitus, and other auditory symptoms. It is a disease entity independent from sudden HL. Although the severity of HL was defined for the first time in 2015 by the Research Group on Intractable Hearing Impairment of the Ministry of Health, Labor and Welfare, only a few studies have examined the treatment outcomes by the severity of HL. In this study, we determined the overall cure rate (cure/all cases) in 336 ALHL cases treated over 11 years (2011–2021) and the cure rates by the severity of the HL and steroid use. The overall cure rate was 64.0%, with 75.0% in cases with grade 1 severity, 74.3% in grade 2, 57.4% in grade 3, and 34.7% in grade 4. The cure rate in grade $\frac{3}{4}$ cases was significantly lower than that in grade $\frac{1}{2}$ cases. No significant difference was noted in the cure rate by steroid use. The cure rate of sudden HL is dependent on the hearing level at the initial diagnosis, and the cure rate of ALHL can be predicted by the sum of the hearing levels of the three lowest frequencies at the initial diagnosis. Although this study did not demonstrate the efficacy of steroid use, the study design biased the sample population. ALHL is associated with higher recurrence than sudden HL; however, steroids have various side effects. Therefore, the appropriateness of steroid use in the treatment of ALHL should be determined by a thorough assessment of comorbidities, patient age, and disease severity.

Keywords

- ▶ ALHL
- ▶ acute sensorineural hearing loss
- ▶ endolymphatic hydrops

Introduction

Acute low-tone sensorineural hearing loss (ALHL) is an auditory disorder primarily characterized by symptoms such as hearing loss (HL), a feeling of fullness in the ear, and tinnitus. It was first identified as an independent disease entity by Abe et al in 1982. Since then, numerous studies

have been published, contributing to its widespread recognition.¹ In some cases, the condition may relapse, becoming refractory and potentially progressing to Meniere's disease.² However, compared with sudden sensorineural HL, a representative cause of acute sensorineural HL, the short-term prognosis is generally favorable.¹ For the diagnosis and

received
August 13, 2024
accepted after revision
October 3, 2024

DOI <https://doi.org/10.1055/s-0045-1802337>.
ISSN 2569-1783.

© 2025. The Author(s).

This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial-License, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (<https://creativecommons.org/licenses/by-nc-nd/4.0/>)

Georg Thieme Verlag KG, Oswald-Hesse-Straße 50, 70469 Stuttgart, Germany

severity assessment of ALHL, criteria were established by the Acute Severe Hearing Loss Research Group in 2010, with a severity classification added in 2015. In cases of sudden sensorineural HL, the healing rate decreases as the severity increases.³ Despite reports on treatment outcomes based on a unique severity classification for ALHL,⁴ studies on prognosis based on the current severity criteria are still limited.

Various theories on its pathophysiology have been made, including similarities to sudden sensorineural HL, endolymphatic hydrops, and autoimmune responses targeting the endolymphatic sac. However, the exact mechanism remains unclear, and no disease-specific treatment has been established. In clinical practice, although diuretics and steroids are administered, no standard treatment has been set. Several studies have examined their effectiveness; however, the number of cases in each study is limited.⁵⁻¹⁰

Therefore, this study investigated the healing rates of ALHL treated in our department, categorized by severity and the healing rates based on steroid use.

Materials and Methods

The study included 336 patients who visited our hospital with hearing-related symptoms between January 2011 and December 2021. These patients were diagnosed with and treated for ALHL based on the results of pure-tone audiometry. The diagnostic criteria were based on those established by the Ministry of Health, Labor, and Welfare’s research group on acute severe HL (►Table 1).¹¹ Severity classification was determined using the criteria established by the Ministry of Health, Labor, and Welfare’s research

group on refractory HL, which categorized patients based on the total hearing level across lower three frequencies (0.125, 0.25, and 0.5 kHz): grade 1 for total hearing levels <100, grade 2 for 100–130, grade 3 for 130–160, and grade 4 for >160 dB HL (►Table 2).¹²

This study enrolled patients who visited the hospital at least twice and underwent pure-tone audiometry. The median observation period was 41 (4–3,767) days.

For treatment, all patients received isosorbide as a diuretic. Steroids were administered based on the judgment of the attending physician. The type, dosage, and route of steroid administration were not classified. The administration was initiated systemically, either by mouth or via injection, and no cases involved intratympanic steroid administration.

For both the steroid-treated and untreated groups, age, sex ratio, mean duration from onset to the first visit, and proportions of definite and probable cases were analyzed.

Treatment effectiveness was assessed on the final day of audiometric testing in accordance with the diagnostic criteria established by the Ministry of Health, Labor, and Welfare’s research group on acute severe HL (►Table 3).^{11,12}

The healing rate was defined as the proportion of cases with complete recovery among all cases. The healing rates were examined by severity and the presence or absence of steroid use within each severity category. Healing rates were compared using Pearson’s χ^2 test according to severity and steroid use. Statistical analyses were performed using IBM SPSS Statistics for Windows version 28 (IBM Corp., Armonk, NY, USA).

This study was approved by the Ethics Committee of Saiseikai Utsunomiya Hospital (approval no. 2020–19).

Table 1 Diagnostic criteria for acute low-tone sensorineural hearing loss

Ministry of Health and Welfare, Special Disease Acute Severe Sensorineural Hearing Loss Research Group, 1999 Annual Research Report, 2000
Primary symptoms
1. Acute or sudden onset of ear symptoms (e.g., ear fullness, tinnitus, and hearing loss)
2. Low-tone sensorineural hearing loss
3. Without dizziness
4. Unknown cause
Reference note
1. Hearing loss (based on pure-tone audiometry)
(a) The sum of hearing levels at the three low tones (0.125, 0.25, and 0.5 kHz) is ≥ 70 dB.
(b) The sum of hearing levels at the three high tones (2, 4, and 8 kHz) is ≤ 60 dB.
2. Some cases have recurring cochlear symptoms.
3. Some cases can progress to Meniere’s disease.
4. Some cases have mild dizziness.
5. Occasionally, both ears are affected.
Confirmed cases: Fulfill all of the primary symptoms and diagnostic criteria (a) and (b).
Probable cases: Fulfill all of the primary symptoms and meet the hearing loss criterion (a), with hearing levels across higher three frequencies comparable with those of a healthy ear.

Table 2 Severity classification of acute low-tone sensorineural hearing loss

Ministry of Health, Labor, and Welfare. Research group on refractory hearing loss, revised 2015
Grade 1: The sum of hearing levels at the three low tones is <100 dB
Grade 2: The sum of hearing levels at the three low tones is between 100 and 130 dB
Grade 3: The sum of hearing levels at the three low tones is between 130 and 160 dB
Grade 4: The sum of hearing levels at the three low tones is ≥160 dB

Table 3 Criteria for evaluating treatment efficacy in acute low-tone sensorineural hearing loss

Ministry of Health and Welfare, Special Disease Acute Severe Sensorineural Hearing Loss Research Group, 1999 Annual Research Report, 2000
1. Recovery (complete recovery)
(1) The hearing levels at three low tones (0.125, 0.25, and 0.5 kHz) were restored to within 20 dB
(2) If the hearing in the healthy ear is stable, the hearing in the affected ear has improved to the same level
2. Improvement: Healing of ≥10 dB in the average hearing level at the three low tones without achieving full recovery
3. Unchanged: Cases with <10 dB improvement in the average hearing level at the three low frequencies
4. Worsen: Excluding the above 1, 2, and 3

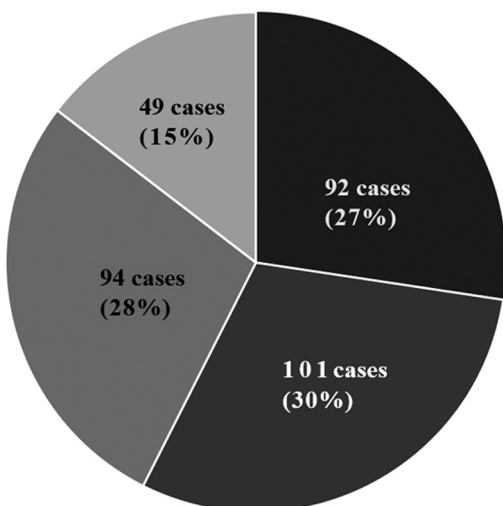
Results

The study included a total of 336 patients, with a mean age of 52.0 ± 15.5 years. Of these patients, 123 were male and 213 were female. The affected ear was the right ear in 156, the left ear in 179, and both in 1 case. The cases were distributed by severity as follows: grade 1, 92 (27%); grade 2, 101 (30%); grade 3, 94 (28%); and grade 4, 49 (15%) cases (→Fig. 1).

Among all cases, 215 were determined as completely recovered (healing rate, 64.0%) (→Fig. 2). When analyzed by severity, 69 cases (healing rate, 75.0%) were categorized as grade 1, 75 (healing rate, 74.3%) as grade 2, 54 (healing rate,

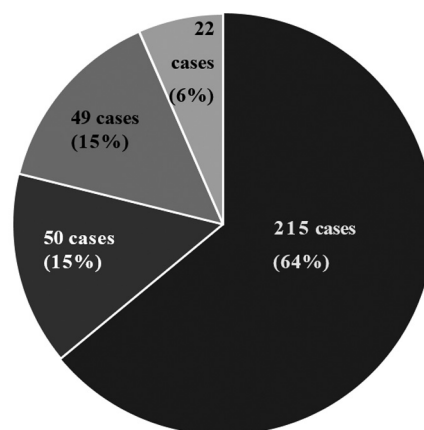
57.4%) as grade 3, and 17 (healing rate, 34.7%) as grade 4 (→Fig. 3). The combined healing rates for grades 3 and 4 were significantly lower than that for grades 1 and 2 (χ^2 test, $p < 0.05$). No significant differences in healing rates were observed between grades 1 and 2 or between grades 3 and 4.

Furthermore, 119 (35%) cases of the total received steroids, including 26 (28%) cases in grade 1, 28 (28%) in grade 2, 40 (43%) in grade 3, and 25 (51%) in grade 4. The frequency of steroid use increased with the severity of the condition. No significant differences were found between the groups regarding age, sex ratio, mean number of days from onset to first visit, or proportion of definite and probable cases (→Table 4).



■ Grade 1 ■ Grade 2 ■ Grade 3 ■ Grade 4

Fig. 1 Severity breakdown. Among 336 patients with acute low-tone sensorineural hearing loss, 92 (27%) were classified as grade 1, 101 (30%) as grade 2, 94 (28%) as grade 3, and 49 (15%) as grade 4.



■ Recovery ■ Improvement ■ Unchanged ■ Worsen

Fig. 2 Overall healing rate. Among 336 patients with acute low-tone sensorineural hearing loss, 215 (64.0% healing rate) were deemed to have healed (complete recovery).

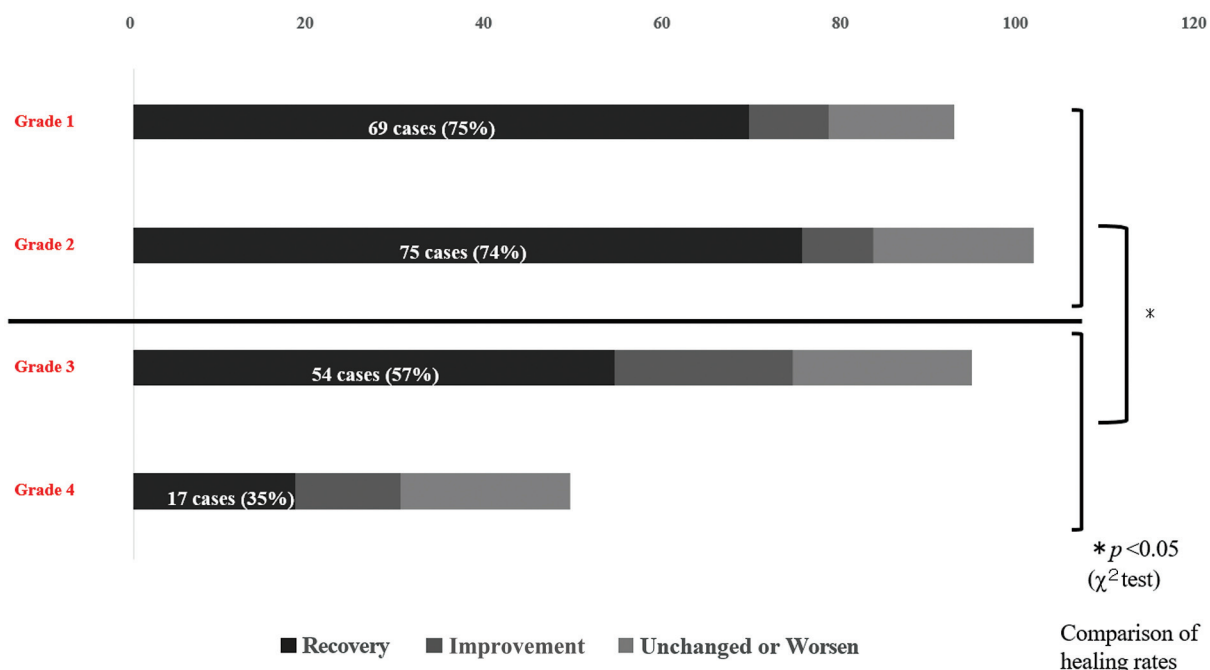


Fig. 3 Healing rate by severity. Among the cases deemed as healed, 69 (75.0% healing rate) were in grade 1, 75 (74.3% healing rate) in grade 2, 54 (57.4% healing rate) in grade 3, and 17 (34.7% healing rate) in grade 4. The combined healing rate for grades 3 and 4 was significantly lower than for grades 1 and 2 (χ^2 test, $p < 0.05$). No significant differences in healing rates were observed between grades 1 and 2 or between grades 3 and 4.

Table 4 Criteria for evaluating treatment efficacy in acute low-tone sensorineural hearing loss

	Steroid treatment group	Non-steroid treatment group
Number of cases	119 cases	217 cases
Age	50.6 ± 14 years	52.6 ± 16.3 years
Male	44 cases	79 cases
Female	75 cases	138 cases
Days from onset to medical visit	27.7 days	26.2 days
Confirmed cases	67 cases	109 cases
Uncertain cases	52 cases	108 cases

Note: No significant differences were observed between the two groups regarding age, male-to-female ratio, average number of days from onset to medical visit, and proportion of definite and probable cases (χ^2 test).

Healing rates were also calculated separately by the presence or absence of steroid use in the overall group and within each severity grade (► **Figs. 4** and **5**). However, no significant differences were observed between the groups at any severity level.

Discussion

ALHL has accumulated clinical reports, and in Japan, its diagnostic criteria have become widely accepted, distinguishing it as a separate condition from sudden sensorineural HL. In this study, the overall healing rate for ALHL was 64%, which is consistent with the previous report of 55–88% (► **Table 5**).^{2,5,7,13–16} In comparison, the healing rate for sudden sensorineural HL (27–34%)^{17–19} indicates that

ALHL has a more favorable prognosis. This finding is consistent with the results of earlier studies.^{20–22} However, studies analyzing the healing rates of sudden sensorineural HL by hearing type have revealed that the recovery rate for low-frequency HL was the highest at 63–70%,^{17–19} which is comparable to the healing rate for ALHL.

A clear criterion has been established for the diagnosis of sudden sensorineural HL, which excludes cases identified as “ALHL.”²³ This criterion is intended to differentiate ALHL from sudden sensorineural HL in most cases. However, despite the diagnostic criteria suggesting a distinction, it remains difficult to make a clear separation between the two conditions in terms of pathophysiology, and the possibility of overlap in their underlying mechanisms cannot be entirely ruled out. In the present study, from the perspective of

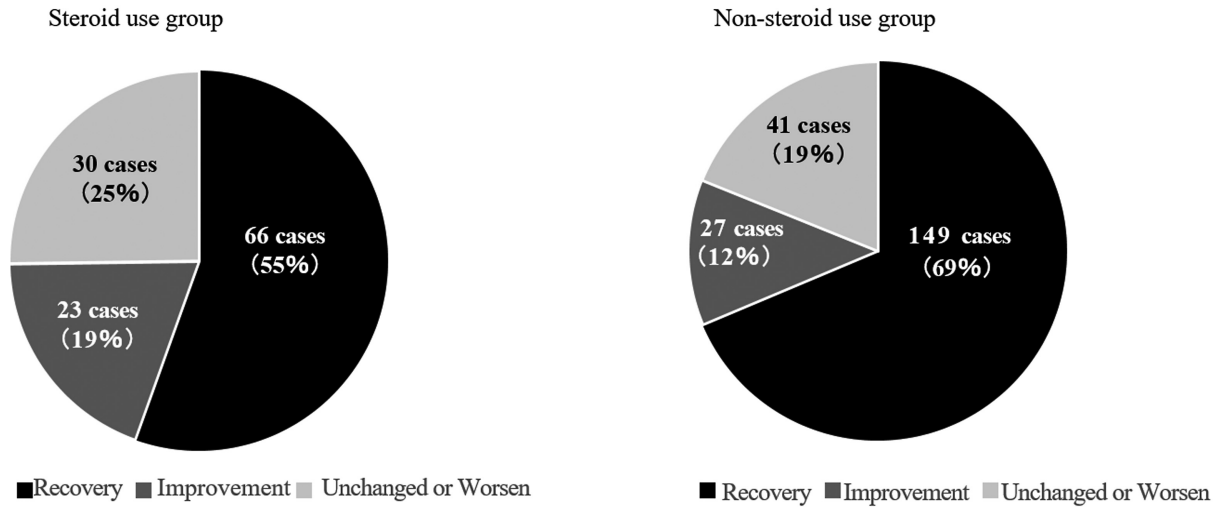


Fig. 4 Healing rates by steroid use (overall). Among the 119 patients who received steroids, 66 were deemed to have healed, resulting in a healing rate of 55.5%. In contrast, among the 217 patients who did not receive steroids, 149 were assessed to have healed, yielding a healing rate of 68.7%. No significant difference in healing rates was observed between the two groups (χ^2 test).

predicting healing rates, no significant differences were observed between the two conditions.

Furthermore, this study did not demonstrate the effectiveness of steroids for ALHL. A previous meta-analysis also reported that although steroids are widely used, limited scientific evidence supports their efficacy.²⁴ In addition, retrospective studies and meta-analyses conducted between 2017 and 2023 examined the effects of steroids and diuretics.

The results indicated that both steroids and diuretics showed comparable effects when used individually, and combining the two treatments did not provide additional benefits.^{16,25,26}

A key contribution of this study is the report of healing rates for each severity grade based on a sample size of >300 cases. The finding of the lack of difference in healing rates between grades 1 and 2 and significantly lower healing rates

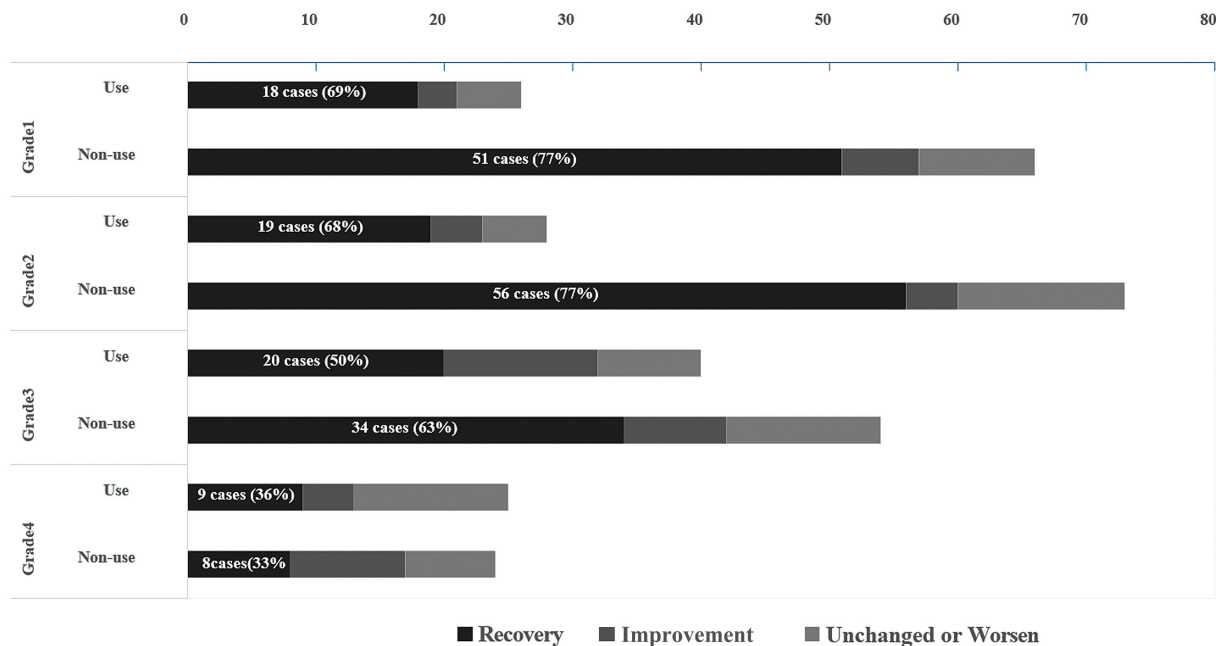


Fig. 5 Healing rates based on steroid use (by severity). The number of cases deemed to have healed was as follows: 18 out of 26 cases (healing rate, 69.2%) in the grade 1 steroid treatment group and 51 out of 66 cases in the non-steroid treatment group (healing rate, 77.3%), 19 out of 28 cases in the grade 2 steroid treatment group (healing rate, 67.9%) and 56 out of 73 cases in the non-steroid treatment group (healing rate, 76.7%), 20 out of 40 cases in the grade 3 steroid treatment group (healing rate 50.0%) and 34 out of 54 cases in the non-steroid treatment group (healing rate, 63.0%), 9 out of 25 cases in the grade 4 steroid treatment group (healing rate, 36.0%) and 8 out of 24 cases in the non-steroid treatment group (healing rate, 33.3%). No significant differences in healing rates were observed between the two groups at any severity level (χ^2 test).

Table 5 Comparison with previous reports

	<i>n</i>	Healing rates	Improvement	Unchanged or worsen
Imamura et al ²	137	55%	20%	25%
Asakuma ¹³	212	81%	6.60%	12%
Fuse et al ⁵	41	71%	9.80%	19%
Manabe et al ¹⁴	83	56%	18%	28%
Imamura et al ¹⁵	298	67%	16%	13%
Morita et al ⁷	156	72%	13%	21%
Seung-Ho et al ¹⁶	49	88%	12%	
Cases from our study	336	64%	15%	21%

Note: The overall recovery rate for acute low-tone sensorineural hearing loss in this study was 64.0%, showing no significant deviation from previous reports.

in grades 3 and 4 than in grades 1 and 2 suggests that the total low-frequency thresholds at the time of the initial visit can be a useful predictor of healing rates. This observation is consistent with previous reports^{18,27,28} on sudden sensorineural HL.

Steroids are sometimes administered as an acute treatment for ALHL, following a protocol similar to that for sudden sensorineural HL. Various studies have reported on their effectiveness: some suggest no benefit, whereas others indicate efficacy, and some argue that they are unnecessary in most cases.²⁹ Currently, no randomized controlled trial has compared steroids alone with a placebo, and no evidence supports their efficacy. Given that steroids are associated with side effects such as peptic ulcers, hypertension, diabetes, glaucoma, and insomnia, justifying their use in all cases is difficult. In ALHL cases, particularly those with recurrent episodes, the necessity of steroid treatment for each recurrence is still controversial.³ Given the tendency of the disease to recur, and the numerous side effects associated with steroids, their use should be approached with caution. Distinguishing ALHL from low-frequency sudden sensorineural HL can be difficult; a comprehensive assessment considering factors such as severity, comorbidities, and patient age is essential. In this study, overall health status, including conditions such as diabetes and heart disease, as well as age, may have influenced treatment decisions. Furthermore, the use of steroids based on the physician's judgment may have introduced a bias toward more severe cases. Therefore, the efficacy of steroids was not demonstrated.

Our institution is a general hospital located in a regional city. This study did not include cases that were treated and healed at a nearby clinic and those that healed before seeking medical attention despite having symptoms. Consequently, the sample may be somewhat biased and may not fully represent the general ALHL population. Future studies should conduct multicenter investigations and carefully select a sample population that more closely resembles the general population. In addition, since this is a retrospective analysis, further studies, such as randomized controlled trials or research into disease-specific treatments based on pathophysiological understanding, are needed to evaluate the efficacy of steroids.

Conclusion

In this study, the healing rates of 336 cases diagnosed with ALHL over 11 years (2011–2021) were investigated, focusing on severity and steroid use. The overall healing rate for ALHL was 64%. Although the healing rate decreased with increasing severity, no significant difference in healing rates was observed between patients who received steroids and those who did not. These findings signify the need for caution regarding the indiscriminate use of steroids and emphasize the importance of assessing severity when determining treatment strategies. However, further research is required to evaluate the efficacy of steroids. The results of this study provide valuable insights into ALHL treatment and may contribute to the improvement of future treatment strategies.

Conflict of Interest

None declared.

References

- 1 Abe T, Yoshihisa K, Murai K, et al. Clinical features of low-tone sudden sensorineural hearing loss. *J Otolaryngol Jpn* 1988; 91:667–676
- 2 Imamura S, Nozawa I, Imamura M, Murakami Y. Clinical observations on acute low-tone sensorineural hearing loss. Survey and analysis of 137 patients. *Ann Otol Rhinol Laryngol* 1997;106(09): 746–750
- 3 Asano T, Futai K, Shinkawa C, et al. Treatment outcomes of 324 cases of sudden sensorineural hearing loss treated with high-dose steroids and PGE1 combination therapy. *J Otolaryngol Jpn* 2020; 123:40–47
- 4 Shizuki K, Ogawa K, Inoue Y, et al. Classification of severity in acute low-tone sensorineural hearing loss. *Audiol Jpn* 2002; 45:144–148
- 5 Fuse T, Aoyagi M, Funakubo T, Sakakibara A, Yoshida S. Short-term outcome and prognosis of acute low-tone sensorineural hearing loss by administration of steroid. *ORL J Otorhinolaryngol Relat Spec* 2002;64(01):6–10
- 6 Suzuki M, Otake R, Kashio A. Effect of corticosteroids or diuretics in low-tone sensorineural hearing loss. *ORL J Otorhinolaryngol Relat Spec* 2006;68(03):170–176
- 7 Morita S, Suzuki M, Iizuka K. A comparison of the short-term outcome in patients with acute low-tone sensorineural hearing loss. *ORL J Otorhinolaryngol Relat Spec* 2010;72(06):295–299

- 8 Fushiki H, Junicho M, Kanazawa Y, Aso S, Watanabe Y. Prognosis of sudden low-tone loss other than acute low-tone sensorineural hearing loss. *Acta Otolaryngol* 2010;130(05):559–564
- 9 Roh KJ, Lee EJ, Park AY, Choi BI, Son EJ. Long-term outcomes of acute low-tone hearing loss. *J Audiol Otol* 2015;19(02):74–78
- 10 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(02):96–101
- 11 Ministry of Health and Welfare, Specific Disease Acute High-Frequency Sensorineural Hearing Loss Research Group. Annual research report for the fiscal year 1999 on acute high-frequency sensorineural hearing loss,. 2000
- 12 Ministry of Health. Labour and Welfare. Research Group on Intractable Hearing Impairments. 2015 Revised edition
- 13 Asakuma S. Acute low-tone sensorineural hearing loss: a 10-year study of 241 cases. *J Otolaryngol Jpn* 1999;102:299–304
- 14 Manabe Y, Saito H, Saito T, et al. Differences in the effects of various steroid agents on acute low-tone sensorineural hearing loss. *Audiol Jpn* 2002;45:176–181
- 15 Imamura S, Honda H, et al. A study on cases with poor prognosis of acute low-tone sensorineural hearing loss. *J Otolaryngol Jpn* 2007;110(07):520–526
- 16 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(04):209–216
- 17 Kuhn M, Heman-Ackah SE, Shaikh JA, Roehm PC. Sudden sensorineural hearing loss: a review of diagnosis, treatment, and prognosis. *Trends Amplif* 2011;15(03):91–105
- 18 Imamura S, Imamura M, Kikushima K, et al. Treatment outcomes of sudden sensorineural hearing loss: particularly factors related to prognosis. *Pract Otorhinolaryngol* 1991;84:287–296
- 19 Yamashita M, Shinohara K, Tsuji T, et al. Steroid treatment outcomes in 270 ears with sudden sensorineural hearing loss. *Pract Otorhinolaryngol* 2002;95:673–677
- 20 Mattox DE, Simmons FB. Natural history of sudden sensorineural hearing loss. *Ann Otol Rhinol Laryngol* 1977;86(4 Pt 1):463–480
- 21 Williams HL, Horton BT, Day LA. Endolymphatic hydrops without vertigo. *Arch Otolaryngol* 1950;51:557–581
- 22 Yoshida T, Sone M, Kitoh R, 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(sup565):S38–S43
- 23 The Japanese Society of Auditory Medicine. Guidelines for the management of acute sensorineural hearing loss (2018 edition). Kanehara Shuppan, 2018
- 24 Kitoh R, Nishio SY, Sato H, et al; Research Group on Intractable Hearing Disorders and Japan Audiological Society. Clinical practice guidelines for the diagnosis and management of acute sensorineural hearing loss. *Auris Nasus Larynx* 2024;51(04):811–821
- 25 Zhu Y, Li G, Zhuang H, et al. Meta-analysis comparing steroids and diuretics in the treatment of acute low-tone sensorineural hearing loss. *Ear Nose Throat J* 2021;100(Suppl 3):281S–285S
- 26 Leong JL, Chen CH, Huang CY, et al. Combination therapy and single-modality treatment for acute low-tone hearing loss: a meta-analysis with trial sequential analysis. *Brain Sci* 2022;12(07):866
- 27 Nagai N, Akira Hagiwara A, Kawaguchi S, et al. A study on the progression of hearing improvement and improvement rates in sudden sensorineural hearing loss. *Audiol Jpn* 2016; 59:58–65
- 28 Nakashima T, Tominaga M, Ishida IM, et al. A nationwide epidemiological survey of sudden sensorineural hearing loss in 2001: a study on factors affecting hearing prognosis. *Audiol Jpn* 2004; 47:109–118
- 29 Sato H. Issues surrounding acute low-tone sensorineural hearing loss. *Audiol Jpn* 2010;53:241–250