ORIGINAL RESEARCH

Treatment success in unilateral idiopathic sudden sensorineural hearing loss

[1]Dr. Theresa Liya CS, [2]Dr. Dhanya Rajan, [3]Dr. Jayaprabha S, [4]Dr. Susan James, [5]Dr. Pushpakumari KP

[1]Junior Resident ENT, Government Medical College, Trivandrum, Kerala, India
[2]Assistant Professor ENT, Government Medical College, Trivandrum, Kerala, India
[3]Professor of ENT, Government Medical College, Trivandrum, Kerala, India
[4]Associate Professor ENT, Government Medical College, Trivandrum, Kerala, India
[5]Additional Professor ENT, Government Medical College, Trivandrum, Kerala, India

Corresponding Author
Dr. Dhanya Rajan
Assistant Professor ENT,Government Medical College, Trivandrum, Kerala, India

Received: 10April, 2024 Accepted: 05May, 2024

ABSTRACT

Aim: The aim of the present study was to assess the treatment success in patients with unilateral ISSNHL and to study the factors associated with the treatment outcome. **Methods:** This prospective observational study included 31 patients with unilateral ISSNHL admitted in the Department of Otorhinolaryngology, Government Medical College, Thiruvananthapuram from January 2019 to June 2020. Patients were given high dose intravenous methylprednisolone for 2 days followed by salvage intratympanic dexamethasone therapy weekly up to a maximum of 3 doses. Patients were also given acyclovir. A semi structured proforma was used to gather the required information. Repeated pure tone audiograms were done till 3 months. **Results:** In this study of 31 patients, 13 patients (41.9%) achieved recovery, out of which 11 patients (35.5%) had complete recovery and 2 patients (6.5%) had partial recovery. Female gender (p=0.027) and upper or upper middle socioeconomic groups (p=0.008) were found to be good prognostic indicators. Patients with mild, moderate and moderately severe hearing loss had significantly better outcomes than severe and profound hearing loss (p=0.007).Five patients with an up-sloping audiometric configuration had complete recovery, a statistically significant finding (p=0.0076). Seven patients presented after one week and none of them recovered (p=0.074). **Conclusion:** Systemic steroids with salvage intratympanic steroids is the most accepted treatment option in ISSNHL. 41.9% patients benefitted from the treatment given. Patients with mild, moderate and moderately severe hearing loss had better outcomes than severe and profound hearing loss. Patients with up sloping audiogram had better recovery than those with down sloping or flat audiogram. Female gender and higher socioeconomic status were found to have good outcome whereas, patients with dyslipidemia had poor recovery.

Key words: Idiopathic sudden sensorineural hearing loss, systemic steroids, intratympanic steroids, pure tone audiogram

INTRODUCTION

According to the World Health Organization reports, adult-onset hearing loss is the 15th leading cause of burden of disease, and is foreseen to move up to 7thby the year 2030, especially in high-income countries. Therefore, sudden hearing loss seems to become a serious social health problem[1].Idiopathic sudden deafness is defined as sensorineural hearing loss of unknown aetiology, exceeding 30dB, occurring in at least 3 contiguous frequencies and appearing abruptly within a period of 3 days or less[2].In some cases there are accompanying symptoms as tinnitus or vertigo (20%-60%). The incidence reaches 5 to 20/100,000 cases with probability of occurrence increasing with age. Adult-onset sudden sensorineural hearing loss typically occurs between 43 and 53 years of age, with equal sex distribution. The majority of cases are idiopathic and almost exclusively unilateral[3].

It appears to be characterized by hypoxia in the perilymph and, therefore, in the scala tympani and the organ of Corti. Several pathophysiological mechanisms of idiopathic sudden sensorineural hearing loss have been described so far including: viral infections, labyrinthine membrane breaks, immune-associated disease, vascular occlusion, abnormal cochlear stress response, trauma, abnormal tissue growth, toxins, ototoxic drugs and cochlear membrane damage or trauma[4].There is also a theory based on an immunologically mediated vasculitis resulting in cochlear hypoperfusion. The basis for this theory is that during viral vasculitis circulating immunoglobulins are deposited perivascularily which may lead to local decrease in perfusion and tissue

hypoxia[5].In many cases, the cause of sudden deafness remains unknown. Sudden sensorineural hearing loss is considered by otologists as a true otologic emergency. The current standard treatment for sudden hearing loss is a tapered course of oral high-dose corticosteroids to increase circulation to the inner ear[6].The hyperbaric oxygenation (HBO) therapy is recommended for use in sensorineural hearing loss by *European Committee for Hyperbaric Medicine* (ECHM), but *Undersea and Hyperbaric Medical Society* has not listed that illness for HBO therapy so far.

The incidence of SSNHL has been estimated to range from 5 to 27 per 100,000 people annually[7].Any age group can be affected but peak incidence appears to be in the sixth decade of life. The males and females are equally affected. ISSNHL is usually unilateral, bilateral involvement being less than 5%[8].A longer duration of hearing loss has an association with decreased probability of hearing recovery, deficits lasting more than 2-3 months likely becoming a permanent disability[9].

The aim of the present study was to assess the treatment success in patients with unilateral ISSNHL and to study the factors associated with the treatment outcome.

MATERIALS AND METHODS

The present study was conducted in the Department of Otorhinolaryngology, Government Medical College, Thiruvananthapuram from January 2019 to June 2020. Patients with unilateral idiopathic sudden sensorineural hearing loss admitted in the Department of Otorhinolaryngology, Government Medical College, Thiruvananthapuram were included. 31 patients were included in the study.

INCLUSION CRITERIA

All patients admitted for unilateral idiopathic sudden sensorineural hearing loss in the Department of Otorhinolaryngology, Government Medical College, Thiruvananthapuram during the study period.

EXCLUSION CRITERIA

1. Children <12 years.
2. Those not willing to give consent.

TREATMENT OUTCOME

Recovery is as per the Pure Tone Audiogram taken at three months of follow up. If complete recovery occurs earlier, it was taken as the end point.

COMPLETE RECOVERY: Recovery of hearing to within 10dB of contralateral ear Pure Tone average.

PARTIAL RECOVERY: Recovery of hearing to within 50 Percentage or more of contralateral ear Pure Tone average.

NO RECOVERY: Less than 50 Percentage recovery of hearing[2].

The premorbid Pure Tone average of the patients may not be available. Hence the contralateral ear Pure Tone average was taken for comparison in recovery assessment[2].

CLINICAL VARIABLE

Time of presentation.

Associated aural symptoms-tinnitus, vertigo.

Associated comorbidities-Diabetes mellitus, Hypertension, Dyslipidaemia, Exanthematous fevers, Chronic liver disease, Chronic renal disease, Coronary artery disease, Cerebrovascular accidents, Malignancy, Autoimmune diseases, Syphilis.

Frequencies affected-low/mid/high frequency loss/flat audiogram.

SOCIODEMOGRAPHIC VARIABLE

Age, Sex, Socioeconomic status.

DATA COLLECTION TOOLS

Semi structured proforma.

Pure Tone Audiogram.

TREATMENT PROTOCOL FOLLOWED IN THE INSTITUTION DURING THE STUDY PERIOD

Patients with Idiopathic sudden sensorineural hearing loss were admitted and intravenous steroids were started,

Inj. Methyl prednisolone 1g over 1 hour.

Inj. Methyl prednisolone 1g over the next 23 hours.

Inj. Methyl prednisolone 1g over the next 24 hours.

After completion of intravenous steroid therapy, a Pure Tone Audiogram was done on the 3rd day. If complete recovery was not obtained, Intratympanic steroid therapy-Dexamethasone 4mg/ml (0.4-0.8 ml) was given.

Intratympanic dexamethasone was given to patients for a maximum of three doses at once weekly dosing.

Pure Tone Audiogram was done before each dose of intratympanic steroid injection and therapy was stopped whenever a complete hearing recovery was obtained.

Patients were also treated with T. Acyclovir 400 mg 5 times per day for 7 days.

DATA COLLECTION METHOD

All patients with unilateral idiopathic sudden sensorineural hearing loss admitted in the Department of Otorhinolaryngology during the study period, satisfying the inclusion and exclusion criteria were included in the study.After obtaining an informed consent, a detailed history was taken. Clinical findings and investigations- including initial Pure Tone Audiogram and MRI were documented.

Repeat Pure Tone Audiograms were taken on

1. 3rd day (after the completion of intravenous steroid therapy).
2. 2nd week (before the second dose of intratympanic steroid injection).

3. 3rd week (before the third dose of intratympanic steroid injection).
4. 3rd month.

The outcome of treatment was classified as complete, partial or no recovery based on the Pure Tone Audiogram done at 3 months of follow up. If complete recovery was obtained earlier, it was taken as the end point.

DATA ANALYSIS

Data was entered in excel sheet and statistical analyses was performed by using a statistical software package SPSS, version 20.0. Categorical variables were expressed as frequency. Chi-square test and Fisher's exact test were used to find association between categorical variables. For all statistical interpretations, $p<0.05$ was considered the threshold for statistical significance.

ETHICAL AND LEGAL CONSIDERATIONS

Research work was started after getting clearance from the Institutional Ethics committee.

Informed consent was obtained from all patients under the study.

Confidentiality was ensured and maintained throughout the study.

No additional expense was caused to the patient.

RESULTS

Table 1: Demographic data

Age	Frequency	Percentage
12-20	1	3.2
21-30	4	12.9
31-40	4	12.9
41-50	9	29
51-60	11	35.5
61-70	2	6.5
Gender		
Male	19	61.3
Female	12	38.7
Socio economic class		
Upper	2	6.5
Upper middle	5	16.1
Lower middle	21	67.7
Upper lower	3	9.7
Laterality		
Right	16	51.6
Left	15	48.4
Tinnitus		
Present	21	67.7
Absent	10	32.3
Vertigo		
Present	9	29.0
Absent	22	71.0

Majority of patients were of the age group 51-60 (35.5%), followed by the age group 41-50 (29%). 19 patients (61.3%) of study subjects were males and 12 patients (38.7%) were females. The male to female ratio was 1.58:1. Majority of patients belonged to the lower middle socioeconomic class (67.7%) as per Modified Kuppusamy classification. Out of 31 patients, 16 (51.6%) had hearing loss in the right while 15 patients (48.4%)had hearing loss in the left. 67.7% of patients complained of associated tinnitus. Vertigo was complained of by 29% of patients.

Table 2: MRI findings

MRI findings	Frequency	Percentage
Bilateral white matter ischemic foci	2	6.5
AICA loop	2	6.5
Gliotic foci lentiform nucleus and corona radiata	1	3.2
Periventricular soft tissue ischemia	1	3.2
Partial empty sella	1	3.2
Normal study	22	70.9

MRI was taken in 29 patients. Rest of the 2 patients had post cardiac valve replacement. So, CT head was taken which showed normal study.

Table 3: Audiometric configuration

Audiometric Configuration	Frequency	Percentage
Up sloping	5	16.2
Down sloping	13	41.9
Flat	13	41.9

Majority of study subjects had down-sloping and flat audiogram (41.9% each). 5 patients had an up-sloping audiogram.

Table 4: Distribution according to Initial PTA and according to number of Intratympanic injections given

Initial PTA	Frequency	Percentage
Mild	4	12.9
Moderate	5	16.1
Moderately severe	5	16.1
Severe	10	32.3
Profound	7	22.6
Number of Intratympanicinjections		
0	4	12.9
1	3	9.7
2	4	12.9
3	20	64.5

Out of 31 patients, 4 patients (12.9%) had mild hearing loss, 5 patients (16.1%) had moderate and moderately severe hearing loss each. 10 patients (32.3%) had severe hearing loss and 7 patients (22.6%) had profound hearing loss. Out of 31patients, 4 patients (12.9%)achieved complete recovery by systemic steroid therapy alone, hence intratympanic steroid therapy was not given. 3 patients(9.7%) achieved complete recovery after 1 dose of intratympanic steroid therapy and 4 patients (12.7%) required 2 doses of intratympanic steroids for complete recovery. 20 patients (64.5%) received 3 doses of intratympanic steroids.

Table 5: Associations of demographic data and outcome

	Recovery		No recovery		χ^2	p
	Frequency	Percentage	Frequency	Percentage		
Age						
≤ 50	8	44.4	10	55.6	0.11	0.739
Gender						
Male	5	26.3	14	73.7	4.92*	0.027
Female	8	66.7	4	33.3		
Socio economic class						
Upper/Upper middle	6	85.7	1	14.3	7.12*	0.008
Lower middle/upper lower	7	29.2	17	70.8		
Laterality						
Right	6	37.5	10	62.5	0.27	0.605
Left	7	46.7	8	53.3		
Tinnitus						
Absent	4	40.0	6	60.0	0.02	0.880
Present	9	42.9	12	57.1		
Vertigo						
Absent	11	50.0	11	50.0	2.02	0.155
Present	2	22.2	7	77.8		

8 patients out of 18 patients (44.4%) who were ≤ 50 years recovered, whereas 5 patients out of 13 patients (38.5%) of more than 50 years recovered. There was no statistical significance associated between age and outcome (p= 0.739). Only 5 out of 19 males (26.5%) recovered, while 8 out of 12 females (66.7%) recovered. Female gender was found to be associated with successful outcome (p=0.027). Out of the 7 patients in the upper or upper middle class, 6 recovered (85.7%), while only 7 out of 24 patients (29.2%) in the lower middle, upper lower or lower class recovered. Upper and upper middle socio-economic classes were found to be associated with successful outcome (p=0.008). 37. 5% of patients with right sided hearing loss and 46.7% patients of left sided hearing loss recovered. Laterality was not found

to be statistically significant (p=0.605). Out of the 10 patients with tinnitus, 4 recovered (40%), while 9 out of 21 patients (42.9%) without tinnitus recovered. Presence of tinnitus was not statistically significant (p=0.88). 11 patients out of 22 (50%) without vertigo recovered while 7 out of 9 patients (77.8%) who complained of vertigo did not recover. Vertigo was not significantly associated with outcome (p=0.155).

Table 6: Distribution of Hearing impairment and Outcome

Initial PTA	Recovery		No recovery	
	Frequency	Percentage	Frequency	Percentage
Mild	4	100.0	0	0.0
Moderate	2	40.0	3	60.0
Moderately severe	4	80.0	1	20.0
Severe	2	20.0	8	80.0
Profound	1	14.3	6	85.7

All 4 cases of mild hearing loss recovered, 2 out of 5 patients (40%) with moderate hearing loss recovered and 4 out of 5 patients (80%) of moderately severe hearing loss recovered. Only 2 out of 10 patients (20%) with severe hearing loss recovered and 1 out of 7 patients (14.3%) with profound hearing loss recovered.

DISCUSSIONS

Sudden sensorineural hearing loss (SSNHL) is an otological emergency. The abrupt development of an unexpected sudden hearing loss is a frightening experience for the patient. No etiology is identified in most of the patients and hence termed idiopathic sudden sensorineural hearing loss (ISSNHL). ISSNHL poses a diagnostic and therapeutic dilemma to clinicians. Uncertainty regarding the natural history, the diagnosis and management of idiopathic sudden sensorineural hearing loss makes it a much debatable topic[10]. The definition of ISSNHL is rather difficult. The definition by Wilson *et al*. is widely quoted[11]. SSNHL is defined as not less than 30dB hearing loss at a minimum of three contiguous frequencies over a period ofthree days or less[12].

The study sample consisted of 31 patients with unilateral ISSNHL and were of the age group of 12 to 70 years. Majority of patients were of the age group 51 to 60 years, which was found to be consistent with existing population studies by Schreiber *et al.* [13] The sample constituted of 19 males and 12 females. The male to female ratio was 1.58:1. Female gender was found to be associated with better outcome. No such association has been seen in population studies.[13] In a study by Xenellis *et al.* [14], men had higher rate of complete recovery (p=0.027) than women. In our study, none of the females had addictions, which could be a confounding factor.

Majority of the patients were from the lower middle socioeconomic class (67.7%). Patients in the upper and upper middle socioeconomic class had significantly better recovery than those in the lower middle, upper lower and lower class (p=0.008).Out of the 7 patients who were in the upper and upper middle socioeconomic class, 6 recovered. All the 6 who recovered had presented within 1 week, whereas the one patient who did not recover presented after 1 week.Out of the 31 patients, 16 (51.6%) had right sided hearing loss and 15 patients (48.4%) had hearing loss of the left ear. Laterality was not found to be statistically significant. A study by Zadeh *et al*. [15]also reports no significant association between laterality and outcome.

21 patients had associated tinnitus (67.7%)and was not found to be significantly associated with recovery (p=0.088). Tinnitus has been associated with good treatment outcome according to study by Danino *et al*. [16], and ashavingno influence on outcome in studies by Zadeh *et al*. [15] Vertigo was complained of by 9 patients (29%) in our study. No statistical significance was found between vertigo and outcome (p=0.155). Vertigo was found to be a negative prognostic indicator in study by Xenellis *et al.* [14] but in a study by Zadeh *et al.* [15] no such association was found.Statistically significant association between vertigo and outcome could not be demonstrated in our study, possibly due to the small sample size.

One study subject with ISSNHL could not turn up for follow-up audiometry and was not included in the study. The patient had developed an acute cerebrovascular accident 2 months following the onset of hearing loss. Accordingto a cohort study by Lin *et al*. [17], 12.7% of the SSNHL patients from the study cohort developed stroke during the 5 year follow up period as compared to 7.8% of patients from the control cohort. The hazard of having a stroke during the 5-year follow-up period was found to be 1.64 times greater for SSNHL patients which was statistically significant. In a study by Umesawa *et al*. [18], found that patients with ISSNHL who had cardiovascular risk factors had more severe hearing loss. Majority of study subjects had no addictions. 7 out of 31 subjects were either alcoholics or smokers. Only 1 out of 7 patients (14.3%) with addictions recovered. No significant relation was found between addictions and outcome. In the study by Umesawa *et al*. [18], found significantly higher proportions of current smokers among both men and women in patients with ISSNHL.

Out of 31 study subjects, 5 patients (16.2%) had up sloping (low frequency) hearing loss. 13 patients (41.9%) had down sloping and flat audiograms each. All patients with up sloping audiogram achieved recovery, which was statistically significant.

According to study by Huy *et al*. [19], 68% patients with up sloping audiogram recovered while only 11% of patients with a flat audiogram recovered, which was statistically significant. Similar findings were seen in study by Zadeh *et al*. [15], in which, out of the 51 patients studied 13 (25%) had an upsloping audiogram, and all the 13 had full hearing recovery.

Patients were distributed according to the degree of hearing loss. 12.4% patients had mild hearing loss (26-40 dB), 16.1% patients had moderate hearing loss (41-55 dB), 16.1% patients had moderately severe hearing loss (41-55 dB), 32.3% patients had severe hearing loss(71-90 dB) and 22.6% patients had profound hearing loss(>91 dB). Patients with initial hearing thresholds less than or equal to 70 dB was compared to patients with hearing threshold more than 70 dB. Mild, moderate and moderately severe hearing loss was significantly associated with good treatment outcome as compared to severe and profound hearing loss (p=0.007). This finding is consistent with previous study by Gupta *et al.* [20] In their study all patients with mild, moderate and moderately severe hearing loss had recovery whereas 53.8% of patients with severe hearing loss and all patients with profound hearing loss failed to recover.

Patients were given high dose intravenous methylprednisolone for 2 days followed by salvage intratympanic dexamethasone weekly up to a maximum of 3 doses. Patients were also given acyclovir.Out of 31 patients, 4 patients (12.9%) recovered by systemic steroid therapy alone, hence intratympanic steroid therapy was not given. 3 patients(9.7%) recovered after 1 dose of intratympanic steroid therapy and 4 patients (12.7%) required 2 doses of intratympanic steroids for recovery. 20 patients (64.5%) received 3 doses of intratympanic steroids.

Out of the 31 patients, 13 patients (41.9%) patients achieved recovery, out of which 11 patients(35.5%) patients had complete and 2 patients (6.5%) had partial recovery. 58.1% patients had no recovery. The recovery rates in published literature were found to be varying. In a study by Kordis *et al.* [21] out of the 59 patients, 40.7% showed improvement in their mean pure tone average (PTA) with ITDI after failed systemic steroid therapy. In the study by Zhou *et al*. [22], 39 patients received conventional steroid treatment and 37 patients received 4 doses of additional transtympanic injections of methylprednisolone 7 days after conventional steroid treatment. 45.9% of the patients in the transtympanic group had at least 15 dB improvement in pure tone average compared with 20.5% of the patients treated with conventional steroid treatment alone at the 8-week follow-up audiogram. Also 43.2% of the patients had an improvement of more than 15% in speech discrimination, compared with 17.9% of the patients treated with conventional steroid treatment alone, hence proving the superiority of salvage intratympanic steroid therapy over conventional steroid therapy alone.

CONCLUSIONS

Systemic steroids followed by salvage intratympanic dexamethasone injection was found be effective in 41.9% of patients with unilateral ISSNHL. Female gender was associated with good recovery. Upper and upper middle socioeconomic status had significant statistical association with recovery, possibly due to their early presentation. Since none of the patients who presented after 1 week had recovery, it is worth mentioning even though statistical significance could not be obtained. Dyslipidaemia was found to be significantly associated with poor outcome. Patients with up sloping audiometric configuration had better treatment outcome than those with down sloping or flat audiogram. Mild, moderate and moderately severe hearing loss had better recovery than severe and profound hearing loss.

REFERENCES

1. The Global Burden of Disease 2004 Update. World Health Organization. 2008.
2. Mathers C, Fat DM, Boerma J. The global burden of disease: 2004 update: World Health Organization; 2008. Geneva, Switzerland. 2020.
3. Rauch SD. Clinical practice. Idiopathic sudden sensorineural hearing loss. N Engl J Med. 2008 Aug 21;359(8):833-40.
4. Murphy-Lavoie H, Piper S, Moon RE, Legros T. Hyperbaric oxygen therapy for idiopathic sudden sensorineural hearing loss. Undersea Hyperb Med. 2012 May-Jun;39(3):777-92.
5. Gloddek B, Lamm K, Arnold W. Pharmacological influence on inner ear endothelial cells in relation to the pathogenesis of sensorineural hearing loss. Adv Otorhinolaryngol. 2002;59:75-83.
6. Schreiber BE, Agrup C, Haskard DO, Luxon LM. Sudden sensorineural hearing loss. Lancet. 2010 Apr 3;375(9721):1203-11.
7. Chandrasekhar SS, Tsai Do BS, Schwartz SR, Bontempo LJ, Faucett EA, Finestone SA, Hollingsworth DB, Kelley DM, Kmucha ST, Moonis G, Poling GL. Clinical practice guideline: sudden hearing loss (update). Otolaryngology-Head and Neck Surgery. 2019 Aug;161(1_suppl):S1-45.
8. Schreiber BE, Agrup C, Haskard DO, Luxon LM. Sudden sensorineural hearing loss. The Lancet. 2010 Apr 3;375(9721):1203-11.
9. Kuhn M, Heman-Ackah SE, Shaikh JA, Roehm PC. Sudden sensorineural hearing loss: a review of diagnosis, treatment, and prognosis. Trends in amplification. 2011 Sep;15(3):91-105.
10. Alexander H A. Sensorineural hearing loss: evaluation and management in adults. Chapter 155. In: Paul F(ed). Cummings

Otorhinolaryngology, Head and Neck Surgery 2010;5(3): 2116-130.
11. Martin J B, Richard J H. Idiopathic sudden sensorineural hearing loss. Chapter 238e. In: Micheal G(ed). Scott-Brown's Otorhinolaryngology, Head and Neck Surgery 2008;7(3): 3577-593.
12. Wilson WR, Byl FM, Laird N. The efficacy of steroids in the treatment of idiopathic sudden hearing loss. A double-blind clinical study. Arch Otolaryngol Chic Ill 1960. 1980 Dec;106(12):772–6.
13. Schreiber BE, Agrup C, Haskard DO, Luxon LM. Sudden sensorineural hearing loss. Lancet Lond Engl. 2010 Apr 3;375(9721):1203–11.
14. Xenellis J, Karapatsas I, Papadimitriou N, Nikolopoulos T, Maragoudakis P, Tzagkaroulakis M, Ferekidis E. Idiopathic sudden sensorineural hearing loss: prognostic factors. The Journal of Laryngology & Otology. 2006 Sep;120(9):718-24.
15. Zadeh MH, Storper IS, Spitzer JB. Diagnosis and treatment of sudden-onset sensorineural hearing loss: a study of 51 patients. Otolaryngol-Head Neck Surg Off J Am Acad Otolaryngol-Head Neck Surg. 2003 Jan;128(1):92–8.
16. Danino J, Joachims HZ, Eliachar I, Podoshin L, Ben-David Y, Fradis M. Tinnitus as a prognostic factor in sudden deafness. Am J Otolaryngol. 1984 Dec;5(6):394–6.
17. Lin H-C, Chao P-Z, Lee H-C. Sudden sensorineural hearing loss increases the risk of stroke: a 5-year follow-up study. Stroke. 2008 Oct;39(10):2744–8.
18. Mohammed AAM. Lipid Profile among Patients with Sudden Sensorineural Hearing Loss. Indian J Otolaryngol Head Neck Surg Off Publ Assoc Otolaryngol India. 2014 Dec;66(4):425–8.
19. Huy PTB, Sauvaget E. Idiopathic sudden sensorineural hearing loss is not an otologic emergency. Otol Neurotol Off Publ Am Otol Soc Am Neurotol Soc Eur Acad Otol Neurotol. 2005 Sep;26(5):896–902.
20. Gupta V, Jain A, Banerjee PK, Rathi S. Sudden sensorineural hearing loss in adults: Our experience with multidrug high dose steroid regimen at tertiary care hospital. Indian J Otol. 2016 Jan 1;22(1):35.
21. Kordiš Š, Battelino S. The Role of High Dose Intratympanic Dexamethasone as Salvage Therapy for Idiopathic Sudden Sensorineural Hearing Loss. J Int Adv Otol. 2017 Dec;13(3):318–21.
22. Zhou Y, Zheng H, Zhang Q, Campione PA. Early transtympanic steroid injection in patients with 'poor prognosis' idiopathic sensorineural sudden hearing loss. ORL J Oto-Rhino-Laryngol Its Relat Spec. 2011;73(1):31–7.