Research article

Idiopathic sudden sensorineural hearing loss: A trial of modified Stennert's infusion therapy

Rukma Bhandary[1], Mahesh S. G.[1], Sapna M.[1], Abhishek Sharma[2]

[1]Department of Otorhinolaryngology, A. J. Institute of Medical Sciences and Research Centre, Mangalore, Karnataka, India
[2]Consultant ENT Surgeon, Sahara hospital, Lucknow, Uttar Pradesh, India

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Corresponding author: **Mahesh S.G.** Email: maheshsanthraya06@gmail.com

ABSTRACT

Introduction and Aim: Sudden sensorineural hearing loss presents as rapid onset hearing deterioration of more than 30dB within 72 hours at the minimum of three adjacent frequencies. The aim of this research was to determine the effect of Modified Stennert's Protocol in addressing idiopathic sudden sensorineural hearing loss.

Materials and Methods: Retrospective pilot study was done. 14 patients were started on Modified Stennert's protocol within 72 hours of onset of symptoms and were observed. Our modification included using hydrocortisone instead of prednisolone.

Results: All patients presenting with sudden sensorineural hearing loss showed significant improvement in hearing by the end of two weeks and at the end of 3 months.

Conclusion: With such obscured pathophysiology, treatment of modified versions of usage of hydrocortisone instead of prednisolone along with dextran and pentoxyfylline has shown prime augmentation towards the patients resulting in near normal hearing.

Keywords: Sensorineural hearing loss; idiopathic, Stennert's protocol; hydrocortisone; dextran; pentoxyfylline.

INTRODUCTION

Sudden sensorineural hearing deterioration is not an uncommon variant among the outpatients. Perceived as a frightening experience this demands immediate recognition and treatment. Sudden sensorineural hearing loss was described in the literature by De Kleyn in 1944 (1). It is defined as acute onset hearing deterioration, occurring within 72-hour period of >30 dB at the minimal of 3 adjacent frequencies (2,3). There is no apparent gender predilection hence making it as a relatively common complaint in otologic and audiologic practices (2,3). Usually affected age group is fifth and sixth decade, although the range is quite wide (3).

In 1979, Stennert devised an infusion therapy consisting of a high dose of cortisone along with low molecular weight dextran and pentoxyfylline (Fig.1; 4). We present our experience with a modified version of Stennert's protocol in treating sudden sensorineural hearing loss of unknown etiology (Fig. 2).

MATERIALS AND METHODS

A retrospective pilot study was carried out in the Department of Otorhinolaryngology from January 2021 to June 2023 at a tertiary care center in Mangalore. Fourteen patients presented with sudden onset of hearing loss to the tertiary center, within 72 hours. A detailed history was obtained. Otoscopic examination was done to rule out the local causes and to assess the status of tympanic membrane followed by tuning fork tests with 256, 512 and 1024 Hz. Audiological profile was carried out in all the patients. Investigations were done to rule out the other identifiable causes of sensorineural hearing loss to exclude them from the study. They were started on Stennert's regimen with modification within 72 hours of onset of symptoms and were observed. Instead of prednisolone, which was the basis of Original Stennert's Regimen, hydrocortisone was used in the Modified version.

Inclusion criteria

- Adults above 18 years of age.
- Sudden onset of >30dB sensorineural hearing loss that appears over at least three adjacent frequencies, occurring within 72 hours.
- No discernible cause for hearing deterioration
- Individuals experiencing vertigo and tinnitus along with abrupt sensorineural hearing loss
- Availability of pretreatment audiograms.

Exclusion criteria

- Patients whose cause has been determined.
- Recurrent hearing loss
- Concomitant middle ear disease
- History of surgery in the affected ear in the past.
- Patients having other neurological signs.

Days of treatment	Cortisone (prednisolone–equivalent dose) (mg/day)			Dextrane 40 with sorbite or mannite 5–10% (ml)	Pentoxifylline (trental) (ml)
		<70 kg	>70 kg		
In-patient 1	Infusion	200	250	500	5
2		200	250	500	10
3		150		500	15
4		150		500	15
5		100		500	15
6		100		500	15
7		75		500	15
8		50		500	15
9	Oral circadian (6–8 a.m.)	40		500	15
10		20		500	15
Out-patient		15			
11		12.5			
12		10			
13		7.5			
14		5			
15		2.5			
16		2.5			
17		2.5			
18					

Fig.1: Original Stennert's Protocol (4)

Day	Dextr	Pentoxy (mg)	Hydrocort
Treatment protocol: modified Stennert's protocol			
1	1,000/16 h	10	200–250 mg/d
2	1,000/16 h	10	200–250 mg/d
3	1,000/16 h	10	150 mg/d
4	500/8 h	10	150 mg/d
5	500/8 h	10	150 mg/d
6	500/8 h	10	100 mg/d
7	500/8 h	10	100 mg/d
8	500/8 h	10	100 mg/d
9	500/8 h	10	50 mg/d
10	500/8 h	10	50 mg/d
11	500/8 h	10	Tapered orally over 8 days
12	500/8 h	10	
13	500/8 h	10	

Fig.2 : Modified Stennert's Protocol(4)

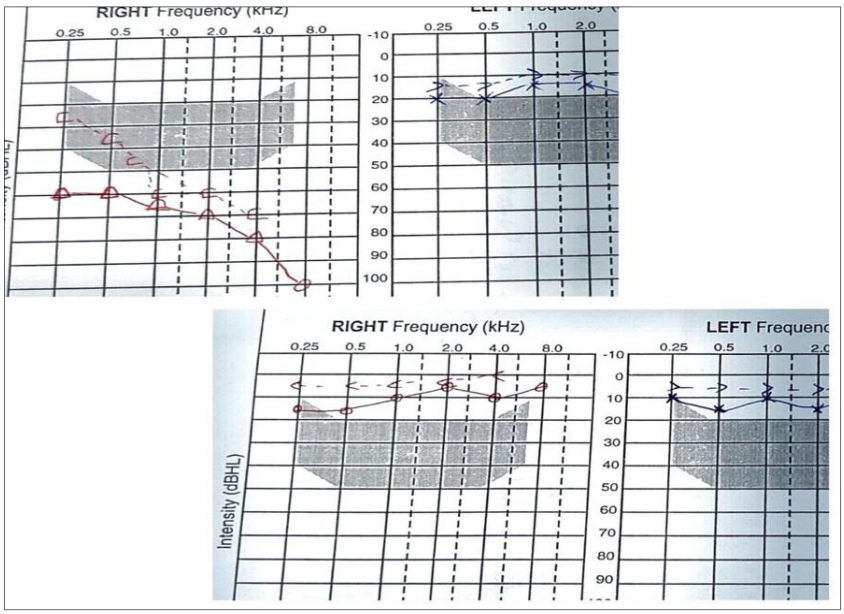

Fig. 3: Audiogram pre and post treatment

Table 1: Audiometric findings of pre and post treatment of modified Stennert's protocol

Sl.No.	Age in years	Sex	Presenting symptoms	PTA before treatment	PTA after treatment (on day 15)
1.	30	M	Muffled hearing	R: 75.25; L- 25.75	R:25.25; L-25.75
2.	43	F	Reduced hearing	R: 68.75;L- 12.5	R: 10; L- 12.5
3.	32	F	Sudden deafness	R: 43.75; L-26.25	R: 16.25; L-26.25
4.	51	M	Ringing sensation with hearing loss	R 21.25; L – 56	R: 21.25 ; L – 27
5.	54	M	Hearing impairment	R: 42 ; L – 22	R: 16 ; L – 21
6.	46	M	Hearing impairment	R: 12 ; L – 32	R: 12 ; L – 15
7.	38	M	Dizziness with hearing impairment	R: 18 ; L – 30	R: 18 ; L – 16.25
8.	48	M	Hearing loss	R: >90 ; L – 18.75	R: 13.75 ; L – 18.75
9.	31	M	Hearing deterioration	R: 87 ; L – 21	R: 16; L – 21
10.	36	M	Sudden deafness	R: 56 ; L - 15	R: 25; L -15
11.	43	M	Deafness on awakening	R: 45 ; L - 26	R: 30 ; L-: 26
12.	52	M	Sudden deafness	R: 20 ; L - 65	R: 20 ; L - 26
13.	48	F	Hearing deterioration	R: 36 ; L - 18	R: 21 ; L - 18
14.	67	M	Sudden deafness	R: 68; L - 25	R : 26; L- 24

Table 2: Improvement score assessed after the treatment (5)

Improvement Score	Range	Results
Large improvement	>30 decibels	8 patients
Moderate improvement	10-30 decibels	6 patients
No improvement	0-10 decibels	0
Total patients		14

RESULTS

Our observations show that the participants in this study were, on average, 40 years old (30-67 years), with a male predisposition (M: F;11: 3). The mean duration of symptoms from the time of onset to the time of presentation to our hospital was within 72 hours. The range of hearing deterioration was found to be between 30 – 90 dbHL with 30 db being the least and 90 db being the highest hearing deterioration as shown in Table 1. All patients showed significant clinical and audiometric improvement on day 15 of treatment as compared to pre-treatment assessment (Fig.3; Table 1). The results were categorized based on hearing improvement as large (>30 decibels improvement), moderate (10-30 decibels hearing improvement) and no improvement as depicted in Table 2 (5). Among the 14 patients, 8 showed large improvement and 6 showed moderate improvement (Table 2).

DISCUSSION

Sudden sensorineural hearing deterioration is not an uncommon variant among the outpatients. It is defined as acute onset hearing deterioration of >30dB at the minimum of 3 adjacent frequencies occurring within 72 hours (1). Perceived as an audiologic and otologic emergency, this disease is reported by majority of patients as a frightening experience as they present with hearing loss on awakening which makes it a clear definition by its standards as Sudden Sensorineural Hearing Loss without any cause, hence the term idiopathic (2,3).

Typically, studies describe a peak incidence in the fifth and sixth decade, with a male preponderance; however, in our investigation, the average age at which the incidence was observed was 40 years (3rd to 4th decade) (3). With global incidence of 5-20 per 1,00,000 adult individuals and 1 in 5000 being affected, the pathophysiology and etiology remains occult to the otologists (6). Additionally, the diverse natural history is probably influenced by its intricate etiology. When spontaneous improvement occurs before the hearing loss becomes apparent the prognosis is often worse the longer the symptoms persist (7).

Although classically it is accepted that the sudden onset hearing deterioration is due to vascular insult, the etiology and pathophysiology always remains occult to the arena. Observed risk factors for these patients include obesity, hypertension, nicotine consumption, and metabolic abnormalities such hyperlipoproteinemia, hyperuricemia, or hyper-glycemia (8).

Eminently a great deal of patients usually experiences sudden onset of hearing impairment at awakening, sometimes with ear block sensation or with concomitant symptoms such as dizziness and ringing sensation in the ear. Therefore, prompt diagnosis and treatment are crucial, and they start as soon as the patient exhibits symptoms of sudden hearing impairment. To exclude the identifiable causes of sudden onset hearing loss, the clinical history remains essential. Theoretically, inflammatory edema, virally driven hypercoagulability, or cardiovascular

risk factors could all lead to cochlear ischemia and the ensuing hearing loss (9).

Comprehensive assessment to rule out middle ear pathology is of prime importance to differentiate between conductive and sensorineural hearing loss. This should be done by otoscopic and oto-endoscopic examination, tuning fork tests and pure tone audiometry with tympanometry for validation before the commencement of steroid therapy exclusively for isolated sensorineural hearing loss. According to a German group of experts, various forms of the audiogram can reveal the precise position of the damage in the cochlea and, therefore, explain the pathophysiology. Low-frequency loss can suggest hydrops, mid-frequency loss can suggest vascular interference, high-frequency hearing loss up to 40 dB can suggest outer hair cell dysfunction, and hearing loss more than 40 dB can suggest inner hair cell dysfunction (10).

Laboratory tests to be included are complete blood count, total count to look for inflammatory etiology, erythrocyte sedimentation rate as 1.5 to 77 percent as patients present with elevated ESR of >30, which is an indicator of poor prognosis (2,3). Serology should be performed to rule out otosyphilis; lipid analysis must be conducted as 40% of the population has hypercholesterolemia; blood sugar levels should be determined prior to starting steroid therapy as well as to rule out cardiovascular risks and since dextran, the carrier solution alters the renal status, renal function tests should also be monitored (2).

Imaging remains mainstay if there is any suspicion of tumors of cerebellopontine angle, vestibular schwannomas and meningiomas. Contrast enhanced MRI is the gold standard but in cases where MRI is contraindicated, auditory evoked brainstem response can be done (if the minimal threshold of hearing deterioration is 75dbHl) (2).

The validation of empirical treatment is challenging due to the low incidence and high spontaneous recovery rate of acute sensorineural hearing loss. Systemic corticosteroids are the standard pilot treatment for any unknown cause of sudden hearing loss unless proven otherwise. Steroid use for a brief period can worsen glaucoma, increase coagulability and intravascular thrombosis, induce sleeplessness, and cause avascular hip necrosis. Cushing's syndrome, diverticulitis, peptic ulcer disease, bleeding ulcers, diabetes, heart failure, myasthenia gravis, osteoporosis, psychosis, renal illness, and ulcerative colitis are a few of the relative contraindications to systemic steroid therapy (11). A study by Shah *et al.*, on COVID 19 patients revealed sudden sensorineural hearing loss in these individuals regardless of normal clinical otologic evaluation. This suggests that the treatment strategy should address the viral etiology and include antiviral therapies in addition to steroids (12). Pentoxifylline and corticosteroids were compared in retrospective research for the treatment of diabetic patients with ISISSNH. The outcomes demonstrated that pentoxifylline was not less effective than corticosteroid treatment (13).

Dextran being the carrier solution is found to improve the microcirculation by hemodilution and pentoxyfylline increases the flexibility of erythrocytes thus impeding the platelet aggregation (2). Our study used the theory of steroid dextran therapy proposed by Kinishi *et al.,* which uses the combination of prednisolone, dextran and pentoxyfylline (5). In our study we have reviewed the modification of using hydrocortisone instead of prednisolone as it is found that hydrocortisone has 100 percent bioavailability, shorter duration of action hence glucose levels in the body can be monitored better (2). For optimal effects, we recommend initiating with a 200 mg infusion of hydrocortisone and tapering it gradually over a period of two weeks. Therefore, the combination of hydrocortisone, dextran and pentoxyphylline has yielded significant results in treating these patients.

According to a 2007 study by Fujimura-Suzuki, individuals with ISSNHL have considerably better hearing outcomes when they receive both hyperbaric oxygen therapy and the anti-inflammatory effects of steroid therapy, as opposed to steroid administration alone (14). Recent years have seen the completion of several trials assessing the advantages of antiviral and steroid therapy. Of these, Wilson *et al.*, and Zadeh *et al.,* have demonstrated a noteworthy improvement of up to 81% with steroid therapy (1,15). Studies by Kinishi *et al.,* Nosrati-Zarenoe *et al.,* and Cinamon *et al.,* disproved this research, finding no therapeutic benefit of steroids above placebo (15).

CONCLUSION

It is a terrifying experience for any individual to awaken with sudden deafness. Sudden deafness should not be disregarded and immediate medical attention along with a complete panel of diagnostic evaluation is mandated. Given the enigmatic entity and obscure pathophysiology, our objective was to propose a treatment protocol as above. Corticosteroids (glucocorticoids>mineralocorticoids) is the mainstay of the treatment, and the therapy should not be delayed for more than 24 hours after diagnosis of the condition. Patients exhibited substantial improvements when hydrocortisone was used instead of prednisolone, in combination with dextran and pentoxyfylline resulting in near normal hearing, spontaneous recovery rates, lesser complications and better quality of life irrespective of the age group.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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