

Role of Transtympanic Steroid in Sudden Sensorineural Hearing Loss: A Retrospective Study

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ABSTRACT

Introduction: Sudden Sensorineural Hearing Loss (SNHL) is medical emergency in otology. The diagnosis and treatment of sudden SNHL remains a matter of discussion as no single treatment is gold standard. Antivirals, systemic and intratympanic steroids, vasodilators, antioxidants and hyperbaric oxygen therapy are a few treatment options for sudden SNHL.

Aim: To assess role of transtympanic steroid in sudden SNHL cases in view of frequency specific gain and average hearing gain.

Materials and Methods: A retrospective cross-sectional study was conducted in Otorhinolaryngology Department of a tertiary teaching hospital, in which records of total 27 patients with diagnosis of sudden SNHL from 1st January 2019 to 31st December 2020 were analysed. All enrolled patient underwent pure tone audiometry before treatment, after 3rd transtympanic injection and On 7th day follow-up. post follow-up. All patient received three transtympanic 0.5 mL methyl prednisolone injection on day 1, day 3 and day 5 of treatment. Pretreatment and post-treatment frequency specific hearing threshold and frequency

specific hearing gain along with average hearing gain were assessed. Statistical analysis was done using student paired t-test independent t-test and one-way Analysis of Variance (ANOVA) test.

Results: Total 35 case ears were analysed among 27 patients as 8 patients had bilateral sudden SNHL. Average gain for frequency 250 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz were 18 dB, 25 dB, 27 dB, 28 dB and 30 dB, respectively. There was average 42% audiometric gain in hearing after transtympanic steroid injection. Cases who received treatment within four days had average gain of 48.5% while those who came after four days had average hearing gain of 39%. Hearing gain in <40 years and >40 years was 44.3% and 41.8% respectively. Hearing gain in bilateral ear was 42.9% and in unilateral ear was 43.5%.

Conclusion: Sudden SNHL has high emotional and social impact on patient and family as it has influence on life quality. Transtympanic steroid injection promises good outcome in all patients with sudden SNHL. However, early diagnosis and early management of sudden SNHL is the key in significant success.

Keywords: Audiometric gain, Frequency specific gain, Intratympanic, Methyl prednisolone, Otology

INTRODUCTION

The Sudden Sensorineural Hearing Loss (SNHL) is the diagnosis when patient have at least 30 dB hearing loss in three contiguous frequencies within 72 hours or less [1]. The probable aetiology for idiopathic sudden SNHL is viral infections, vascular occlusion, immunological with activation of nuclear factor kappa B (NFkB) in cochlea [2]. The annual incidence of sudden SNHL per one lac population is 4000 in United States [3]. This incidence is 60.9 in Japan and 160 in Germany [4,5]. World Health Organisation (WHO) has predicted SNHL as seventh most common burden of disease by 2030 [6]. Spontaneous recovery in cases of sudden SNHL may occur in 25% of the patients [7]. There are various treatment options available for sudden SNHL comprising hyperbaric oxygen therapy, vasodilators, systemic steroids and antiviral agents [8]. Ferri E et al., reported improvement in 52.7% of patient in sudden SNHL in similar study assessing role of intratympanic steroids in idiopathic sudden SNHL [8]. There are multiple prognostic factors including age of patients, time interval between treatment and onset of symptoms and status of contralateral ear [9]. The present study was done with aim to estimate frequency specific gains and average hearing gain in sudden SNHL patient after transtympanic steroid injection.

MATERIALS AND METHODS

A retrospective cross-sectional study was conducted in Otorhinolaryngology Department of a tertiary teaching hospital. Data collection duration was from first January 2019 to 31st December

2020. Analysis done from first April 2021 to 30th June 2021. Records of all patients with diagnosis of sudden SNHL in 2019 and 2020 were analysed after obtaining Ethical Clearance from Institutional Ethical Committee and Research Committee. (HIMS/RC/2021/48).

Inclusion criteria: All patients presenting with history of sudden hearing loss of sensorineural nature within 72 hours, who had minimum 30 dB hearing loss in three contiguous frequencies among 250 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz, were included in present study.

Exclusion criteria: All patients with mixed or conductive hearing loss were excluded from study. Patients with history of head trauma, chemotherapy, radiotherapy, diabetes mellitus or known autoimmune diseases and those who were diagnosed with Meniere's disease or retrocochlear hearing loss during the course of treatment were also excluded.

Study Procedure

All of these patients underwent thorough Ear, Nose and Throat (ENT) examination including otoscopy, zero degree otoendoscopy and tuning fork tests. Total 27 patients were finally enrolled in this study. Out of 27 patients 8 patients were having bilateral sudden SNHL. So, total 35 case ears were analysed in present study, considering each ear as a separate case. All cases were divided in to three groups for statistical analysis.

- Group 1 comprises those cases who came within 72 hours and transtympanic steroid injection was given within four days of onset of their hearing loss.

- Group 2 had cases who came after four days but within seven days, while
- Group 3 comprise of the cases who received treatment after seven days of onset of symptoms. For analysis point of view cases were also divided according to age comprising less than 40 years and more than 40 years. Analysis was also done between unilateral cases and bilateral cases.

Audiometric Assessment

Audiometric assessment was done by qualified audiologist with masters degree using inter acoustic AD 629 audiometer after proper daily calibration. All patients underwent pure tone audiometry assessment before the start of treatment, after 3rd transtympanic injection and seven days after the discharge from hospital during follow-up visit. Pretreatment audiogram and seven days post-treatment follow-up audiogram were analysed for assessing gain in hearing threshold.

Transtympanic Injection Procedure

Transtympanic steroid injections were given by ENT surgeon with minimum five years work experience after obtaining masters degree. Total three transtympanic injections were given on day one, day three and day five using 25 gauge needle in posteroinferior quadrant of tympanic membrane. Local anaesthesia was given using 10% lidocaine soaked cotton ball over tympanic membrane for about 15 minutes. Total 0.5 mL methyl prednisolone with consistency of 40 mg/mL was instilled every time. In bilateral cases 30 minutes gap was kept between injection on either side. Patient was asked not to swallow and lie down on opposite side for 20 minutes. All patients vitals were monitored for 30 minutes after the injections.

STATISTICAL ANALYSIS

All data collected using case recording pro forma was entered in MS excel 2010. Data analysis was performed using Statistical Package for the Social Sciences (SPSS) software version 20.0. Data was analysed using student paired t-test independent t-test and one-way Analysis of Variance (ANOVA) test. If p-value <0.05, then data was considered significant.

RESULTS

In present study, out of 27 patients, 19 (70%) were male while 8 (30%) were female in age range of 18-56 years with median age of 40 years. Out of these 27 patients, 10 (37%) patients had right side sudden, 9 (33.3%) patients had left side sudden SNHL. Total 8 (29.6%) patients (four male and four female) had bilateral sudden SNHL. So, there were total 35 case ears with the diagnosis of sudden SNHL. Patients presented to hospital from day one of onset of symptoms to sixty days of onset of symptoms with median presentation being day six of hearing loss. Total 11 (31.4%) number of case ears received treatment within four days of their onset of symptoms, 11 (31.4%) number of case ears from four days to within seven days while 13 (37.2%) number of case ears received treatment after seven days [Table/Fig-1].

Out of 35 case ears of 27 patients, 18 (51.4%) were less than 40 years of age while 17 (48.6%) were more than 40 years of age. Out of 35 case ears 16 (45.7) were bilateral (eight patients with bilateral SNHL) while 19 (54.3%) were unilateral case ears. Post-treatment average gain for frequency 250 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz were 18 dB, 25 dB, 27 dB, 28 dB and 30 dB, respectively [Table/Fig-2].

On statistical analysis p-value was less than 0.05, so this suggests significant improvement in all frequencies [Table/Fig-3].

Treatment interval	No. of case ears (n=35)	Percentage cases	Post-treatment dB gain	Percentage hearing gain
<4 days (group 1)	11	31.4%	29.5 dB	48.5%
4-7 days (group 2)	11	31.4%	26.2 dB	39.2%
>7 days (group 3)	13	37.2%	24.6 dB	39.3%
Age of patients				
Up to 40 years	18	51.4%	28.7 dB	44.3%
>40 years	17	48.6%	23.8 dB	41.8%
Laterality of cases				
Bilateral case ear	16	45.7%	28.75 dB	42.9%
Unilateral case ear	19	54.3%	24.91 dB	43.5%

[Table/Fig-1]: Demographic table showing grouping of cases as per treatment interval, age and laterality.

Frequency	Pretreatment (dB)	Post-treatment (dB)	Hearing gain (dB)	Percentage gain (%)
250 Hz	39	21	18	46.2
500 Hz	56	31	25	44.6
1000 Hz	66	39	27	40.9
2000 Hz	72	44	28	38.8
4000 Hz	79	49	30	37.9

[Table/Fig-2]: Frequency specific pretreatment and post-treatment pure tone audiometry threshold and average hearing gain in sudden SNHL cases.

Frequency	Pretreatment	Post-treatment	df	t-value	p-value
	Mean±SD	Mean±SD			
250 Hz	39.17±10.46	21±9.22	34	15.16	0.001
500 Hz	56.14±13.88	31.29±12.44	34	17.59	0.001
1k Hz	65.71±13.51	38.71±15.78	34	14.1	0.001
2k Hz	71.86±13.12	43.71±17.07	34	12.27	0.001
4k Hz	79.43±15.99	49.14±16.99	34	14.7	0.001

[Table/Fig-3]: Frequency specific gains levels before and after transtympanic Steroids. Student paired t-test was used

Among the group 1 case ears average hearing gain was 48.5%, among group 2 average hearing gain was 39.2% while among group 3 it was 39.3% average hearing gain. Average hearing gain among less than 40 years case ears was 44.3% while among more than 40 years case ears it was 41.8%. Average hearing gain among bilateral case ears was 42.9% and among unilateral case ears it was 43.5%.

Although, significant hearing gain was seen in patient who received treatment within four days compare to delayed treatment but it was statistically not significant. There was no statistically significant difference between less than 40 years and more than 40 years. There was no statistically significant difference in unilateral and bilateral cases [Table/Fig-4].

Treatment interval	No. of case ears	Average dB gain	F-value	p-value
<4 days	11	29.5±13.7	0.676	0.156
4-7 days	11	26.2±8.56		
>7 days	13	24.6±8.63		
Age of patients				
Up to 40 years	18	28.7±11.9	1.39	0.173
>40 years	17	23.8±7.33		
Laterality of cases				
Bilateral case ear	16	28.75±8.57	1.09	0.282
Unilateral case ear	19	24.91±11.6		

[Table/Fig-4]: Statistical analysis for treatment interval, age and laterality of cases Independent t-test was used and F denotes one-way ANOVA.

DISCUSSION

Sudden SNHL is a terrifying and crippling event which may impair social life if a person do not recovers from it. Idiopathic sudden SNHL is a diagnosis of exclusion. Common probabilities are viral infections, vessel occlusion, breaks in membrane and immunology related [2]. Due to variable aetiologies different treatment options are in practice. These treatment options like antiviral, steroids, heparin, carbon and hyperbaric oxygen therapy are used alone or in combination [7]. In the present study there were 70% male and 30% female patients. Authors saw clear male preponderance but literature suggest only slight in proportion of 1.30:1 in patient more than 60 years [10]. A study from South Korea reported female preponderance in preparation of 1.35:1 for sudden SNHL [11]. Authors had 40 years as median age of sudden SNHL patients. Anyah A et al., reported 54 years as average age for sudden SNHL in their study [12]. In the present study, 37% patients had right sided sudden SNHL, 33.3% had left sided and 29.6% had bilateral sudden SNHL. So, in the present study 70.3% patients had unilateral sudden SNHL and 29.6% patients had bilateral sudden SNHL. Sara SA et al., reported total 103 cases of bilateral sudden SNHL in their review [13]. In the present study, median presentation was six day from symptoms ranging from 1-60 days. In study by Anyah A et al., average presentation was 55th day ranging from 1-240 days of onset of symptoms [12]. In the present study, 31.4% cases received treatment within four days and 37.2% cases after seven days. Patients who received treatment within four days had average 48.5% hearing gain while those who received between four to seven days and those who received after seven days had average 39.2% hearing gain. So, it suggests less time interval between onset of symptom and start of treatment in sudden SNHL is important. So, it clarifies diagnosis of sudden SNHL within 72 hours and urgent treatment is golden point. In present study, we found hearing gain in all patient who received transtympanic steroid injection. However, patients receiving within four days of onset of symptoms compare to those who received after four days had average 9.3% more hearing gain. It also suggests that results after four days or after seven days have no significant difference. However, results among these three groups were not statistically significant which may be due to smaller number of sample size warranting larger study on sudden SNHL. Gupta V et al., reported complete recovery in 52.38% cases of sudden SNHL who presented within 72 hours and only complete recovery in 12.5% cases who reported after 72 hours [14]. Possible reasons for poor prognosis in cases of delayed treatment may be irreparable inflammatory damage to vascular stria which is the site of insult in sudden SNHL [15]. In present study, there was no significant difference in average hearing gain among cases less than 40 years and more than 40 years. Bhandari A and Jain S also reported no significant difference in hearing gain in cases less than and more than 50 years [16]. In the present study, author did not find any significant difference in average hearing gain between unilateral and bilateral cases. In present study, frequency specific hearing gain was also assessed. We found average hearing gain of 46.2%, 44.6%, 40.9%, 38.8% and 37.9% in frequencies of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz, respectively. This suggests that maximum hearing gain was seen in lower frequencies. It also suggests that average hearing gain decreases with upper frequencies. Bhandari A and Jain S also reported greater improvement in lower frequencies [16].

Now a days steroids either systemic or transtympanic or in combination are most widely accepted treatment in sudden SNHL. Transtympanic steroid injection can also be given in patients

who otherwise contraindicated for systematic steroids. Possible mechanism for transtympanic steroid administration is diffusion. Steroid diffuses from round window in to cochlear turn in base to apex direction [17]. New research options for sudden SNHL are mesenchymal stem cell therapy which may act by inner ear regeneration [18]. Tumour Necrosis Factor Alpha (TNF α) targeted therapies have shown some promising results in animal models for sensorineural hearing loss [19].

Limitation(s)

First limitation of present study was sample size due to less incidence and delayed reporting of patient to tertiary care otology centre. Second limitation of present study was design of study as this was a retrospective study. Better study may be double blinded multicentre prospective cohort study having two groups one receiving transtympanic steroids injections while other receiving placebo or no transtympanic steroid injection. But there may be ethical issues in conducting such study.

CONCLUSION(S)

Sudden SNHL is an otological emergency, so it should be diagnosed and treated promptly. Transtympanic steroid injections are most favoured cost effective treatment option due to feasibility, acceptability and less side effects in skilled hands. Patients who present early have significant improvement in average hearing thresholds. There is better improvement in lower frequencies and there is no significant effect of patient's age and laterality of sudden SNHL. Further research and large meta-analysis is need of hour to prove significant efficacy of transtympanic steroid injection in sudden SNHL.

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