

# The efficacy of intratympanic steroid injection for the treatment of idiopathic sudden sensorineural hearing loss

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## ABSTRACT

**Objective:** A systemic steroid is known to have a potential to recover hearing after idiopathic sudden sensorineural hearing loss (ISSHL). However, lately many centres have introduced the use of intratympanic (IT) steroid therapy as an option. We reviewed our experience in the treatment of patients with ISSHL looking at the overall success of using systemic steroid, IT steroid injections as salvage therapy and primary IT steroid injection.

**Methods:** A retrospective study was conducted on 20 patients who had suffered from ISSHL from January 1, 2012, to December 31, 2017. ISSHL is defined as a rapid decline in hearing over three days or less affecting three or more frequencies by 30dB or greater. Comparison between the mode of steroid therapies and improvement in patients was done. At least 15dB improvement in pure tone audiogram (PTA) was considered as successful therapeutic intervention.

**Results:** Twenty male and female patients who fit the inclusion and exclusion criteria were included. The mean age of the patients was 41.4 years with a range from 13 to 72 years. Ninety percent patients presented with unilateral ISSHL involvement. Eight ears of patients who received systemic steroid therapy alone had improved hearings (75%). Out of seven ears from six patients who received salvage therapy, four ears (57.1 %) had improvement in PTA. Seven ears showed improvement in PTA from a total of eight patients who primarily received IT injections.

**Conclusions:** IT steroid therapy promises a favourable outcome in the improvement of the hearing, as compared to systemic steroid administration. Its usage is recommended not only for salvage therapy but should be used as primary treatment especially in those with co- morbidities.

## KEY WORDS:

*Hearing loss, sudden, intratympanic injection, steroids*

## INTRODUCTION

Idiopathic sudden sensorineural hearing loss (ISSHL) was first reported nearly 60 years ago. However, the causative agents for this disorder, pathophysiology, the diagnostic approach as well as the treatment options are still highly debatable. The postulated causes of idiopathic ISSHL include viral infection followed by vascular occlusion, membrane breaks, immunological and activation of cochlear nuclear factor

kappa B (NFkB).<sup>1</sup>

ISSHL presents as an acute unilateral deafness of more than 30dB hearing loss involving three contiguous frequencies, with a sudden onset, generally within three days or less. It occurs in 5-20 persons per 100,000 population.<sup>2</sup> The management of this disorder poses a challenge. Normally, steroids are delivered systemically either orally or parenterally. Though the systemic delivery of medication promises a favourable outcome, it has several drawbacks, such as variable access to the inner ear due to the blood-cochlea barrier and potential systemic side effects.

Systemic steroid therapy has been linked to deteriorating hyperglycaemic status, hypertension, hypokalaemia, peptic ulcer, osteoporosis, immune suppression, adrenal suppression,<sup>3</sup> and serious organ damage.<sup>4</sup> These side effects lead to the exploration of more effective alternative mode of administration of steroid to the inner ear. The recent discovery of glucocorticoid and mineralocorticoid receptors in the inner ear lead to the development of techniques for local drug delivery.<sup>4,5</sup>

It has been known that about 30-50% of patients did not respond to high-dosage of oral or intravenous steroid therapy. Therefore, IT steroid injections was proposed as rescue therapy for refractory cases.<sup>6-9</sup> Certain centres used IT steroid injections as primary treatment without systemic steroids with the main indication in patients who are at greater risk for complications from systemic steroids.<sup>7,10,11</sup> We review here our experience in the treatment of patients with ISSHL looking at the overall success of using systemic steroid, IT steroid injections as salvage therapy and primary intratympanic steroid injection.

## MATERIALS AND METHODS

A retrospective record review of the patients who suffered from ISSHL from January 1, 2012, to December 31, 2017 was done. This study was approved by the Human Research and Ethical Committee of our institution. All patients with history of hearing loss of at least 30dB over three contiguous frequencies developing within 72 hours and received steroid therapy were included. Those without pre and post treatment pure tone audiogram (PTA) or received other than steroid therapy was excluded from the study. The average PTA was calculated as an average of the threshold measured at 0.5, 1.0, and 2.0kHz.

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**Table I: Demographic profiles of the patients**

Profiles		Freq (%)
Age range (years)		13-72 (mean=41.35)
Sex	Male	11 (55)
	Female	9 (45)
Side of Hearing Loss	Right	8 (40)
	Left	10 (50)
Treatment	Bilateral	2 (10)
	Systemic	7 (35)
	Salvage	6 (30)
	Primary	7 (35)

**Table II: Mode of therapy and outcomes**

Patient ID	Treatment Type	Age	Gender	Co-Morbid	Associated Symptoms	PTA (Pre & post treatment)	
						Pre	Post
1	Systemic therapy	35	M		T/ V	Bil. Profound	Lt Mild to Moderate Rt Severe
2		21	F		T	Lt Severe	Lt Moderate
3		13	F		-	Lt Profound	Lt Profound
4		30	M		T/ V	Rt Severe	Rt Moderate
5		47	M		T	Lt Profound	Lt Profound
6		22	F		T	Lt Severe	Lt Moderate to Severe
7		35	F		-	Lt Profound	Lt Moderate to Severe
8	Salvage therapy (systemic & IT)	31	F	-	T	Lt Severe	Normal
9		59	F	DM, HPT, HPL	-	Bil. Severe o Profound	Bil. Severe to Profound
10		25	M	-	T	Rt Moderate to Severe	Rt Mild to Moderate
11		40	M	-	-	Lt Moderate to Severe	Normal
12	Primary IT treatment	19	F	-	T/ V	Rt Severe	Rt Severe
13		28	M	-	T/ V	Rt Severe	Rt Moderate to Severe
14		72	M	HPT, CKD, HPL	T	Lt Severe	Lt Mild
15		57	M	DM, HPT	T	Rt Severe to Profound	Normal
16		46	M	DM, HPT	T/ V	Rt Moderate to Severe	Rt Mild to Moderate
17		71	M	DM, HPT (UN-CONTROLLED)	-	Rt Profound	Rt Profound
18		46	F	DM, HPT, HPL	V	Rt Severe	Rt Mild to Moderate
19		63	F	DM, HPT	-	Lt Severe	Lt Mild to Moderate
20	67	M	DM, HPT	T	Rt Severe	Rt Mild to Moderate	

PTA: pure tone audiometry, IT: intratympanic injection, M: Male, F: Female, DM: diabetes mellitus, HPT: hypertension, HPL: hyperlipidaemia, CKD: chronic kidney disease, T: tinnitus, V: vertigo, Bil.: Bilateral; Rt: Right, Lt: Left.

Data is presented in numeric and percent form. Comparison between the mode of steroid therapies and improvement are represented by descriptive statistics. At least 15dB improvements in PTA were considered as a successful therapeutic intervention.

## RESULTS

Table I shows demographic profile of the patients. A total of 20 patients were included with a range from 13 to 72 years of old. ISSHL predominantly affects the aged group above the third decade of life (65%). The gender predominance is almost equal in both females and males. The left and right ears were both equally affected and two (10%) patient presented with bilateral ears involvement.

Table II and Fig. 1 shows the mode of therapy and outcomes of the treatment. Eight ears had received systemic steroid therapy alone with six ears (75%) having improved hearings. Systemic steroids were given to patients without any co-morbidities. However, our success rate of 75% does not reflect the number of patients who had not responded well to

systemic steroid therapy and proceeded with salvage IT injection. When those who proceeded with salvage IT injection is considered, the success rate was 40% (six out of 15 ears).

A total of six patients (seven ears) who failed systemic steroid therapy received salvage therapy. We observed four (57.1 %) ears with improvement in PTA including two ears with the hearing level normalised.

A total of eight ears primarily received IT injections. In our set up, primary IT injection was given to patients with co-morbidities such as diabetes mellitus and chronic kidney disease. Seven ears showed improvement in PTA with one ear markedly improving to having a normalized hearing level.

## DISCUSSION

Studies have been conducted and proven that steroids have beneficial effects on cochlear function. Some studies have shown steroids are able to reduce inflammation from labyrinthitis,<sup>12</sup> improve cochlear blood flow,<sup>13</sup> protect against

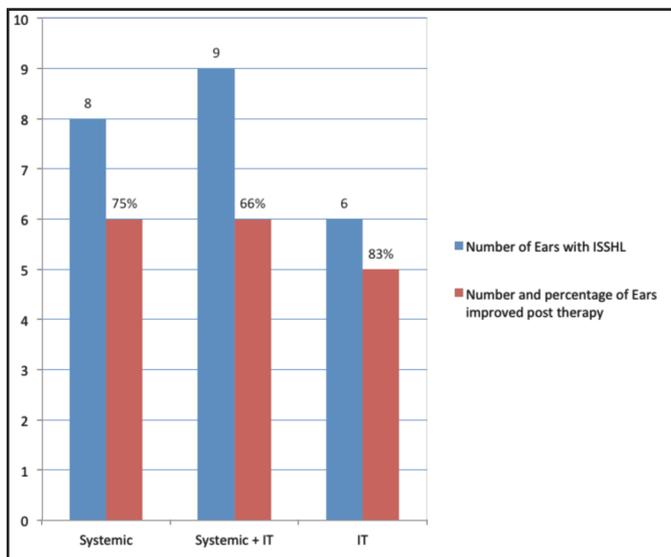


Fig. 1: The bar chart showing the number of ears with different modes of therapy and the outcome.

cochlear ischemia,<sup>14</sup> protect against noise-induced hearing loss,<sup>15</sup> and regulate inner ear de novo protein synthesis.<sup>16</sup> The stria vascularis which regulates Na/K secretion necessary for maintenance of the endocochlear potential, has been identified as the site for potential pathology in sudden hearing loss.<sup>17</sup> It has been shown that systemic steroids are able to improve stria vascularis function and morphology<sup>18</sup> and thus, the potential of recovering hearing after sudden hearing loss.

IT steroids in the treatment of sudden hearing loss was first reported by Silverstein in 1996<sup>19</sup> followed by Parnes in 1999.<sup>7</sup> Subsequently, multiple reports have been published mostly since 2001.<sup>8,11,12,20-30</sup> Mostly, these studies showed positive outcomes of IT steroids in the treatment of sudden hearing loss in patients who had failed previous systemic therapy. Roebuck and Chang reported that IT steroid injections had improved speech discrimination scores of more than 15% in 39% of patient as compared to only 10% in the group without injections.<sup>9</sup> Plaza and Herráiz had found that 55% of patients had improvement after IT steroid injections with a mean PTA improvement of 33dB versus none in those patients who refused therapy.<sup>31</sup>

IT steroids administration can achieve high concentrations in perilymph, which is higher than when given by either via intravenous or oral routes.<sup>7,32</sup> Multiple studies have shown that IT steroids are safe without evidence of histological changes or cochlear dysfunction.<sup>19,33-35</sup> Otoacoustic emission (OAE) has been widely used for early detection of hearing loss.<sup>36,37</sup> IT dexamethasone has shown no adverse effect on cochlear function as measured by otoacoustic emission.<sup>34</sup>

In patients with diabetics, IT steroid injections marked improved hearing in 70% of patients with a mean PTA improvement of 41dB, versus 67% and 25dB, respectively, in patients who received intravenous dexamethasone.<sup>38</sup> Therefore, some authors promote IT steroids as the first-line therapy for all ISSHL.<sup>6-9,31,39</sup>

By introducing IT steroid injection; this mode of drug administration helps to overcome the complications or side effects associated with systemic drug delivery. However, we should consider several downsides of IT injection; for example, anatomic barriers to absorb at the round window membrane, loss of drug down to the Eustachian tube, and the varying pharmacokinetic profiles of medications currently used for IT delivery.<sup>4</sup> The round window membrane is the primary transfer site for IT therapy. A study reported about one-third of the round window membrane were obstructed by a pseudo membrane, fibrous tissue, or a fat plug.<sup>40</sup> Persistent tympanic perforation, short-duration vertigo, tinnitus, and otitis media may occur after perfusion of high concentrations of steroids, but the incidence was very low in clinical applications.

The fact that this study was conducted in only one tertiary centre and thus has limited data collections. Therefore, only descriptive statistics could be done due to small number of samples. It is recommended that a large scale and multicentre study be done in future thus enabling inferential statistics to be done for a better conclusion.

## CONCLUSIONS

IT steroid therapy promises a favourable outcome in the improvement of the hearing as compared to systemic steroid administration. Its usage is recommended not only for salvage therapy but also used as primary treatment especially in those with co-morbidities.

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