Therapy of Idiopathic Sudden Sensorineural Hearing Loss with Intratympanic Steroid Injection

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Objective: *To evaluate the efficacy of intratympanic steroid injection in patients with idiopathic sudden sensorineural hearing loss (SSNHL) who are not responding to systemic steroids.*

Material and Method: *A prospective cohort study of 31 patients, with idiopathic SSNHL refractory to oral steroid therapy, who were treated with intratympanic steroid injection. The injections were performed once a week for three consecutive weeks. Pure tone audiometry (PTA) and speech discrimination score (SDS) was performed before and two months after intratympanic steroid injection had been completed. Successful treatment was defined as a decrease in PTA by 10 dB or more, or an increase in SDS by 20% or more.*

Results: *Thirty-one patients were treated with intratympanic steroid injection, 22 women and 9 men. The average age was 53 years. Overall success was 14 patients (45.2%). Eleven of the patients (35.5%) showed either improvement in PTA or SDS, among these there were two patients who had improvement in only PTA and nine patients had improvement only in SDS. Besides, three of the patients (9.7%) had improvement in both PTA and SDS.*

Conclusion: *Intratympanic steroid injection effectively improves hearing in patients with SSNHL after treatment failure with oral systemic steroid and is not associated with side effects. Therefore, it can be used as salvage therapy after failed conventional treatment. Further studies are required to consider whether intratympanic steroid injection might be used as the first line treatment in SSNHL.*

Keywords: *Sudden sensorineural hearing loss, Intratympanic steroid injection*

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Sudden sensorineural hearing loss (SSNHL) is defined as the acute onset of sensorineural hearing loss of at least 30 dB in three contiguous frequencies, occurring within a 3-day period, with a time period from onset of hearing loss to treatment administration of 30 days or less and requiring immediate and specific treatments[1-5]. SSNHL has an incidence of 5 to 20 patients per 100,000 per year. It is considered an otological emergency[2,3].

The treatment of SSNHL patients is controversial. The current treatment of choice is high dose oral or intravenous systemic steroids, however some patients develop complications from systemic therapy and the treatment may be contraindicated in others with medical conditions such as diabetic mellitus or hypertension. If the patient has side effects, contraindication or a significant amount of treatment failure remain, intratympanic steroid injection is the alternative treatment, to improve hearing recovery by increasing concentration in the inner ear[6].

Plaza G et al reported intratympanic methylprednisolone treatment improved hearing loss by more than 15 dB in pure tone average in 55% of cases which had failed to improve following intravenous steroid treatment[7].

In animals, intratympanic steroid treatment has been found to result in significantly higher perilymph concentrations of steroid than intravenous or oral administration[8,9]. Intratympanic steroids have been shown to be effective as salvage treatment for SSNHL patients who failed initial systemic treatment. The objective was to determine the effectiveness of intratympanic steroid injections in SSNHL patients who did not respond to systemic steroids.

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Material and Method

Between September 2004 and December 2008, 31 patients meeting the following criteria were assigned into the present study.

Study design

A prospective case review was used to evaluate the potential benefits and safety of intratympanic steroid therapy.

Patients involved in the present study met the following inclusion criteria:

1. The diagnostic criteria for SSNHL as described above.

2. No specific cause of the hearing loss (idiopathic SSNHL).

3. No improvement in hearing following normal treatment with high dose systemic steroids (1 mg/kg/day) for 2 weeks, pure tone average worse than 30 dB in 4 frequencies (500, 1,000, 2,000 and 4,000 Hz).

All patients underwent a full otolaryngological history and physical examination, a routine audiological evaluation including pure tone audiometry (PTA), auditory-evoked brainstem response (ABR) and laboratory investigations to rule out retrocochlear lesion or specific diseases such as Venereal Diseases Research Laboratory or Fluorescent Treponemal Antibody Absorption.

Auditory function was evaluated by pure tone audiometry and mean hearing level was recorded as the average of hearing thresholds at 500, 1,000, 2,000, 4,000 Hz and speech discrimination scores (SDS). PTA and SDS performed before each injection and approximately two months after intratympanic steroid injection had been completed. Successful treatment was defined as a decrease in PTA by 10 dB or more, or an increase in SDS by 20% or more. Patients' baseline characteristics were recorded, included age, sex, side of affected ear, presence of vertigo and interval from hearing loss onset to intratympanic steroid injection therapy.

Injection technique

The patient was given the intratympanic steroid injection under microscope. Local anesthesia was administered with a cotton ball soaked with 10% xylocaine, which was applied onto the tympanic membrane for approximately 15 minutes. When the anesthesia was working, the patient was instructed to lie in the supine position with the head tilted 45 degrees to the healthy side. A 25-gauge needle was introduced into the anterosuperior portion of the tympanic membrane and 0.5 to 1.0 ml of 40 mg/ml methylprednisolone was injected in to the middle ear cavity. The patient was instructed to maintain the 45-degree head tilt and avoid swallowing or moving for 30 minutes.

Statistical analysis

Statistical analysis was performed using SPSS. The clinical outcomes of the SSNHL patients after standard treatment and after intratympanic steroid injection were analyzed using the marginal Chi-squares test for categorical data and relationship between clinical outcome and sex, presence of vertigo, interval from hearing loss to treatment and proportion of improvement were used Chi-square test or Fishers exact test where appropriated. Significance was deemed to be at the significant level of $p < 0.05$.

Results

Thirty-one patients were treated with intratympanic steroid injection, 22 women and 9 men. All had an unknown etiology for their SSNHL. The average age was 53 years, ranging from 20 years to 83 years. The distribution of clinical features included presence of vertigo 17 in 31 (54.8%), and interval of hearing loss to therapy more than seven days was 14 in 31 (45.2%).

Eleven of the patients (35.5%) showed either improvement in PTA or SDS, among these there were two patients who had improvement in only PTA and nine patients had improvement only in SDS. Beside, three (9.7%) had improvement in both PTA by 10 dB and SDS by 20%. Overall successful was 14 patients (45.2%). There were no complications such as tympanic membrane perforation, infection, or dysquesia.

Comparing the clinical outcome between sex, presence of vertigo, the interval from hearing loss to treatment and the proportion of the improvement of SDS and PTA, the differences were not statistically significant ($p > 0.05$), as shown in Table 1.

Discussion

De Kleyn first reported the phenomenon of sudden sensorineural hearing loss with no specific identifiable cause[4]. Incidence rates are now thought to be 5 to 20 cases per 100,000 populations per year[2-4]. Spontaneous recovery rates of SSNHL are 32 to 65%, if spontaneous recovery does not occur; the current gold standard treatment for SSNHL is systemic steroids, with recovery rates in 60-70%[4,5,10].

Table 1. Relationship between sex, presence of vertigo, interval from hearing loss to treatment and clinical outcome in patients with SSNHL, 2 months after intratympanic steroid injection

	SDS improvement No. (%)	p-value	PTA improvement No. (%)	p-value
Sex				
Male	3/9 (33.3)	0.706	2/9 (22.2)	0.804
Female	9/22 (40.9)		3/22 (13.6)	
Presence of vertigo	5/14 (35.7)	1	3/14 (21.4)	0.698
No vertigo	7/17 (41.1)		5/17 (29.4)	
Interval from hearing loss to treatment ≤ 7 days	6/17 (35.3)	0.766	8/17 (47.1)	0.483
Interval from hearing loss to treatment >7 days	7/14 (50.0)		3/14 (21.4)	

SSNHL = sudden sensorineural hearing loss; SDS = speech discrimination scores; PTA = pure tone audiometry

However, systemic steroids do not work in all patients. Xenellis et al reported 47.4% of the patients with SSNHL who failed with intravenous steroids as a first line treatment; they may have serious side effects and may be contraindicated in patients with peptic ulcer, diabetes, hypertension and other diseases[4]. Residual hearing loss has also been reported in some cases. Vertigo and onset to treatment has been noted to be a poor prognostic sign to recovery.

Intratympanic steroid injection has been tried as an alternative method for patients who are contraindicated or suffer side effects from systemic steroids or as additional treatment for residual hearing loss after failed conventional treatment. It had minimal systemic absorption, toxicity and side effect is very low. Several studies have demonstrated that higher endolymph and perilymph drug levels can be obtained in intratympanic steroid[11,12].

Herr BD et al found hearing recovery of 53% with intratympanic steroids after failed treatment with systemic steroids[2]. Haynes et al have also recorded a 40% improvement in hearing in patients with SSNHL who had first failed systemic therapy and use intratympanic steroids[13].

Kakehata S et al used intratympanic steroids in SSNHL with diabetes with a dexamethasone 4 mg/ml injection through a perforation made by laser-assisted myringotomy or through a tympanostomy tube and 67% of his subjects showed improvement of more than 10 dB, with a mean improvement of 25 dB[14,15]. Killic R et al studied a series of five intratympanic methylprednisolone injected at three day intervals, with 73.6% of the subjects experiencing hearing improvement equal to or greater than 10 dB[16].

Several studies have found methylprednisolone to show the best pharmacokinetic profile for clinical application[4,9,17]. This drug can be used safely and easily, and inexpensive. The present study adds further confirmation of the value of methylpred-nisolone intratympanic treatment for SSNHL, as 45.2% of the present study treatment group showed improvement in either or both PTA and SDS.

The mechanism of action of steroids in the inner ear is incompletely understood. The local effects may be mediated by the presence and distribution of glucocorticoid receptors in the inner ear. Gross et al suggested that corticosteroids might affect the Na, K-ATPase system and influence local microhomeostasis by regulation of cochlear fluid and electrolyte balance[14]. The actions attributed to steroids in the inner ear include ion homeostasis, antioxidant action, inhibition of apoptosis, down-regulation of local pro-inflammatory cytokines, and promotion of cochlear blood flow. Steroids decrease the number of circulating blood leukocytes and inhibit the formation and liberation of inflammatory mediators[1].

The present study found a 45.2% recovery rate for SSNHL patients using intratympanic steroid injections after failure of conventional treatment, which suggests such injections could be considered as a first line of treatment in certain situations, notably in patients with a contraindication for systemic steroid therapy. The present study also confirms again that intratympanic steroid injection is a safe and effective treatment in SSNHL.

About injection technique, a 25-gauge needle was introduced into the anterosuperior portion of the tympanic membrane replace the posterosuperior part like the other study. If the authors inject into the posterosuperior part, methylprednisolone may come out through the site of injection, the amount of drug is less than that injected into the anterosuperior part.

In conclusion, intratympanic steroid injection effectively improves hearing in patients with SSNHL after treatment failure with oral systemic steroid and is not associated with side effects. Therefore, it can be used as salvage therapy after failed conventional treatment. More and further studies are required to be considered that intratympanic steroid injection might be used as the first line treatment in SSNHL.

Potential conflicts of interest

None

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การรักษาภาวะสูญเสียการได้ยินเฉียบพลันโดยไม่ทราบสาเหตุด้วยการฉีดยาสเตียรอยด์เข้าไปในโพรงหูชั้นกลาง

วันดี ไข่มุกด์, กิตติ จันทรพัฒนา

วัตถุประสงค์*: เพื่อประเมินประสิทธิผลของการฉีดยาสเตียรอยด์เข้าไปในโพรงหูชั้นกลาง ในผู้ป่วยที่มีภาวะสูญเสียการได้ยินเฉียบพลันโดยไม่ทราบสาเหตุซึ่งไม่ตอบสนองต่อการให้ยาสเตียรอยด์ชนิดรับประทาน*

วัสดุและวิธีการ*: เป็นการศึกษากลุ่มผู้ป่วยแบบมุ่งไปข้างหน้าจำนวน 31 ราย ที่มีภาวะสูญเสียการได้ยินเฉียบพลันโดยไม่ทราบสาเหตุซึ่งไม่ตอบสนองต่อการให้ยาสเตียรอยด์ชนิดรับประทานด้วยการฉีดยาสเตียรอยด์เข้าในโพรงหูชั้นกลาง สัปดาห์ละหนึ่งครั้ง เป็นเวลา 3 สัปดาห์ ติดต่อกัน ตรวจการได้ยินโดยเสียงบริสุทธิ์ก่อนการรักษาและ 2 เดือนเมื่อเสร็จสิ้นการฉีดยาสเตียรอยด์ ให้คำจำกัดความของการรักษาได้ผลสัมฤทธิ์คือลดการได้ยินโดยการใช้เสียงบริสุทธิ์ (pure tone audiometry-PTA) 10 เดซิเบลหรือมากกว่า หรือ เพิ่มความสามารถในการแยกแยะคำพูด (speech discrimination score-SDS) ร้อยละ 20 หรือมากกว่า*

ผลการศึกษา*: ผู้ป่วยจำนวน 31 ราย ที่ได้รับการรักษาด้วยการฉีดยาสเตียรอยด์เข้าไปในโพรงหูชั้นกลาง เพศหญิง 22 ราย และเพศชาย 9 ราย อายุเฉลี่ย 53 ปี โดยรวมการรักษาได้ผลสัมฤทธิ์ 14 ราย (ร้อยละ 45.2) ผู้ป่วย 11 ราย (ร้อยละ 35.5) มีค่าตรวจการได้ยินโดยการใช้เสียงบริสุทธิ์ลดลงหรือความสามารถในการแยกแยะคำพูดอย่างหนึ่งอย่างใดดีขึ้น ในจำนวนนี้ผู้ป่วย 2 ราย ดีขึ้นเฉพาะค่าตรวจการได้ยินโดยการใช้เสียงบริสุทธิ์ และผู้ป่วย 9 รายดีขึ้นเฉพาะค่าความสามารถในการแยกแยะคำพูดนอกจากนี้ ผู้ป่วยอีก 3 ราย (ร้อยละ 9.7) ดีขึ้นทั้งค่าตรวจการได้ยินโดยการใช้เสียงบริสุทธิ์และความสามารถในการแยกแยะคำพูด*

สรุป*: การฉีดยาสเตียรอยด์เข้าไปในโพรงหูชั้นกลางในผู้ป่วยที่มีภาวะสูญเสียการได้ยินเฉียบพลันโดยไม่ทราบสาเหตุและไม่ตอบสนองต่อยาสเตียรอยด์ชนิดรับประทาน ผู้ป่วยมีอาการดีขึ้นและไม่มีผลข้างเคียง วิธีการรักษานี้สามารถใช้เป็นการรักษาเพิ่มเติมหลังจากการรักษาด้วยวิธีมาตรฐานล้มเหลว การศึกษาต่อ และศึกษามากขึ้น จำเป็นในการพิจารณาว่าการฉีดยาสเตียรอยด์เข้าไปในโพรงหูชั้นกลางในผู้ป่วยที่มีภาวะสูญเสียการได้ยินเฉียบพลันเป็นการรักษามาตรฐานได้หรือไม่*