

# Intratympanic dexamethasone for managing pregnant women with sudden hearing loss

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## Abstract

**Objective:** This study aimed to investigate the effect and safety of intratympanic dexamethasone in pregnant women with idiopathic sudden sensorineural hearing loss (ISSNHL).

**Methods:** We performed a prospective study on pregnant women who suffered from ISSNHL and were treated in our clinic during 2016. The patients received intratympanic treatment three to four times a week. A pure tone audiogram (PTA) was performed before treatment and patients were followed up until 2 months after treatment was finished.

**Results:** A total of six pregnant women were included. All of the patients tolerated intratympanic treatment well. The mean improvement in hearing was  $48 \pm 7.33$  dB. There were no complications, including permanent perforation of the ear drum or middle ear infection. Each patient delivered a healthy newborn.

**Conclusion:** Intratympanic dexamethasone is effective and safe for treating pregnant women with ISSNHL. Further randomized, controlled studies on this treatment need to be performed.

## Keywords

Hearing loss, idiopathic sudden sensorineural hearing loss, dexamethasone, tympanic membrane, pregnant women, intratympanic steroid injection

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## Introduction

Idiopathic sudden sensorineural hearing loss (ISSNHL) is referred to as sensorineural hearing loss of at least 30 dB in three sequential frequencies, which occurs with no definite reasons over a period of less than

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72 hours. ISSNHL may occur during pregnancy, but it is rare. Previous studies have shown that pregnancy-associated hearing loss may be a new disease, which is similar to pregnancy-induced hypertension that is caused by systemic changes resulting from pregnancy.<sup>1</sup> Clinically, systemic and/or intratympanic steroids are used as first-line treatment in patients with ISSNHL. However, because of the potential adverse effects of ISSNHL on the fetus following medical treatment, treatment of ISSNHL in pregnant patients is extremely challenging and lacks clinical experience. The study aimed to present the outcomes of sudden hearing loss in pregnancy following intratympanic dexamethasone treatment.

## Materials and methods

### Patients

We performed a prospective study on pregnant women who suffered from ISSNHL and were treated in our clinic during 2016. The study protocol, which was in accordance with the Helsinki Declaration, was approved by the Institutional Board of the Eye & ENT Hospital. Each patient who was included in the study signed written informed consent.

Clinical data, which included the patients' age, gestational weeks, and co-existing symptoms, such as tinnitus, dizziness, and ear fullness, and the time between onset of the disease and treatment, were collected. All of the patients still had regular obstetric examinations. Nonidiopathic causes of sudden sensorineural hearing loss (SSNHL) were excluded through routine obstetric examinations and a detailed medical history. To avoid potential loud noise produced by a magnetic resonance imaging (MRI) machine that may affect the fetus, we recommended that patients have a MRI exam after delivery to exclude acoustic neuroma and other masses in the cerebellopontine angle.

### Pure tone audiogram

The average threshold of a pure tone audiogram (PTA) (500, 1000, 2000, and 4000 Hz) was recorded. A PTA was performed before treatment was initiated and again when the treatment was finished. A PTA was performed after 2 months if hearing did not completely recover when treatment was finished.

### Intratympanic dexamethasone injection technique

Each patient was seated with her head tilted at 45° to the healthy side with the affected ear elevated. Local anesthesia was induced with lidocaine in the ear after confirming an intact tympanic membrane using an otoscope. After local anesthesia, two punctures were made on the tympanic membrane using a 25-gauge spinal needle. One puncture was made in the anterosuperior portion for ventilation and the other was at the posteroinferior portion for perfusion. The patients received a dosage of 0.8 mL of dexamethasone (5 mg/mL) each time transtympanically. The patients were instructed to keep their head still and avoid swallowing for 30 minutes after injection.

Intratympanic dexamethasone was administered every other day for 1 week. If the hearing threshold returned to serviceable hearing (PTA value  $\leq 50$  dB according to the American Academy of Otolaryngology-Head and Neck Surgery), therapy was stopped. If the hearing threshold did not return to serviceable hearing, the therapy continued until the patient's hearing level remained unimproved.

## Results

The general information of the six pregnant women with ISSNHL and the results of intratympanic dexamethasone treatment are shown in Table 1. All of the six patients

**Table 1.** General information of the six pregnant women with ISSNHL and the results of intratympanic dexamethasone treatment.

	Age (years)	Affected ear side	Onset of ISSNHL (days)	Gestational weeks	Co-existing symptoms	Initial PTA result (dB)	Times of injection	Final PTA result (dB)
Case 1	30	Left	4	31	T	94	7	48
Case 2	32	Left	4	25	T/F	61	3	23
Case 3	36	Right	8	30	T	80	4	26
Case 4	26	Left	1	26	T/D	88	3	50
Case 5	27	Left	1	37	F/T/D	109	3	49
Case 6	30	Left	14	33	F/T/D	111	14	59

ISSNHL: idiopathic sudden sensorineural hearing loss; PTA: pure tone audiogram; F: fullness of the ear; T: tinnitus; D: dizziness.

showed considerable improvement in hearing. The mean ( $\pm$ standard deviation) improvement in hearing was  $48.0 \pm 7.33$  dB. Frequency-dependent improvement in hearing was  $58.3 \pm 20.6$  dB at 0.5 kHz,  $50.8 \pm 9.2$  dB at 1 kHz,  $45.0 \pm 8.3$  dB at 2 kHz, and  $37.5 \pm 15.0$  dB at 4 kHz. Recovery of hearing was better at lower frequencies and worse at higher frequencies. All of the patients tolerated the procedures. None of the patients complained of severe pain during injection. There were no complications, including permanent perforation of the ear drum or middle ear infection. All of the patients delivered a healthy newborn with Apgar scores  $>9$  at birth. All of the newborns were followed up for 6 months and height and weight were comparable to those of children at the same age. MRI of the brain was performed within 2 months after delivery, and the results showed no abnormalities. Two special cases are discussed below.

#### Case 4

A 26-year-old woman at 26 weeks of gestation suffered from severe ISSNHL in the left ear and visited our clinic 1 day after onset of hearing loss. She also complained of dizziness and continuous tinnitus. She did not experience any ear fullness. A PTA showed 80 dB on the first day of

visiting our clinic. When she returned on the second day for intratympanic dexamethasone, she felt slightly better without treatment. A PTA showed much better hearing without treatment (63 dB). On the fifth day after the second injection, a PTA showed approximately 36 dB. After another injection on the fifth day, the PTA on the seventh day was nearly normal (33 dB). Figure 1 shows the changes in the air conduction threshold in Case 4.

#### Case 6

In Case 6, this patient had the most injections. A 30-year-old woman who was pregnant for 33 weeks was diagnosed with profound hearing loss in her left ear. She also had continuous tinnitus and ear fullness in her left ear. Furthermore, she had severe dizziness without nausea or vomiting. She received intratympanic dexamethasone injections every other day for a total of 10 injections. Her hearing improved in the left ear and a PTA showed 63 dB. She had another three injections and the PTA showed 60 dB. Therefore, she had the final injection. She returned to have another hearing test after she gave birth to a healthy neonate. Figure 2 shows the changes in the air conduction threshold in Case 6. An endoscopic examination showed that the tympanic membrane was intact.

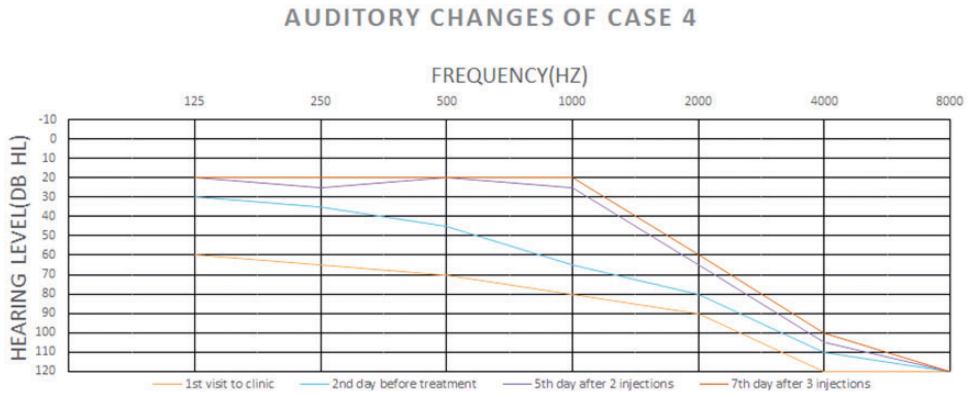


Figure 1. Auditory changes (air conduction threshold) of Case 4.

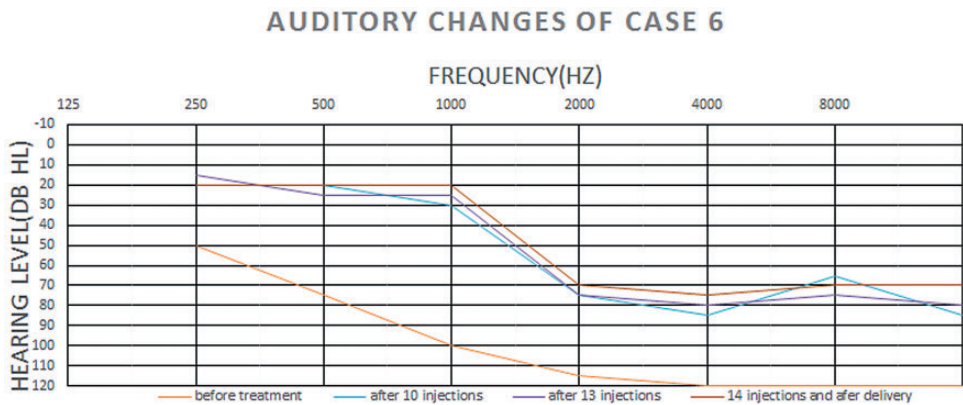


Figure 2. Auditory changes (air conduction threshold) of Case 6.

## Discussion

The reason for sudden deafness in pregnant women is unknown. To examine the effect of pregnancy on hearing, Sennaroglu and Belgin<sup>2</sup> investigated 20 pregnant women who felt that they had normal hearing. These authors found a gradual decrease in hearing levels. However, this hearing loss was slight and reversible. Hearing levels of the pregnant women returned to normal after delivery. Hearing loss suffered by pregnant women may be associated with a hypercoagulable state that occurs during

the normal process of pregnancy. This hypercoagulable state may result in formation of microemboli in the microcirculation of the inner ear, which may cause pathological changes resulting in ISSNHL. Additionally, a reduction in the protective effect of estrogen in pregnant women causes a tendency of hearing loss. Estrogen is an important steroid hormone and its physiological action is mediated by estrogen receptors. The distribution of estrogen receptors in the human inner ear, which was first mapped by Stenberg et al.,<sup>3</sup> shows the potential effect of estrogen on hearing

levels. The differences in auditory brainstem recordings in males and females have been well documented. Shorter latencies in auditory brainstem recordings have been found in females than in males, which suggests that hearing levels may be closely related to estrogen levels.<sup>4</sup> Therefore, a pregnancy-induced reduction in estrogen levels may also be one of the pathogenic factors of ISSNHL.

All of our six patients had considerable improvement in hearing. However, because the natural history of ISSNHL in pregnancy has not been established, whether our finding of improved hearing was natural or an effect of intratympanic dexamethasone or both is unclear. In Case 4, we observed obvious spontaneous recovery. A PTA showed 80 dB on the first day and 63 dB on the second day without any treatment. Therefore, spontaneous recovery played at least some part in recovery of hearing. Wilson et al.<sup>5</sup> conducted the first double blind study to clarify the effect of steroids on ISSNHL. They showed that mid-frequency hearing loss had a good recovery rate in the steroid and placebo groups, and profound hearing loss had a poor recovery rate. However, in our six patients, three patients suffered from profound hearing loss, but they showed an improvement in hearing after intratympanic dexamethasone injection. This finding suggests that the pathophysiology of ISSNHL in pregnancy may be different from that in non-pregnant people.

Because of the small number of cases, there is no consensus on the management of ISSNHL in pregnancy. Dextran 40, which is a form of plasma expander, is a unique drug with good clinical results. A study conducted by Wang and Young<sup>6</sup> showed that dextran 40 significantly increased the incidence of improved hearing in a group of pregnant patients with ISSNHL. Dextran 40 is thought to improve the cochlear state of hypoxia by enhancing the microcirculation in the inner ear.<sup>7</sup> However, because of the rarity of this

clinical problem, this previous study only included six cases in the dextran group and five cases in the control group. Therefore, the effectiveness of dextran 40 requires further verification. Furthermore, dextran can have some adverse effects, including coagulopathy, renal failure, and non-cardiogenic pulmonary edema.<sup>8</sup> Therefore, the potential benefits and risks of dextran should be fully considered before treatment.

Other proposed drugs for ISSNHL are steroids.<sup>5</sup> Despite the fact that steroids are recommended in the American guidelines for ISSNHL, they are not recommended for pregnant women because of the potential detrimental effects of these drugs on the fetus, such as changes in metabolism and disturbance of endocrine balance. Intratympanic steroids, which are believed to be more targeted and have few side effects, are ideal for drug administration to the inner ear.<sup>9</sup> Steroid concentrations are high in the inner ear after intratympanic administration, and thus have a good effect in inhibition of the local inflammatory response.<sup>10</sup> The intratympanic route is also believed to be a safe administration route with few complications.<sup>11</sup> In our study, all six patients had no persistent tympanic membrane perforation, including the patient who had the most injections.

Intratympanic dexamethasone is effective and safe for treating pregnant women with ISSNHL. However, further studies need to be performed, especially randomized, controlled studies, to confirm the effect of intratympanic dexamethasone on pregnant women suffering from ISSNHL. The different results of pregnant women and non-pregnant patients may lead to indications of the pathology and physical changes of ISSNHL.

#### **Declaration of conflicting interest**

The authors declare that there is no conflict of interest.

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