



# Comparison of the effects of the temperature of intratympanic dexamethasone injections on vertigo<sup>☆</sup>

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## ARTICLE INFO

### Keywords:

Intratympanic  
Vertigo  
Temperature  
Dexamethasone  
Visual analogue scale

## ABSTRACT

**Objective:** This study aimed to compare if vertigo improved in patients when the dexamethasone used in the intratympanic (IT) injection was applied at body temperature or at room temperature.

**Methods:** The study included 54 patients who had undergone intratympanic treatment due to sudden hearing loss and tinnitus. The IT injection was administered to all patients, 2 times with 1-day intervals. Two different IT injection techniques were used for each patient: injecting dexamethasone at room temperature and injecting it at body temperature. Patients were asked to report the vertigo they felt immediately, and at 15 min after the injection using the visual analogue scale (VAS) and the four-point categorical rating scale (CRS-4).

**Results:** The level of vertigo immediately after injection was lower when the dexamethasone was injected at body temperature rather than at room temperature for both the VAS and CRS-4 ( $p < 0.05$ ). However, no statistical differences in the VAS and CRS-4 self-report values between the two methods were found 15 min after the injection ( $p > 0.05$ ).

**Conclusion:** Vertigo due to IT decreases within minutes. When the IT drugs are administered at body temperature, temporal vertigo due to injection is lower than when they are administered at room temperature.

## 1. Introduction

Beginning in the 1980s, intratympanic (IT) steroid injection was used in an increasing number of clinical studies to treat different inner ear diseases. IT steroid injection was first administered in 1982 by Sakata et al. to treat tinnitus [1]. In 1991, it was first described by Itoh et al. to treat Meniere's disease [2]. Silverstein reported IT steroid treatment for the first time in 1996 for idiopathic sudden sensorineural hearing loss (ISSNHL) [3]. More recently, IT has been reported as a treatment approach for different ear diseases, such as facial paralysis, serous otitis media and benign paroxysmal positional vertigo [4–6].

IT treatment has important advantages. IT administration of steroids effectively treats the affected ear; and, the lack of significant side effects associated with systemic steroids has made the application popular. Moreover, animal studies have shown that it is possible to obtain a higher perilymph concentration with IT steroid injections in comparison to systemic steroid administration [7,8].

IT steroid treatment can be used as a primary, combined, or rescue therapy for various internal ear diseases. IT steroid treatment is a minimally invasive procedure, which is often well tolerated by patients,

and it is a simple procedure that can be performed in an outpatient clinic. Needle-related ear pain and caloric vertigo are common procedure-related side effects [7,9]. Vertigo pathology due to IT injection is still unknown, but is thought to be due to the temperature of the drug that is administered because injected steroids can have a caloric response when their temperature is lower than the patient's body temperature [10].

In almost all studies, although the body temperature of the IT drug administered can decrease the caloric vertigo, no previous study in the literature has investigated effect of the drug's temperature on vertigo. Thus, this study aimed to compare the effect of the temperature of an IT dexamethasone injection on caloric vertigo when the drug was administered at body temperature and at room temperature.

## 2. Materials and methods

### 2.1. Study population and inclusion criteria

This retrospective study was performed at a tertiary university hospital between 2017 and 2018. This study included 19 patients with

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<https://doi.org/10.1016/j.amjoto.2019.05.021>

Received 30 April 2019

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SSNHL and 35 patients with tinnitus (age range: 18–78) who did not benefit from oral medication therapy.

Approval from the local Ethics Committee was obtained for the study. The benefits and risks of the treatment were explained to the patients, and written informed consent was obtained from all participants.

The exclusion criteria for this study were: patients who were using vertigo medications, patients with Meniere's disease, those with dizziness with SSNHL, those diagnosed with a retrocochlear pathology, those who did not undergo IT injection at two different temperatures and those who were unable to report on their level of vertigo using dizziness scales.

All 54 patients received IT injections twice (on day 1 and day 2). The patients were not randomised, and each received an IT dexamethasone injection at two different temperatures: at room temperature and at body temperature.

In the first method, before injection of IT dexamethasone, the vial of dexamethasone was heated for 5 min in the palm of the patient's hand, to reach body temperature. In the second method, the vial containing dexamethasone was applied in at a fixed, 25 °C room temperature by pulling it into the 25-gauge spinal injector without being heated.

## 2.2. IT injection technique

The senior author administered all of the IT injections at the outpatient clinic. IT injection was performed without any previous ear anaesthesia. Before administering the IT injections, the patients were informed about the procedure and a clear explanation was given for the application of the drug at two different temperatures.

Each patient was asked to lie in a supine position, rotating his/her head at a 45° angle to the unaffected ear. Dexamethasone (4 mg/ml) was placed in a 25-gauge spinal needle, and under an otomicroscope it was injected into the posterior-inferior quadrant without local anaesthesia to fill the middle ear (approximately 0.4 ml). The patients were asked to stay in the same position for 20 min after the injection, and to avoid swallowing. Thus, the maximum absorption of the drug from the round window was targeted, and every attempt was made to reduce leakage from the Eustachian tube in order to obtain the maximum efficiency from the injection. Each patient received dexamethasone at two different temperatures: body temperature and room temperature.

## 2.3. Measures

The level of vertigo was measured twice, immediately after the IT injection, and 15 min later. The patients were asked to report on the vertigo level they felt after each injection using two different scales: the visual analogue scoring scale (VAS) and the four-point categorical rating scale (CRS-4). Using the VAS, the patients were asked to identify their level of vertigo, ranging from 0 (no vertigo) to 10 (unbearable vertigo). Using the CRS-4, the patients were asked to identify the degree to which they experienced vertigo: no vertigo (0), mild vertigo (1–3), moderate vertigo (4–6) or severe vertigo (7–10).

## 2.4. Statistical analysis

The data analysis was performed using the Statistical Package for the Social Sciences for Windows, version 17.0 (SPSS Inc., Chicago, IL, USA). We used the Shapiro-Wilk test to determine whether the distributions of continuous variables were normal. Data are shown as the mean  $\pm$  standard deviation. The differences between groups were compared using Student's *t*-test or Mann-Whitney *U* test, where appropriate. Categorical data were analysed by Fisher's Exact Test, where appropriate. A *p*-value of  $< 0.05$  was considered statistically significant.

## 3. Results

We included 54 patients in the study, and the mean age was  $49.65 \pm 16.9$  years (range: 18–78 years). Twenty-seven patients were male, and 27 were female; 19 participants (35.2%) reported sudden hearing loss, and 35 patients (64.8%) were diagnosed with tinnitus. The right ear (53.7%) was affected in 29 patients, while the left ear (46.3%) was afflicted in 25 of the patients.

When the IT injection was applied at room temperature, the mean VAS score 1 min after injection was  $3.63 \pm 3.01$  (range: 0–10). In contrast, warming the IT injection so that it could be given at body temperature produced a mean VAS score of  $2.07 \pm 2.07$  (range: 0–8) after the first minute. Therefore, injection at body temperature resulted in statistically significantly less vertigo than injection at room temperature according to the VAS scores ( $p = 0.009$ ) (Mann-Whitney *U* test). When dexamethasone was applied at room temperature, transient vertigo was reported in 41 of 54 patients; when dexamethasone was injected at body temperature, only 36 patients had vertigo.

The mean VAS score 15 min following injection at room temperature was  $0.666 \pm 1.01$  (range: 0–3). Fifteen minutes after the application at body temperature, the mean VAS score was  $0.4259 \pm 0.77$  (range: 0–3). There was no statistically significant difference between the two methods according to the Mann-Whitney *U* test when the VAS scores of vertigo were compared 15 min after the injection ( $p = 0.237$ ).

According to the CRS-4 scale values, when the dexamethasone used in the IT injection was at room temperature, 13 (24.1%) of the patients had no vertigo, while 17 (31.5%) reported mild vertigo. The remaining 11 (20.4%) participants experienced moderate to severe vertigo. When dexamethasone was warmed to body temperature before the injection, the CRS-4 scale values revealed that 18 (33.3%) of the patients had no vertigo, and 23 (42.6%) of them reported mild symptoms; 11 (20.4%) experienced severe vertigo, while 2 (3.7%) patients had moderate vertigo. Based on these CRS-4 scale values, IT injections of dexamethasone administered at room temperature were found to produce significantly fewer vertigo symptoms ( $p = 0.001$ , Fisher's Exact Test).

When the CRS-4 scale values obtained during the 15th minute after injection were compared, there was no difference between the two groups. Regardless of the injection temperature of the drug, vertigo was not detected in 40 of the patients (74.1%), and mild vertigo was found in 14 (25.9%).

## 4. Discussion

IT injection is a minimally invasive procedure that can be performed in the outpatient clinic without premedication, and this technique is usually well tolerated by patients. Some serious complications that may arise with the use of systemic steroids, such as glucose intolerance, liver dysfunction, Cushing's disease, acne, gastrointestinal side effects, hypertension, immunosuppression and avascular necrosis of the femoral head, do not occur with IT steroid injections [11]. In addition, this method allows high concentrations of the drug to enter the inner ear, which is not possible with systemic dosing. Major complications associated with IT injection are not usually seen [7].

The most common complications of IT injection are pain and dizziness. Other side effects include bleeding, a burning sensation, tinnitus, numbness in the tongue, infection and tympanic membrane perforation [9,10]. The use of thin needles for the injection may reduce pain [12].

Local anaesthetic sprays, EMLA cream and local anaesthetic injections may be used prior to the injection to reduce pain [7]. Two studies in the literature about pain management in IT treatment have reported that injections given following a local anaesthetic spray and EMLA cream administration produced similar pain levels as injections given without any local anaesthesia [7,9]. In addition, patients who have received a local anaesthetic injection have two times the pain due to the use of both the anaesthesia needle and the needle for the IT injection, which caused more anxiety [7].

Current IT therapy guidelines recommend that steroids be applied by direct injection rather than through a ventilation tube because there is less risk of tympanic membrane perforation, bleeding, scar formation and infection when a ventilation tube is not involved. Direct injections also do not require patients to protect the ear from water contact, which is required with ventilation tubes [9].

Acute onset transient dizziness due to the injection is quite common. The duration of dizziness is usually < 10 min. Vertigo typically disappears in minutes. Although the mechanism of temporary vertigo due to IT treatment is not completely understood, it is thought that it may occur due to a caloric test response [10]. A caloric stimulus is not physiological; instead, it is a response to thermally induced convection. A caloric test stimulus mainly occurs in the lateral semicircular canal endolymph due to the formation of heat-dependent intensity and fluidity change [13].

It has been reported that the lidocaine agent used for IT injection anaesthesia may cause vertigo if it passes into the inner ear. Therefore, any lidocaine remaining on the tympanic membrane should be thoroughly cleaned before the IT injection [10]. To avoid these side effects of anaesthetic drugs, we recommend directly injecting the dexamethasone with a fine needle without any local anaesthesia.

Many studies in the literature have reported that warming the steroid in the palm of the hand prior to IT injection may reduce caloric vertigo, but no study has compared the effect of dexamethasone temperature on vertigo symptoms. This study was the first study to investigate the level of vertigo resulting from the injection of dexamethasone at room temperature and also at body temperature. Transient vertigo is a common side effect of IT treatment. In the present study, temporal vertigo dexamethasone was seen in 41 of 54 patients when the drug was applied at room temperature. When dexamethasone was given at body temperature, vertigo was experienced by 36 patients.

The present study found that when the steroid used in the IT treatment was injected at body temperature, the VAS and CRS-4 scores were statistically low immediately after the injection. However, no difference was observed in the scores measured 15 min after the injection. These results indicate that warming steroids in the palm of the hand prior to administration reduces the symptoms of vertigo in the first few minutes after the injection. After 15 min, the VAS scores were < 1, and the CRS-4 scores were significantly lower, which indicates that IT-induced vertigo was reduced in minutes regardless of the injection temperature.

Our study had some limitations. One such limitation was the retrospective nature of this study, which may have caused biased results. We also measured the vertigo level using subjective scales. In future prospective studies, the vertigo level should be assessed with objective vertigo tests.

## 5. Conclusion

IT dexamethasone can be used in different internal ear diseases in primary, combined or salvage treatments. IT dexamethasone is a safe and effective agent that is well tolerated by patients. Although it is quite

common for this injection to cause vertigo, the symptoms usually resolve within minutes. Bringing the dexamethasone up to body temperature before the injection significantly reduces the vertigo reported by patients in the first few minutes after the injection.

## Ethics committee approval

Ethical approval was obtained from the Medical Faculty, KTO Karatay University.

## Informed consent

Written informed consent was obtained from patient who participated in this case.

## Financial disclosure

The authors declared that this study has received no financial support.

## Declaration of Competing Interest

No conflict of interest was declared by the authors.

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