Comparative study between Intratympanic Steroid Injection and Intratympanic Platelet Rich Plasma (PRP) Injection in Sudden Sensorineural Hearing Loss (SSNHL)

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How to Cite This Article

Sherif, Ashraf Mohammad Hasan; Alawady, Mohammed Kamel; Mahfouz, Ragab Moomtaz; Abbas, Ahmed Ismael; and Ali, Hany Fawzy (2024) "Comparative study between Intratympanic Steroid Injection and Intratympanic Platelet Rich Plasma (PRP) Injection in Sudden Sensorineural Hearing Loss (SSNHL)," *Al-Azhar International Medical Journal* Vol. 5: Iss. 4, Article 41.  
DOI: https://doi.org/10.58675/2682-339X.2385

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Comparative study between Intratympanic Steroid Injection and Intratympanic Platelet Rich Plasma (PRP) Injection in Sudden Sensorineural Hearing Loss (SSNHL)

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Abstract

Background: Sudden sensorineural hearing loss (SSNHL) is a sudden, often unilateral hearing impairment with unclear causes. An intratympanic dexamethasone injection is a treatment option, delivering anti-inflammatory benefits directly to the inner ear with fewer side effects. Platelet-rich Plasma (PRP) therapy is an innovative approach that enriches blood plasma with growth factors, promoting inner ear hair cell health and hearing improvement. Both treatments offer hope for those with SSNHL.

Aim of the work: To examine the effectiveness of intratympanic platelet-rich plasma (PRP) injections and Dexamethasone in treating sudden sensorineural hearing loss (SSNHL).

Patients and methods: 30 patients with SSNHL participated in this study. They were divided into two equal groups: group A received PRP intratympanic injection, and group B received Dexamethasone intratympanic injection. Pure tone audiometry (PTA) was done before and after injection to assess hearing improvement at 500Hz and 2000Hz.

Results: In the dexa group, the hearing threshold improvement (Mean±SD) was 10.33±19.04 dB and 16 ± 20.02 dB at 500Hz and 2000Hz, respectively, while in the PRP group, the hearing threshold improvement (Mean±SD) was 20±17.32 dB and 22.2 ±21.36 dB at 500Hz and 2000Hz respectively.

Conclusions: There are no significant differences between PRP and dexamethasone groups; both treatments have shown potential efficacy in improving hearing outcomes in SSNHL. Further research and larger studies are needed to establish the effectiveness and optimal protocols for PRP injections in SSNHL treatment.

Keywords: SSNHL; SSHL; Dexamethasone; PRP; Intratympanic injection

1. Introduction

Sudden sensorineural hearing loss (SSNHL) is an abrupt and frequently severe auditory impairment distinguished by its swift initiation. Although the impact of this condition can be observed across many age groups, it is primarily prevalent among the older population. Studies suggest that the estimated yearly incidence of this condition is approximately 10-20 instances per 100,000 individuals.1 Typically, SSNHL presents unilaterally, and its severity can range from mild to profound, potentially leading to complete deafness. It often comes with accompanying symptoms like vertigo, tinnitus, and ear pressure.2

The precise cause of sudden sensorineural hearing loss (SSHL) remains uncertain. However, several variables have been proposed, such as viral infections, vascular issues, disturbances in the cochlear membranes, immunological disorders, and otologic malignancies.3
The existing therapeutic interventions for sudden sensorineural hearing loss (SSNHL) encompass the administration of corticosteroids, vasodilators, antiviral medications, diuretics, and adherence to low-salt dietary regimens. Many cases exhibit spontaneous recovery without treatment, with estimates ranging from 30% to 60%. Most of these improvements are observed within two weeks following the onset of symptoms.

Transtympanic steroids (TTS) delivered via injection into the middle ear have emerged as a popular alternative therapy modality. Transtympanic steroids (TTS) has several possible benefits in comparison to oral corticosteroids, including the possibility of decreased systemic steroid exposure and the subsequent mitigation of related adverse effects. Research conducted on animals has demonstrated that trans-tympanic steroid (TTS) delivery results in elevated drug concentrations in the perilymph, in comparison to the administration of steroids through intravenous or oral routes.

Dexamethasone is a preferred steroid in the treatment of TTS due to its anti-inflammatory characteristics and its capacity to attain elevated drug concentrations within the cochlea when injected via the intratympanic route. In contrast to systemic administration, the act of intratympanic injection does not result in an elevation of cortisol levels in the perilymph. This is because the inner ear, an end organ, possesses a blood-labyrinth barrier that safeguards its blood supply.

Dexamethasone is the favored choice among many steroids, such as methylprednisolone. Although methylprednisolone has the largest relative concentration in lymphatic fluid, its administration is associated with a burning feeling. Morphological investigations have indicated a correlation between hydrocortisone and an inflammatory response of the round window membrane.

Platelet-rich Plasma (PRP) therapy is increasingly becoming recognized as a promising treatment modality in the realm of hearing loss and deafness care. Platelet-rich plasma (PRP) is blood plasma enhanced with platelets and growth factors. Platelets are small cellular fragments that serve a crucial function in blood clotting. Additionally, they possess growth factors and natural compounds that can encourage the growth and mending of cells. Platelet-rich plasma (PRP), or autologous conditioned plasma, is a concentrated form of plasma protein generated from whole blood, wherein the removal of red blood cells is achieved through centrifugation.

Intratympanic instillation of PRP has shown promise in enhancing the function of the hair cells within the inner ear, ultimately leading to improved hearing outcomes. This research highlights the diverse treatment options available for SSNHL, providing hope for individuals affected by this sudden and distressing condition. As SSNHL remains a complex and often unpredictable condition, a collaborative approach to treatment is paramount.

This study aims to assess and compare the effectiveness of the intratympanic administration of dexamethasone and the intratympanic administration of platelet-rich plasma (PRP) in treating sudden sensorineural hearing loss (SSNHL).

2. Patients and methods
A prospective study was conducted at Al-Hussein University Hospital and Damanhour Medical National Institute, involving 30 patients of both genders diagnosed with sudden sensorineural hearing loss (SSNHL). Before their participation, the patients were provided with written informed consent and received counseling explaining the study's objectives. The participants were allocated into two cohorts: Group A was administered intratympanic platelet-rich plasma (PRP) injections, and Group B got intratympanic dexamethasone injections. The injections were provided three times within three weeks, with a one-week gap between each administration.

Inclusion Criteria: The study included individuals of both genders, ranging in age from 20 to 70, who were diagnosed with idiopathic, abrupt, unilateral sensorineural hearing loss (SSNHL) with a minimum threshold of 30 dB across three frequencies. Patients who exhibited an inadequate response to combination therapy, which included the administration of systemic steroids, during a period of two months were also included.

Exclusion Criteria: Patients with conductive or mixed hearing loss, presence of pathological tissues, acute or chronic otitis media, head and neck trauma, evidence of retrocochlear disease on MRI, or sensorineural hearing loss lasting over two months.

Intervention: The patients were prepared, and the medication (Dexamethasone or PRP) was slowly injected into the middle ear under endoscopic visualization. The patient was observed for any adverse reactions.

Outcome: The main outcome measure was the improvement of (SNHL), assessed by comparing the results of pure tone audiometry before and after treatment. A change of 10 decibels or more was considered a significant improvement.
3. Results

Table 1. Hearing threshold at low frequency [500 (Hz)] according to PTA between both groups.

<table>
<thead>
<tr>
<th></th>
<th>PRP GROUP (N = 15)</th>
<th>DEXA GROUP (N = 15)</th>
<th>PRP GROUP</th>
<th>DEXA GROUP</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEFORE INJECTION</td>
<td>58 ± 48.33 ± 23.05 dB</td>
<td>48.33 ± 24.18 dB</td>
<td>MEAN ± SD.</td>
<td>MEDIAN (IQR)</td>
<td>40 (40 - 80) dB</td>
<td>25 (65) dB</td>
</tr>
<tr>
<td>AFTER INJECTION</td>
<td>38 ± 38 ± 24.63 dB</td>
<td>49 ± 18.34 dB</td>
<td>MEDIAN (IQR)</td>
<td>RANGE (MIN-MAX)</td>
<td>20 (20 - 70) dB</td>
<td>10 (80) dB</td>
</tr>
<tr>
<td>LOW FREQUENCY 500 (Hz)</td>
<td>t = 1.455</td>
<td>0.157</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Hearing threshold at high frequency 2000 (Hz) according to PTA between both groups.

<table>
<thead>
<tr>
<th></th>
<th>PRP GROUP (N = 15)</th>
<th>DEXA GROUP (N = 15)</th>
<th>PRP GROUP</th>
<th>DEXA GROUP</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEFORE INJECTION</td>
<td>48 ± 27.16 dB</td>
<td>49 ± 18.34 dB</td>
<td>MEAN ± SD.</td>
<td>MEDIAN (IQR)</td>
<td>30 (30 - 52.5) dB</td>
<td>45 (62.5) dB</td>
</tr>
<tr>
<td>AFTER INJECTION</td>
<td>26 ± 7.61 dB</td>
<td>33 ± 20.02 dB</td>
<td>MEDIAN (IQR)</td>
<td>RANGE (MIN-MAX)</td>
<td>20 (20 - 70) dB</td>
<td>15 (35) dB</td>
</tr>
<tr>
<td>HIGH FREQUENCY 2000 (Hz)</td>
<td>t = 0.791</td>
<td>0.852</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There is no statistical significant difference (p=1) between the two groups at low frequency 500 Hz.

Table 3. Hearing threshold improvement according to PTA between both groups.

<table>
<thead>
<tr>
<th></th>
<th>PRP GROUP (N = 15)</th>
<th>DEXA GROUP (N = 15)</th>
<th>PRP GROUP</th>
<th>DEXA GROUP</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW FREQUENCY 500 (Hz)</td>
<td>t = 1.455</td>
<td>LOW FREQUENCY 500 (Hz)</td>
<td>MEAN ± SD.</td>
<td>MEDIAN (IQR)</td>
<td>20 (10 - 50) dB</td>
</tr>
<tr>
<td>HIGH FREQUENCY 2000 (Hz)</td>
<td>t = 0.82</td>
<td>HIGH FREQUENCY 2000 (Hz)</td>
<td>MEAN ± SD.</td>
<td>MEDIAN (IQR)</td>
<td>10 (15 - 20) dB</td>
</tr>
</tbody>
</table>

There is no statistically significant difference (p = 0.236) observed between the two groups at a high frequency of 2000 Hz.

Table 4. Subjective improvement of hearing according to number of injections.

<table>
<thead>
<tr>
<th></th>
<th>PRP GROUP (N = 15)</th>
<th>DEXA GROUP (N = 15)</th>
<th>PRP GROUP</th>
<th>DEXA GROUP</th>
<th>X2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ONE INJECTION</td>
<td>3 (20%)</td>
<td>5 (33.33%)</td>
<td>MEAN ± SD.</td>
<td>MEDIAN (IQR)</td>
<td>30 (20 - 60) dB</td>
</tr>
<tr>
<td>TWO INJECTIONS</td>
<td>6 (40%)</td>
<td>5 (33.33%)</td>
<td>MEDIAN (IQR)</td>
<td>RANGE (MIN-MAX)</td>
<td>20 (10 - 35) dB</td>
</tr>
<tr>
<td>THREE INJECTIONS</td>
<td>3 (20%)</td>
<td>3 (20%)</td>
<td>X2 = 0.852</td>
<td>0.791</td>
<td></td>
</tr>
<tr>
<td>NO IMPROVEMENT</td>
<td>3 (20%)</td>
<td>2 (13.33%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In relation to the aspect of subjective improvement, no statistically significant distinction was seen between the two groups under investigation (p = 0.852).

4. Discussion

Sudden sensorineural hearing loss (SSNHL) is a pathological disorder defined by an abrupt and significant decline in auditory function, often manifesting within a timeframe of 72 hours.9

It is considered a medical emergency that requires immediate attention and effective
management. Managing SSNHL can be challenging due to the need for a standardized treatment approach. However, the primary treatment modality for several decades has been systemic corticosteroids. Corticosteroids, such as prednisone or methylprednisolone, have shown clear benefits in reversing SSNHL by reducing inflammation and improving cochlear blood flow.10 Nevertheless, the administration of systemic corticosteroids presents inherent risks, including the possibility of experiencing adverse effects such as weight gain, hyperglycemia, and heightened vulnerability to infections. In recent times, there has been an increasing level of attention towards the utilization of intratympanic steroids as a potential alternative therapeutic approach for sudden sensorineural hearing loss (SSNHL). The procedure of intratympanic steroid injections entails the administration of corticosteroids directly into the middle ear cavity, thereby facilitating the delivery of a more concentrated dosage of the medication to the inner ear.11 Dexamethasone is frequently employed for intratympanic injections owing to its anti-inflammatory characteristics. The implementation of a localized strategy serves to mitigate the occurrence of systemic adverse effects commonly associated with the administration of oral corticosteroids while concurrently optimizing the therapeutic impact of the medicine on the inner ear. Intratympanic platelet-rich plasma (PRP) injections have emerged as a potential therapy option for sudden sensorineural hearing loss (SSNHL). Platelet-rich plasma (PRP) is obtained from autologous blood and possesses a substantial concentration of platelets, growth factors, and cytokines that facilitate the process of tissue regeneration and repair.8 PRP injections have been used to enhance tissue healing in various medical fields, including orthopedics and dermatology. In the context of SSNHL, PRP injections aim to stimulate the repair and regeneration of damaged cochlear tissues, and they are believed to have broader effects on injured cochlear tissues beyond inflammation suppression. It’s important to note that the evidence supporting PRP injections for SSNHL still needs to be expanded compared to the extensive research on dexamethasone injections. When comparing intratympanic PRP injections to intratympanic dexamethasone injections, first, several studies have investigated the effectiveness of intratympanic PRP injections in SSNHL treatment; these studies have reported positive outcomes, with some patients experiencing significant improvements in hearing thresholds and speech discrimination scores, which are in agreement with our study results.8,12 On the contrary, a considerable body of research has been dedicated to examining the effectiveness of intratympanic Dexamethasone injections as a therapeutic intervention for sudden sensorineural hearing loss (SSNHL). The research above has repeatedly exhibited positive outcomes, signifying significant enhancements in auditory thresholds. The findings above are consistent with the outcomes obtained in our research investigation.10,13,14,15,16,17 Both PRP and dexamethasone injections have shown acceptable safety profiles with minimal reported side effects.18,19 However, the specific application details, such as the dosage, frequency of injections, and treatment duration, may vary between studies and individual practitioners.

5. Conclusion
While systemic corticosteroids have traditionally been the primary treatment option, alternative approaches such as intratympanic dexamethasone and PRP injections have demonstrated potential benefits; at the same time, our study did not find significant differences between PRP and dexamethasone, both treatments have shown potential efficacy in improving hearing outcomes in SSNHL. Further research and larger studies are needed to establish the effectiveness and optimal protocols for PRP injections in SSNHL treatment as intratympanic dexamethasone injections have been extensively investigated.

Disclosure
The authors have no financial interest to declare in relation to the content of this article.

Authorship
All authors have a substantial contribution to the article.

Funding
No Funds : Yes

Conflicts of interest
There are no conflicts of interest.

References