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Intratympanic platelet-rich plasma injection for the treatment of sensorineural hearing loss: a prospective study

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Abstract

Background: This study evaluated the efficacy and safety of intratympanic platelet-rich plasma (PRP) injection for the treatment of sensorineural hearing loss (SNHL) in Yemen, and identified predictors of successful treatment outcomes in a resource-limited setting.

Methods: In this prospective cohort study, 120 patients diagnosed with SNHL at the Military General Hospital in Yemen were administered intratympanic PRP injections. Patients were followed up for three months, with hearing thresholds assessed via pure-tone audiometry (PTA) before and after treatment. Statistical analyses were used to assess treatment outcomes and identify significant predictors of success.

Results: The cohort (30% women, 70% men; mean age 29.72 $\pm$ 11.85 years) had noise-induced (35.8%) or sudden (30%) hearing loss (HL) as primary causes. Mean PTA thresholds improved from 48.27 $\pm$ 17.77 dB (HL) to 31.56 $\pm$ 20.45 dB HL post-treatment ($p < 0.0001$) . Patients with baseline hearing of 26–45 dB showed optimal gains, reaching $\leq$ 25 dB. Etiology predicted better outcomes ($p = 0.002$), unlike age, sex, or duration. Minor adverse effects were rare.

Conclusion: Intratympanic PRP injections effectively and safely improved hearing in SNHL patients, particularly with early, etiology-driven intervention. Larger, long-term studies are needed to confirm these findings in resource-limited contexts.

Article Info

Keywords:
hearing improvement, intratympanic injections, platelet-rich plasma, resource-limited settings, sensorineural hearing loss, Yemen.

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1. INTRODUCTION

Sensorineural hearing loss (SNHL) is a significant global health issue that affects millions of individuals worldwide [1]. SNHL results from damage to hair cells in the cochlea or auditory nerve, leading to permanent hearing deficits [2]. According to the World Health Organization (WHO), over 466 million people worldwide suffer from disabling hearing loss, with SNHL being the predominant type [3]. This condition impairs communication and has profound social, psychological, and economic impacts on affected individuals and their families [4, 5]. Recent advancements in regenerative medicine have introduced innovative treatment approaches, such as platelet-rich plasma (PRP) therapy. PRP is an autologous concentration of platelets in a small volume of plasma rich in growth factors and cytokines that promotes tissue regeneration and healing. [6]. The application of PRP in otology, particularly for treating SNHL, has garnered significant interest because of its potential to regenerate damaged hair cells and improve auditory function [7, 8]. Studies have shown promising results, with PRP improving hearing in patients with varying degrees of SNHL [9, 10, 11]. PRP growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and insulin-like

growth factor (IGF) play crucial roles in cellular repair and regeneration, making PRP a promising candidate for SNHL treatment [12]. This global burden is amplified in conflict-affected regions, such as Yemen, where ongoing instability exacerbates the challenges of managing SNHL. Traditional treatments such as hearing aids and cochlear implants are often inaccessible in these regions because of their high cost and lack of specialized healthcare infrastructure [13]. In the Middle East and North Africa (MENA) region, factors such as high rates of consanguinity, untreated infections, and limited healthcare access contribute to a substantial SNHL burden [14]. In Yemen, a population-based study found a prevalence of 1.6% of SNHL among schoolchildren, higher than the global average, with many cases remaining undiagnosed and untreated owing to economic and logistical barriers [15, 16, 17]. This often results in untreated cases and a reduced quality of life. This study aimed to evaluate the efficacy and safety of intratympanic PRP injections in the treatment of SNHL in Yemen. By investigating this novel approach, we sought to address this knowledge gap and provide evidence-based recommendations for healthcare providers in resource-limited settings. These findings could enhance SNHL management in Yemen by offering a cost-effective and accessible treatment option while also contributing to the global understanding of PRP therapy for SNHL.

2. METHODS

2.1. Study Design and Setting

This prospective cohort study evaluated the efficacy and safety of intratympanic PRP injections in the treatment of SNHL. The study was conducted at the Department of Otorhinolaryngology, Military General Hospital, Yemen, over a period of 12 months from January 2023 to December 2023. This study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

2.2. Participants

A total of 120 patients (36 females and 84 males) aged 11-60 years diagnosed with SNHL were recruited for this study. The inclusion criteria were Patients with SNHL and intact tympanic membranes. The exclusion criteria were conductive hearing loss, retrocochlear disorders on MRI, previous chemotherapy or radiation therapy, absence of cochlea on CT or MRI, cancer, chronic liver disease, hemodynamic instability, hypofibrinogenemia, platelet dysfunction syndromes, systemic disorders, sepsis, low platelet count, and medical contraindications to PRP injection.

2.3. Sample Size

The sample size was calculated using the Epi Info™ statistical calculator for cohort studies, based on an expected improvement rate of 80%, confidence level of 95%, and power of 80%. The minimum required sample size was 100 patients; however, we included 120 patients to account for potential dropouts.

2.4. Data Collection

Each patient underwent comprehensive evaluation, including a detailed medical history and clinical assessment. Baseline data, including demographic information and audiological assessments, were collected before the intervention. Preoperative procedures included pure-tone audiometry (PTA), vestibular tests, radiographic tests, laboratory tests, and additional tests, such as speech audiometry, otoacoustic emissions, and auditory brainstem response. All observations and findings were systematically documented in a structured form. All audiometric assessments, including pre-treatment, interim, and post-treatment PTA evaluations, were conducted by a certified audiologist with over 10 years of experience in audiological testing. The same audiologist performed all assessments to eliminate inter-observer variability and ensure consistency.

2.5. Pure-Tone Audiometry

PTA was performed using an Interacoustics AC40 Clinical Audiometer (Denmark). The machine was calibrated in December 2022 following the ISO 8253-1:2010 audiometric calibration standards. All PTA tests were conducted in a dedicated soundproof room within the Audiology Unit of the Military General Hospital to ensure accurate and reliable measurements.

2.6. Intervention

2.6.1. Preparation Technique

PRP was prepared by collecting 10 mL of venous blood from each participant into M-LAB PRP tubes containing anticoagulants. PRP was prepared using a T-LAB Centrifuge S-106 (Diaqual LTD) following a single-spin protocol at 830G (RCF) at approximately 2300 RPM for 10 min. This process separates platelet-poor plasma (PPP) (top layer), platelet-rich plasma (PRP) (middle layer, 4-5 mL extracted for use), and red blood cells (RBCs) (bottom layer).

2.6.2. Intratympanic PRP Instillation

The intratympanic PRP instillation procedure was performed after confirming the integrity of the external and tympanic membranes using a Karl Storz oto-endoscope (0-degree angle, 4 mm diameter). All PRP injections were performed unilaterally to ensure precise treatment

administration and evaluate localized treatment effects. Local anesthesia was administered by placing a cotton sponge soaked in 10% lidocaine solution (Xylocaine 10 mg/dose) on the tympanic membrane for 10 min. After removing the sponge and cleaning any remaining fluid from the external canal, the patients were placed supine with their heads tilted 45^0 to the healthy side. A 26-gauge spinal needle was then introduced into the posterior inferior tympanic membrane and 0.5-0.7 mL of intratympanic PRP, activated with calcium chloride, was instilled into the middle ear. Patients were instructed to minimize swallowing as much as possible for 30 min after injection to optimize PRP retention in the middle ear. Although complete avoidance is impractical, this recommendation is based on existing otological practices to prevent the displacement of the injected material. PRP injection was repeated for five consecutive sessions with a 3-week interval between sessions. Pure-tone audiometry was performed at the initial visit (pretreatment) and before each subsequent treatment session. Final hearing levels were defined as the audiometric thresholds measured three weeks and three months after the fifth PRP instillation session.

2.7. Follow-Up

Post-treatment follow-up involved subjective evaluation of hearing improvement based on patient-reported outcome measures and any reported adverse events related to the intervention. Follow-up was continued for 3 months after the last injection.

2.8. Outcome Measures

The primary outcome measures included the change in hearing thresholds evaluated by pure-tone audiometry (PTA) across four frequencies (0.5, 1, 2, and 4 kHz), and the degree of hearing improvement was categorized according to the modified Segel criteria [18, 19]. The secondary outcome measures focused on identifying predictors of successful treatment and the adverse effects of PRP. We clarified that the outcomes were analyzed separately for unilateral and bilateral cases, and no significant differences were observed.

2.9. Data Analysis

Data were analyzed using IBM SPSS Statistics (v.26). Continuous variables are summarized as mean ± standard deviation (SDs), while categorical variables are expressed as frequencies and percentages. Repeated measures ANOVA was used to compare pre- and post-treatment pure-tone audiometry (PTA) thresholds across four frequencies (0.5, 1, 2, and 4 kHz), with effect sizes (η^2) interpreted as small (0.01), moderate (0.06), or large ($\geq$ 0.14). Chi-square (χ^2) tests were used to assess associations between hearing outcome categories, with degrees of freedom (df) calculated as $(rows-1)(columns-1)$. The exact p-values were reported, and Fisher's exact test was used when the expected cell count was < 5. Adjusted residuals > $\pm$1.96 indicated statistically significant shifts in hearing thresholds. A two-tailed p$-$value < 0.05 was considered significant, and statistical assumptions were verified before analysis.

2.10. Ethical Considerations

Ethical approval was obtained from the Ethics Committee of the Military General Hospital, which ensured that the study was conducted in an ethically responsible manner. Written informed consent was obtained from all the adult participants. For minor participants (under 18 years of age), written informed consent was obtained from minors and their parents or legal guardians. This process ensured that both the child's and the guardian's agreements were documented before participation. The consent forms provided comprehensive information regarding the study objectives, procedures, potential risks, and benefits, presented in an age-appropriate language. Participants' autonomy and rights to privacy and confidentiality were respected throughout the study. This study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

3. RESULTS

3.1. Demographic and Clinical Characteristics

The study included 120 patients diagnosed with SNHL, comprising 36 women (30%) and 84 men (70%), with a mean age of 29.72 ± 11.85 years. The age distribution showed that the highest percentage of patients (29.2%) was between 21 and 30 years, and the lowest percentage (5%) was between 51 and 60 years. The distribution of hearing loss types showed that 53.3% and 46.7% of patients had unilateral and bilateral hearing loss, respectively. Regarding the duration of hearing loss, 28.3% of the patients experienced hearing loss for less than 6 months, 21.7% for 6-12 months, and 50% for more than 12 months. The etiology of SNHL varies among patients. Noise-induced hearing loss is the most common cause, followed by sudden, gradual, mumps-related, traumatic, and congenital hearing loss (Table (1)).

3.2. Audiometric Outcomes of Pre- and Post-PRP Treatment

A significant improvement in the hearing threshold was observed after intratympanic PRP treatment in patients with SNHL. The mean PTA decreased from 48.27 ±

Table 1. Demographic and Clinical Characteristics of the Study Participants (n = 120)

Variables	No. of patients	%
Age		
Mean ± SD	29.72 ± 11.85	
Median (IQR)	27 (12–60)	
Age by group		
11–20 years	33	27.5
21–30 years	35	29.2
31–40 years	29	24.2
41–50 years	17	14.2
51–60 years	6	5.0
Gender		
Male	84	70
Female	36	30
Laterality of hearing loss		
Unilateral hearing loss	64	53.3
Bilateral hearing loss	56	46.7
Duration of hearing loss		
<6 months	34	28.3
6–12 months	26	21.7
>12 months	60	50
Etiology of SNHL		
Noise-induced	43	35.8
Sudden	36	30.0
Gradual	34	28.3
Mumps	4	3.3
Traumatic	2	1.7
Congenital	1	0.8

17.77 dB HL to 31.56 ± 20.45 dB HL ($p < 0.0001$). Repeated measures ANOVA confirmed a significant effect of time ($F(1, 119) = 462.499$, $p < 0.0001$, $\eta^2 = 0.795$). Chi-square analysis showed a significant association between pre- and post-treatment hearing categories, χ^2 (9, N=120) = 197.684, $p < 0.0001$, with 100% of patients in the pretreatment 26-45 dB group improving to 25 dB post-treatment (Table (2)).

Abbreviations: dB, Decibels, HL: Hearing Level; η^2, Eta Squared (effect size); F, F-value (ANOVA); χ^2, Chi-Square, PRP: Platelet-Rich Plasma, N: Number of cases

3.3. Hearing Improvement Outcomes

According to the modified Siegel criteria, 106 of 120 patients (88.3%) experienced hearing improvement after intratympanic PRP instillation. Among the different pre-treatment hearing grades, grade 2 (26-45 dB) demonstrated the highest improvement rate, with 100% of the cases achieving complete or partial recovery. Grade 3 (46-75 dB) showed an even higher improvement rate (89.2%), whereas grade 4 (76-90 dB) showed minimal improvement at 50%. Unfortunately, grade 5 (> 90 dB) did not improve, and all cases were classified as non-serviceable (Table (3)).

3.4. Factors Associated with Treatment Outcomes

Younger patients, particularly those aged 12-20 and 21-30, demonstrated the highest improvement rates, although age ($p = 0.903$) and sex ($p = 0.903$) were not significantly associated with treatment outcomes. The etiology of hearing loss was significantly associated with treatment success ($p = 0.002$), with noise-induced and sudden hearing loss showing the most favorable responses. The duration of hearing loss did not significantly affect the effectiveness of PRP treatment ($p = 0.220$), although a trend toward shorter durations (< 6 months) was associated with better improvement rates (Table (4)). The laterality of hearing loss (unilateral or bilateral) was not significantly associated with treatment outcomes (χ^2 (8) = 10.718, $p = 0.218$).

3.5. Adverse Effects of PRP Treatment

During the study, a few patients experienced adverse effects related to the intratympanic PRP therapy. Specifically, 4 patients (3.3%) experienced a transient increase in tinnitus following the initial PRP injection, but this was resolved by the time of the second injection. Additionally, 10 patients (8.3%) reported transient vertigo during the PRP injection (Table (5)).

4. DISCUSSION

Our study employed a prospective cohort design to evaluate the efficacy and safety of intratympanic PRP injections for the treatment of sensorineural hearing loss (SNHL) in Yemen. We found significant hearing threshold improvements, particularly in patients with noise-induced and sudden hearing loss and those with moderate pre-treatment hearing levels (26-45 dB). The study included 120 patients diagnosed with SNHL, comprising 36 women (30%) and 84 men (70%), with a mean age of 29.72 ± 11.85 years. The highest percentage of patients (29.2%) was aged 21–30 years, while the lowest percentage (5%) was aged 51-60 years. This demographic distribution is significant because it reflects the population that is most affected by SNHL in the study setting. The predominance of younger patients in our study cohort is consistent with the findings from other studies that have highlighted a higher prevalence of SNHL among younger age groups [9, 20, 21]. Regarding clinical characteristics, 53.3% of the patients had unilateral hearing loss, and 46.7% had bilateral hearing loss. The duration of hearing loss varied, with 28.3% of patients experiencing hearing loss for less than 6 months, 21.7% for 6-12 months, and 50% for more than 12 months. These findings emphasize the chronic nature of hearing loss in many patients and highlight the need for effective and timely intervention. Similarly, previous studies have noted the chronicity of hearing loss and the necessity for prompt treatment to prevent further deterioration [22]. Our study revealed a higher prevalence of noise-induced and sudden hearing loss, which may reflect specific environmental or occupa-

Table 2. Audiometric Results and Statistical Analysis of Hearing Improvement after Intratympanic PRP Treatment in Patients with SNHL

Measurement	Mean ± SD	Statistical Test	Value	p-value	Effect Size
Pre-treatment hearing level	48.27 ± 17.77 dB HL	Repeated measures ANOVA	F = 462.499	< .0001	.795
Post-treatment hearing level	31.56 ± 20.45 dB HL	Chi-square test (pre vs post)	χ^2 = 197.684	$< .0001^*$	–
Hearing improvement	16.7 $\pm$ 8.51 dB HL	–	–	–	–

Note: * P-value = chi-squared test; F: significant F-value = ANOVA test.
Abbreviations: dB, Decibels, HL: Hearing Level; η^2, Eta Squared (effect size); F, F-value (ANOVA)
χ^2, Chi-Square, PRP: Platelet-Rich Plasma, N: Number of cases

Table 3. Pre-treatment Hearing Grades and Post-treatment Hearing Recovery Outcomes Based on Modified Siegel Criteria.

Pre-treatment hearing grades	CR	PR	SI	NI	NS	Hearing improvement
						(CR+PR+SI)/subtotal
Grade 2 (26–45 dB)	67	5	0	0	0	72/72 (100%)
Grade 3 (46–75 dB)	15	18	0	4	0	33/37 (89.2%)
Grade 4 (76–90 dB)	0	0	1	1	0	1/2 (50%)
Grade 5 (>90 dB)	0	0	0	0	9	0/9 (0%)
Total	82	23	1	5	9	106/120 (88.3%)

CR: Complete Recovery, PR: Partial Recovery, SI: Slight Improvement, NI: No Improvement, NS: Non-serviceable Ear.

Table 4. Treatment Responses according to Demographic Variables.

Category	CR	PR	SR	NI	NS	Total	P-value
Age Group							0.903
11–20	21 (64%)	5 (15%)	0 (0%)	1 (3%)	6 (18%)	33	
21–30	23 (66%)	9 (26%)	0 (0%)	3 (9%)	0 (0%)	35	
31–40	24 (83%)	4 (14%)	1 (3%)	0 (0%)	0 (0%)	29	
41–50	11 (65%)	3 (18%)	0 (0%)	1 (6%)	2 (12%)	17	
51–60	3 (50%)	2 (33%)	0 (0%)	0 (0%)	1 (17%)	6	
Gender							0.903
Female	26 (72%)	7 (19%)	0 (0%)	1 (3%)	2 (6%)	36	
Male	56 (67%)	16 (19%)	1 (1%)	4 (5%)	7 (8%)	84	
Etiology							0.002^*
Noise Induced	32 (74%)	9 (21%)	0 (0%)	2 (5%)	0 (0%)	43	
Congenital	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	1	
Mumps	0 (0%)	2 (50%)	0 (0%)	0 (0%)	2 (50%)	4	
Sudden	28 (78%)	5 (14%)	1 (3%)	2 (6%)	0 (0%)	36	
Gradual	20 (59%)	7 (21%)	0 (0%)	1 (3%)	6 (18%)	34	
Traumatic	2 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2	
Duration							0.220
< 6 months	21 (62%)	11 (32%)	0 (0%)	1 (3%)	1 (3%)	34	
6–12 months	21 (81%)	2 (8%)	0 (0%)	2 (8%)	1 (4%)	26	
> 12 months	40 (67%)	10 (17%)	1 (2%)	2 (3%)	7 (12%)	60	

Note: * p-value = 0.05 (chi-square test < 0.05)
CR: Complete Recovery, PR: Partial Recovery, SI: Slight Improvement, NI: No Improvement, NS: Non-serviceable Ear

Table 5. Frequency of adverse effects of PRP.

Adverse Effect	Frequency (%)
Transient increase in tinnitus	4 (3.3%)
Transient vertigo during injection	10 (8.3%)

tional factors prevalent in Yemen. Noise-induced hearing loss was the most common etiology in our study, consistent with global observations that noise exposure is a significant risk factor for SNHL [9] . Sudden SNHL, which is often associated with vascular and immune factors, was also highly prevalent in our cohort, which is consistent with studies that emphasize its frequent occurrence and the need for rapid intervention [23]. This distribution shows notable similarities and differences from global trends. Globally, the etiology of SNHL varies significantly, with genetic factors accounting for 28-39.3% of cases, whereas acquired causes (e.g., prenatal complications, perinatal factors, infections, and ototoxic exposure) contribute to 29.3%-36% [24, 25]. Interestingly, a substantial proportion of SNHL cases (31.4%-57%) remained idiopathic, reflecting the complex multifactorial nature of the disease [26]. In Yemen, where environmental factors such as consanguinity and untreated infections are prevalent, the proportion of idiopathic cases may be lower than global statistics. Further epidemiological studies are warranted to better characterize the regional distribution of SNHL. The lower prevalence of congenital and genetic factors in our study could be due to under-

diagnosis or limited access to genetic testing and prenatal care in Yemen, as noted in previous global studies [27, 28]. These findings highlight the importance of considering regional environmental and healthcare factors when addressing the etiology of SNHL and underscore the need for tailored intervention strategies in different settings. The current study demonstrated a significant improvement in hearing thresholds following intratympanic PRP injection in patients with SNHL. The mean PTA hearing thresholds improved from 48.27 $\pm$ 17.77 dB HL pre-treatment to 31.56 $\pm$ 20.45 dB HL post-treatment with a significant effect size (η^2 = 0.795). These results are consistent with those of previous studies by Tyagi (2021) and Kanaujia et al. (2023), who reported substantial hearing improvements following PRP treatment [9, 10]. Tom et al. (2022) also found that PRP treatment yielded better results than steroid therapy, underscoring PRP's superior efficacy of PRP in enhancing hearing outcomes [11]. This finding supports a growing body of evidence that PRP is a promising treatment modality for SNHL and could provide a cost-effective and accessible treatment option in resource-limited settings such as Yemen. Our analysis showed no significant correlation among age, sex, and treatment success (p = 0.903 for both). While younger patients (11-20 and 21-30 years) exhibited high improvement rates, other factors, such as etiology and baseline hearing thresholds, appeared to be more critical. Wittig et al. (2014) similarly found no sex-based differences in hearing recovery [10]. Although some studies hypothesized hormonal influences on inner ear regeneration [29], our data do not support a gender-based variation in PRP response. Future research with larger cohorts may clarify subtle sex-based differences. The etiology of hearing loss was a significant predictor of treatment success (p = 0.002), with noise-induced and sudden hearing loss showing the most favorable responses. This finding is consistent with that of Kanaujia et al. (2023), who reported that patients with noise-induced hearing loss experienced significant improvement [9]. Furthermore, pre-treatment hearing level is a critical predictor of treatment response. Patients with pretreatment hearing levels of 26-45 dB showed the highest improvement rates, with 100% achieving a final hearing level of $\leq$ 25 dB. In contrast, patients with pretreatment levels of > 90 dB showed no improvement, with all remaining in the > 90 dB category. This finding is consistent with previous studies showing that patients with moderate hearing loss showed a better response to PRP treatment [9, 30]. These findings highlight the importance of early intervention, and suggest that PRP therapy is effective in patients with moderate SNHL. The duration of hearing loss did not significantly affect the effectiveness of PRP treatment (p = 0.220), although patients with a shorter duration of hearing loss (< 6 months) showed better improvement than those with a longer duration. These findings are supported by previous studies, which reported that earlier treatment initiation was associated with better outcomes [9, 22]. These findings suggest that timely intervention is crucial for maximizing the benefits of PRP therapy. PRP treatment for SNHL is generally safe with few reported adverse effects. In our study, 3.3% of the patients experienced a transient increase in tinnitus and 8.3% reported transient vertigo during the injection. These side effects are consistent with several adverse events and complications reported in previous studies. Common side effects include transient dizziness (41.4%) and pain (61.4%) following PRP injection [9]. Other reported complications include vertigo, tinnitus, and persistent eardrum perforation [29, 31]. In rare cases, more severe reactions such as serum sickness have been observed, particularly in patients with autoimmune conditions [32]. The injection site on the tympanic membrane may influence the likelihood of certain complications, with posterior quadrant injections being more likely to induce vertigo [31]. Despite these potential complications, PRP treatment is generally considered safe when properly administered [33, 34]. This is particularly relevant in the context of Yemen, where healthcare resources are limited, and safety is a critical concern. The therapeutic benefits of PRP are attributed to its rich composition of growth factors and cytokines, which promote cellular proliferation, vascularization, and neurodegeneration. PRP can protect cochlear hair cells and enhance the survival and growth of spiral ganglion neurons [35]. Key growth factors in PRP, such as PDGF, TGF-β1, IGF-1, and FGF, play crucial roles in cellular regeneration and repair, underpinning PRP's effectiveness in treating SNHL [8, 36].

The significant improvement in hearing thresholds observed in our study highlights the potential of PRP as an effective treatment for SNHL, particularly in resource-limited settings such as Yemen. Its favorable safety profile and minimal adverse effects further support its clinical application. These findings suggest that PRP could be a valuable alternative or adjunct to traditional treatments such as steroids, particularly for patients who do not respond well to conventional therapies or have contraindications. Our study underscores the importance of early intervention to maximize treatment outcomes. Patients with a shorter hearing loss duration showed better improvement rates, emphasizing the need for prompt diagnosis and treatment initiation. This is crucial in regions such as Yemen, where healthcare access delays are common due to ongoing conflicts and economic instability. Although our findings suggest the potential of PRP in the treatment of SNHL, several limitations should be considered when interpreting the results. First, the single-center design may introduce a selection bias, and future multicenter studies may offer more generalizable data. Second, the 3-month follow-up period was insufficient to assess the long-term durability and safety profile of PRP, necessitating future research with extended ob-

servation periods. Third, the absence of a control group (e.g., placebo or standard treatment arm) makes it difficult to definitively attribute the observed improvements solely to the PRP intervention. Although ethical and logistical constraints prevented controlled comparisons in our resource-limited setting, future studies should prioritize controlled designs, whenever feasible. Finally, although we used commercially available kits to minimize variability, subtle differences in PRP preparation methods across facilities could have influenced patient outcomes. Therefore, standardized PRP preparation protocols are crucial to ensure consistent results and to facilitate comparisons among studies.

5. CONCLUSION

This study confirms that intratympanic PRP injection is an effective and safe treatment for improving hearing thresholds in patients with SNHL. These findings highlight the importance of early intervention and standardized protocols to optimize treatment outcomes. Further studies with larger sample sizes, multicenter designs, and longer follow-up periods are needed to establish the long-term efficacy and safety of PRP therapy in patients with SNHL. Given the limited access to advanced medical treatments in Yemen, PRP is a promising, cost-effective, and accessible option for managing SNHL, with the potential to significantly improve the quality of life of affected individuals.

DISCLOSURE

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DATA SHARING STATEMENT

The data supporting the findings of this study are available from the corresponding author (HMJ) upon reasonable request.

CONFLICTS OF INTEREST

All authors completed the ICMJE uniform disclosure form. The authors declare that they have no conflicts of interest.

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ETHICAL STATEMENT:

Ethical approval was obtained from the Ethics Committee of the Military General Hospital, ensuring that the study was conducted in an ethically responsible manner. Written informed consent was obtained from all adult participants (18 years and older). For minor participants (under 18 years of age), written informed consent was obtained from minors and their parents or legal guardians. This process ensured that both the child's and guardian's agreements were documented before participation. The consent forms provided comprehensive information regarding the study objectives, procedures, potential risks, and benefits presented in age-appropriate language. The participants' autonomy and rights to privacy and confidentiality were respected throughout the study. The study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

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