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Research Article

Treatment of Sensorineural Hearing Loss in Children: Platelet Rich Plasma

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Abstract

Introduction: Hearing loss is one of the common disabilities in India. The prevalence of this disability is higher in children. The children with sensorineural hearing loss is very common which requires the safe, clinically effective and cost effective method of treatment.

Methods: The platelet rich plasma (PRP) was instilled in 24 children od age less than 10 years and the hearing improvement was assessed by the audiogram through BERA or PTA.

Results: It was found that 87% patients had bilateral impairment, and maximum patients were with moderate hearing impairment. The rate of improvement was found to be 99% except one patient who had no improvement in the left ear post PRP.

Conclusion: In our study, the patients with moderate to profound sensorineural hearing loss were found to have improved hearing levels after treatment with PRP which directly enhanced their speech discrimination levels. Further studies with bigger sample size are needed to establish this method as new doorway for improving the childhood hearing.

Keywords: Sensorineural Hearing Loss; PRP; Children with Hearing Loss; BERA

Introduction

Deafness or the hearing loss can be partial or total. The WHO definition of "deafness" refers to the complete loss of hearing ability in one or two ears. The cases include in this category will be those having hearing loss more than 90 dB in better ear (profound impairment) or total loss of hearing in both the ears. The WHO definition of "hearing impairment" refers to both complete and partial loss of ability to hear. In India, "hearing handicapped" as defined by the Rehabilitation Council of India Act., 1992, is – hearing impairment of70 dB and above, in better ear or total loss of hearing in both ears. This law is applicable to only those persons with severe hearing impairment whose hearing loss is 70 dB and above [1-3].

In India, deafness is the most common disability accounting or more than 6.3 million sufferers. It has been estimated that four in every 1000 children suffer from severe to profound hearing loss. Around 100,000 babies are in-born with this disability. The estimated childhood onset deafness was found to be 2-4% [2,3].

Children with hearing loss cannot develop the speech and language abilities due to which affects their quality of life. The condition of these children gets worse in rural areas due to unavailability of medical facilities. Indian government has taken an initiative in this direction but the efforts are yet to provide the positive impact [3,4]. The level of hearing impairment is assessed usually with PTA but in case of patients noncooperative to PTA another procedure called BERA is used [5-7].

Sensorineural hearing loss occurs due to obstructed transmission of stimuli after cochlea which may include air cells dysfunc-

tion or the eighth nerve itself. These patients perceive the sounds diminished and distorted [8].

The common symptoms of SNHL are plugged feeling or fullness of ear, tinnitus, vertigo, and hearing loss. The available pharmacological treatments options like antioxidant vitamins, coenzyme Q10 options are not curative but palliative only. Cochlear implants are helpful in the children below three years of age. And this technique is not cost effective in a country like ours [9].

Platelet rich plasma instillation therapy not only addresses the underlying cause bit is also cost effective. Platelets play an important role in stopping the bleeding, healing and enhancing the cell growth through the growth factors and bioactive substances present in them. This amazing property of platelets has been utilized for treatment of olfactory dysfunctions, skin diseases, alopecia and in sensorineural hearing loss improvement [10]. Platelet rich plasma, also called autologous conditioned plasma, is the form of blood plasma, derived from whole blood, that has been enriched with platelets and growth factors [11]. Alpha granules and the dense granules contribute to the mechanism of action of platelet rich plasma. Alpha granules refers to the cluster of 7 growth factors which include; insulin like growth factors IGF-1 and IGF-2, platelet-derived growth factors (PDG Faa, PDG Fbb and PDG Fab), transforming growth factor beta (isoforms TGFβ1 and 2); epithelial growth factor (EGF), and vascular endothelial growth factor (VEGF). Cell proliferation, cellular migration, differentiation angiogenesis and chemotaxis are the processes modulated by alpha granules. Dense granules basically contain bioactive agents (serotonin, histamine, dopamine, calcium and adenosine) which enhance the membrane permeability and modulate the inflammatory processes. Pre-packaged growth factors are released from these degranulated organelles. Due to short half-lives of these degranulated organelles, PRP need to be activated at or just before the application. This higher concentration of platelets followed by greater release of growth factors post initiation stimulates the cell proliferation and differentiation leading to the tissue regeneration [11,12]. Insulin-like growth factor 1 (IGF-1) is a single-chain, 70-amino-acid polypeptide, similar in structure to pro-insulin, and is highly conserved across species. IGF-1 plays a significant role in neuronal development, recovery from neuronal injury, neuronal survival, and neurite outgrowth following crush injury. It likely contributes to improved nerve regeneration [16-18], including proliferation, mobilization, myelination, and schwan cell–axon interaction. IGFs also stimulated neurite outgrowth from immature sympathetic neurons. IGF-I and IGF-II mRNA was found to be expressed in E7 sympathetic ganglia during the period of neurogenesis. IGF-I was detectable in fibroblasts, whereas IGF-II mRNA was expressed by neurons, glia, and fibroblasts.

There is a need for the evaluation of technique of PRP in the treatment of SNHL.

This study was conducted to assess the PRP for the treatment of the SNHL in the children below the age of 10 years.

Methods

This study was conducted in a private clinical setting for a duration of one year. High risk neonates and children with delayed speech as well as language development were included in the study. The hearing loss and the degree of impairment was detected in the patients with Pure tone audiometry (PTA) and Brain evoked response audiometry (BERA). Pure tone audiometry was used for the patients who were cooperative to it. While BERA was used for those who were uncooperative for PTA. Brain evoked response audiometry was done, in the dust free, sound-proof, air-conditioned room, 15 min after giving the feed. Half an hour before the beginning of BERA, triclofos syrup (20mg/kg) was given to sedate the patients. The altered polarity with click sounds and stimulus of 11/s or 21/s was used. In the procedure, 110dB sound pressure level was used as the threshold stimulus that was decreased gradually till the V wave was just identifiable with satisfactory morphology. Air conditioned BERA wave was used. Absence of waves at 120dB SPL was considered as absence of BERA waves. The hearing sensitivity was assessed based of following [5].

Based on initial audiogram 24 patients with sensorineural hearing loss (SNHL) and mixed hearing loss were selected.

Followed by this the PRP instillation was conducted. The time to draw the blood influences the clotting process. The whole blood sample was withdrawn with the large bore needle (>22) by venipuncture method. This sample was taken in the tube with the acid

Hearing threshold	Sound pressure levels
Normal hearing sensitivity	≤25 dB
Mild hearing impairment	30-45 dB
Moderate hearing impairment	50-65 dB
Severe hearing impairment	70-85 dB
Profound hearing impairment	90 dB and above

Table 1: Hearing thresholds.

dextrose so as to prevent the early activation of the platelets. Then it was subjected to centrifugation using a soft spin at a temperature of 21°C-24°C.The supernatant plasma containing platelets was transferred into another sterile tube (without anticoagulant). This tube was centrifuged at a higher speed (a hard spin) to obtain the platelet concentrate. The lower one-third was PRP and upper two-third was platelet-poor-plasma (PPP). This PPP was removed and the platelet pellets formed at the bottom of the tube were suspended in the minimum quantity of plasma (2-4mL) by gentle shaking.

Just before the injection PRP was activated exogenously by any of these; thrombin or calcium chloride or mechanical trauma. The patients received 3 injections per affected ear. Injection PRP was injected intratympanic in round window niche. S can be monitored with audiogram results each time patient reviewed. After injection patient was kept on antibiotics, antihistamines, and antacids and analgesics sos for a duration of five days. Injections were repeated every three weeks with audiogram and compared with the previous audiogram. Dextrone was used as the control in the study as it has been an established standard treatment [13].

The samples were assessed based on age, laterality of hearing loss (bilateral or unilateral), and type of hearing loss (conductive or sensorineural).

Results

In the present study, 24 children (age <10 years), with delayed speech and language development, were enrolled in the study. Bilateral impairment was found among 87.5% patients (Table 2). The average age was 4 ± 2.99 years.

Each of the moderate and severe impairment was found in both the ears in seven patients. Profound impairment was reported in both the ears of one patient and in left ear of one patient. Profound hearing impairment was found in right ears of three patients (Table 3).

Hearing loss	n (percentage)
Bilateral	21 (87.5%)
Unilateral	3 (12.50%)

Table 2: Percentage of patients with Bilateral and Unilateral hearing loss.

Ear with impairment	V Wave		
	< 70 dB	70-90 dB	90-120 dB
Both	7	7	1
Left	3	5	1
Right	4	0	3

Table 3: Patient distribution across different ranges of V Wave.

An average improvement of 29 ± 15.49 dB was observed post PRP for both the ears with same hearing impairment. The left ear has with initial average hearing impairment of 70 ± 17.32 dB was found to have the improvement of 25.55 ± 15.70 dB (Table 4).

Ear with impairment	Initial PRP/ BERA (dB) (mean ± SD)	PTA/BERA post PRP (dB) (mean ± SD)	Improvement post PRP (dB) (mean ± SD)*
Both	94.76 ± 17.42	63 ± 17.7	29 ± 15.49
Left	70 ± 17.32	66.67 ± 19.52	25.55 ± 15.70
Right	56.66 ± 41.63	68.57 ± 20.35	28.57 ± 20.35

Table 4: Improvement post PRP.

*it is the average of individual improvement recorded.

Discussion

Speech and language acquisition occur during first three years of life and auditory deprivation interferes with the neural structures which are responsible for hearing. If it is left undected, it negatively affects the speech and language acquisition, academics achievements as well as the social and emotional development. These can be decreased or even prevented through early intervention. The incidence of hearing impairment in children as reported in different studies varies from 1-40%. The technique of BERA is used for assessing the hearing impairment because it is rapid, easy, results not influenced by anesthetics and sedatives, cost-effective, and gives electrophysiological response of hearing without assessing the newborn behavior [14].

In the present study, 70% (n = 17) patients were below the age of five years. of these 17 patients, 6 were below the age of two years.in the study by Thakkar (2018) 80% of patients werein the age group of 0–5 yearsand20% aged 6 to 18 years [5].

In our study more maximum number of patients were found to have bilateral hearing impairment. Sudharahan Raj. C and Venkat Reddy. S (2016) conducted study on neonates and concluded that bilateral hearing impairment was more common than unilateral [14]. On initial examination it was found that maximum patients had moderate hearing loss which contributed to the delayed speech and language development. Thakkar (2018) reported that 40% of patients with decreased hearing showed profound hearing loss, 40% showed severe hearing loss, and 20% showed mild-to-moderate hearing loss [5].

Some patients were observed to have equal hearing impairment in both the ears while others had different levels of impairment in each of the ears. Maximum number of patents were found to have moderate hearing impairment. None of the patient was found to have severe hearing impairment in right ear whereas one patient was reported to have profound hearing impairment in left ear.

After instillation of PRP, an average improvement of 29 ± 15.49 dB was found in the patients with hearing impairment in both the ears. In patients with more impairment in left ear were reported to have an improvement of 25.55 ± 15.70 dB while this improvement for right ear impairment was recorded as 28.57 ± 20.35 dB. This enhancement in the hearing level lead to the improvement in the speech discrimination level. In our study the overall hearing improvement rate was 99% as only one patient was found to have no improvement in the hearing level after instillation of PRP. Yi Qian., *et al*. in the study of 75 children with SNHL, reported the overall recovery rate of 70% while using intratympanic methylprednisolone and compound betamethasone injected post auricularly [15].

Conclusion

In our study, the patients with moderate to profound sensorineural hearing loss were found to have improved hearing levels after treatment with PRP which directly enhanced their speech discrimination levels. Further studies with bigger sample size are needed to establish this method as new doorway for improving the childhood hearing.

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