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RADIOLOGICAL EVALUATION OF PEDIATRIC SENSORINEURAL HEARING LOSS AT A TERTIARY CARE CENTER IN CENTRAL INDIA

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ABSTRACT

Objective: Hearing dysfunction is the most common sensory deficit in children. If hearing is lost, especially in children's, it may have a huge impact on life, interfering with the acquisition of spoken language and social development. It is therefore important to detect any abnormalities at an early age. Patients with complaint of inability to hear since birth attending ENT OPD, M.Y.H Hospital, Indore and patients referred to M.Y.H hospital from district hospitals with inability to hear since birth were evaluated clinically and audiometry was done. Patients with SNHL fulfilling the inclusion criteria were considered and their radiological evaluation was done. High resolution computed tomography scan (HRCT) of temporal bone were used in radiological evaluation of patients with congenital sensorineural. **SUBJECTS AND METHODS:** The study was conducted at a tertiary care centre Maharaja Yashwantrao Holkar (MYH) hospital and Mahatma Gandhi Memorial Medical College (MGMMC), Indore in the Department of otorhinolaryngology and head & neck surgery. Cases with hearing loss from 1 to 16 years of age were selected. A detailed medical history with primary focus on inability to hear was obtained with emphasis on previous hospital stays, developmental delay, maternal history, family history. Complete ENT examination was done. **Results:** Our study included a total 30 children. All children were between 1-16 years of age with sensorineural hearing loss. Majority 11(36.67%) of the participated in the study were between 5-8 years of age. Cochlear anomaly was found in 03(10%) patients. Cochlea was found normal in 27(90%) on both the ears, 03(10%) child had hypoplastic cochlea bilaterally, none were with aplastic cochlea. Vestibular anomaly was seen normal in 28(93.33%) patients on bilateral side. 02(6.67%) patients were present with dysplastic vestibule. SSC was found dysplastic/malformed in 04(13.33%) patients who had dysplastic/malformed semicircular canal. **Conclusion:** The selection of candidates for hearing aid trials and cochlear implantation requires consideration of a variety of clinical, audiological and radiological factors. Imaging is a fundamental part of the preoperative workup, it provides the surgeon with details which will lead him to a successful cochlear implantation with no or minimal complications. HRCT temporal bone provided us the information about the presence of various inner ear malformations including cochlea, vestibule, SCC, IAC. Mastoid, pneumatization, variations in vascular anatomy which included forward lying sigmoid sinus and high riding jugular bulb. All these findings are important for a detection of cause of SNHL in patients.

INTRODUCTION

Hearing dysfunction is the most common sensory deficit in children. It may have a huge impact on life, interfering with the acquisition of spoken language and social development. It is therefore important to detect any abnormalities at an early age. There has been no consensus on a specific diagnostic protocol for children presenting with sensorineural hearing loss (SNHL). This because of the differential diagnosis for SNHL in children is very broad.

The prevalence of Sensorineural hearing loss (SNHL) is 2-3 per 1000 live birth in India[1,2]. Cochleo-vestibular anomalies are common amongst pediatric cochlear implant candidates because they often correlate with severe to profound Sensorineural hearing loss. Sensory hearing impairment cannot be surgically improved but can be helped with conventional acoustic hearing aids but in a profoundly deaf child, acoustic amplification will not give significant benefits.

The purpose of this study is to evaluate the many types of bony inner ear Malformations by using high resolution CT and discuss its role in the evaluation of children with SNHL. High resolution computed tomography (HRCT) is highly efficient in demonstrating the anatomy and abnormalities of the temporal bone and inner Ear.[3]

Sensorineural hearing loss (SNHL) is a malfunction of the inner ear or a retro Cochlear condition involving cochleovestibular nerve or that involves the Central auditory pathway[4]. Cases with bilateral congenital sensorineural Hearing loss (SNHL) can suffer long term consequences because they fail to develop language skills.

Radiology of the temporal bone was not routinely done in prelingually deaf children, but it is now common practice to obtain imaging evaluation of the temporal bone as soon as patient is diagnosed with severe to profound SNHL. It may

influence the counseling of the parents regarding the cause of Hearing loss. Early detection by radiological imaging prevent delay in identification of hearing Impairment that can adversely affect speech and language development, academic achievements, and social and emotional development of children. In the present study, we review the relevant radiological imaging methods, normal anatomical findings, congenital anomalies, a brief note on the cochlear Implantation devices, review the major imaging findings associated with Congenital SNHL and to evaluate the child for hearing aid trial, cochlear Implantation and auditory brain stem implants.

METHODS

Type Of Study: Prospective and retrospective observational study.

Sample: Minimum 30 patients

Duration And Place Of Study: The study was done from March 2022 to Febuary 2023 in the Department of ENT, Maharaja Yashwantrao Holkar Hospital, Indore, India.

Inclusion Criteria

- Patient's attenders giving consents for radiological exposure and audiological investigations
- Age group 1- 16 years.
- Cases with sensorineural hearing loss.

Exclusion Criteria

- Patient's attenders not giving consent for radiological exposure and audiological investigations.
- Any cause of conductive hearing loss.
- Active Middle ear pathology/ diseases.
- Age below 1yrs and above 16 yrs.
- Children with developmental delay

RESULTS

Our study included a total 30 children. All children were between 1-16 years of age with sensorineural hearing loss. Among the study patients, majority 11(36.67%) patients were in 5-8 years age group, followed by 09(30%) patients in 1-4 years of age group ,07 (23.33%) in 9 to 12 years, 03 (10%) in 13-16 years of age group and no patient was below 1 and above 16year age. Majority 11(36.67%) of the participated in the study were between 5-8 years of age.

Cochlear anomaly was found in 03(10%) patients. Cochlea was found normal in 27(90%) on both the ears, 03(10%) child had hypoplastic cochlea bilaterally, none were with aplastic cochlea.

Vestibular anomaly was seen normal in 28(93.33%) patients on bilateral side. 02(6.67%) patients were present with dysplastic vestibule.

SSC was found dysplastic/malformed in 04(13.33%) patients who had dysplastic/malformed semicircular canal.

DISCUSSION

The present study entitled "RADIOLOGICAL EVALUATION OF PEDIATRIC SENSORINEURAL HEARING LOSS AT A TERTIARY CARE CENTER IN CENTRAL INDIA" was conducted on 30 children satisfying the inclusion criteria, all patients had sensorineral hearing loss and mild to severe deafness in BERA & OAE with no developmental delay or mental retardation, some was benefitted from hearing aid and some parients were candidate for cochlear implant surgery. Radiological evaluation using HRCT Temporal bone imaging was done.

In our study, we included patients with the age between 1 ton16 years, among the participants, majority 11(36.67%) children were in 5-8 years age group with male preponderance, on correlating to a study by Gupta A. et al[5] 2018 who reported maximum patients (36%) in age group of 2-4 years.

Cochlear anomaly was found in 3(10%) patients. Cochlea was found normal in 27(90%) children on right side and in 27(90%) on left side, none of the child had an aplastic cochlea, 03(10%) child had hypoplastic cochlea bilaterally. Harnsberger et al[6] found CT of the middle and inner ear normal in 24 patients (57.1%) and cochlear anomalies were present in 2 patients. Similarly Gupta A.et al 2018[5] observed abnormal cochlea in CT scan in 4% cases in bilateral ears. In one case (2%) enlarged cochlea was observed in bilateral cars and in one case (2%) fusion of middle and apical turns cochlea (Mondini Deformity) was observed in bilateral ears. Casselman et al[7] found cochlear aplasia in 3% of their patients which is similar to our study in which we reported 3.33% patient with cochlear aplasia.

02(6.67%) children had vestibular abnormalities on right side and 02(6.67%) children on left side which were associated with other congenital malformations. SCC was found dysplastic or malformed in 08 inner ears. 04(13.33%) patients had bilateral SCC dysplasia. Gupta A. et al[8] found that out of total 50 patients evaluated by CT scan and MRI, vestibular abnormality was reported in 16.05% on right side and 18.31% on left side. Abnormal semicircular canals in CT scan were observed in 8% cases in right ear and 10% cases in left ear. Most commonly observed abnormality of semicircular canal in CT scan was dysplasia (4% in bilateral ears) and enlarged semicircular canal (4%) in bilateral ears. Young et al[8] highlights that although the risk for CSF leakage increases when inner-ear malformations are present, isolated anomalies of the vestibule or semicircular canal typically do not affect surgical planning Their importance lies predominantly in the associated cochlear or syndromic abnormalities.

CONCLUSION

In the evaluation of children with unexplained SNHL, routine laboratory evaluation should be considered given its low diagnostic yield. Clinical suspicion should lead to specific testing. The radiologic abnormalities of the inner ear are common and contribute significantly to the identification of the etiology of SNHL in childhood.

Identification of inner ear malformations has direct impact on management of these children, suggesting that children should undergo radiologic imaging as an integral component of evaluation of SNHL. Cochlear implant is a surgically implanted device which restores hearing in patients with severe to profound SNHL, but all patients with severe to profound SNHL are not the candidates for a successful implantation and a detailed radiologic evaluation is needed before a decision is taken.

We conclude that radiological evaluation is a fundamental component for SNHL in childrens with inability to speak and talk since birth and after birth. Identification of the inner ear abnormality has significant effect on decision making for diagnosis and for hearing aid trial or for prognosis of implantation. HRCT and MRI temporal bone are complementary to each other in evaluating children for SNHL because HRCT is excellent for demonstrating bony details but lags in providing details of inner ear neural structures and fluid. MRI is better than CT in demonstrating vestibulocochlear nerves but it fails to provide information about bony structures. Therefore a dual modality approach should be followed whenever radiological assessment of child for detection of the cause of hearing loss has to be done.

Table 1: Distribution Of Study Participants By Age Group (n=30)

Age Group	Number	Percentage
1-4 years	9	30%
5-8 years	11	36.67%
9-12 years	7	23.33%

13-16 years	3	10%
Total	30	100%

Table 2: Distribution Of Study Participants By Cochlear Pathology (n=30)

Cochlear pathology	Right Number	Percentage	Left Number	Percentage
Normal cochlea	27	90.00%	27	90.00%
Aplastic	00	00%	00	00%
hypoplastic	03	10%	03	10%
Total	30	100%	30	100%

Table 3: Distribution Of Study Participants By Vestibular Pathology (n=30)

Cochlear pathology	Right Number	Percentage	Left Number	Percentage
Normal	28	93.33%	28	93.33%
Dysplastic	02	6.67%	02	6.67%
Dilated	00	00%	00	00%
Total	30	100%	30	100%

Table 4: Distribution Of Study Participants By Semicircular Canal Pathology (n=30)

Cochlear pathology	Right Number	Percentage	Left Number	Percentage
Normal	26	86.67%	26	86.67%
Dysplastic/ malformed	04	13.33%	04	13.33%
Total	30	100%	30	100%

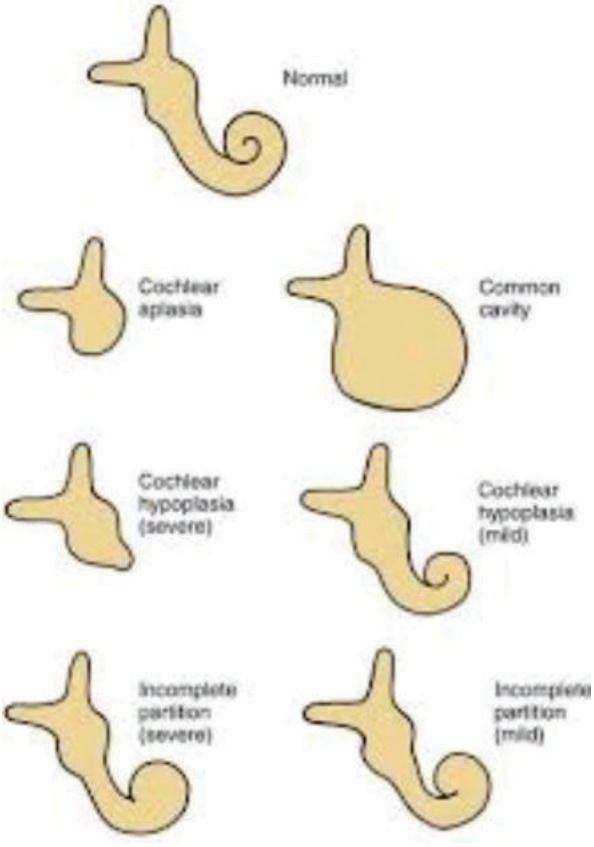

Fig 1: Cochlear Anomalies

REFERENCES

1. Kumar S, Gautam P. Sharma R. Taneja V. Etiological factors for pediatric sensorineural hearing loss. Indian Journal of Otology.2011 Oct 1:17(4):162.
2. Jallu AS. Jehangir M. Ul Hamid W. Pampori RA. Imaging Evaluation of Pediatric Sensorineural Hearing Loss in Potential Candidates for Cochlear Implantation. Indian Journal of Otolaryngology Head Neck Surg. 2015 Dec 1;67(4):341-6.
3. Preoperative Variables Affecting Outcome Of Cochlear Implant - Full Text View - ClinicalTrials.gov [Internet]. Available from: https://www.clinicaltrials.gov/ct2/show/NCT03719963
4. Bhavana K, Kumar S. Modifying radiology protocols for cochlear implant surgery in a government sponsored scheme: Need of the hour. International Journal of Medical Research & Health Sciences, 2016 Dec 28:5(6):151-7. Ann Otol Rhinol Laryngol. 1995;104:587–9.
5. Gupta SS. Maheshwari SR. Kirtane MV, Shrivastav N. Pictorial review of MRI/CT Scan in congenital temporal bone anomalies, in patients for cochlear implant. Indian J Radiol Imaging. 2009 May;19(2):99-106.
6. Harnsberger HR, Dart DJ, Parkin JL, Smoker WR, Osborn AG. Cochlear implant candidates:assessment with CT and MR imaging. Radiology 1987 Jul 1;164(1):53-7.
7. Casselman JW, Offeciers EF. De Foer B. CT and MR imaging of congential abnormalities of the inner ear and internal auditory canal. Eur J Radiol 2001;40(2):91-104.
8. Young JY. Ryan ME, Young NM. Preoperative Imaging of Sensorineural Hearing Loss in Pediatric Candidates for Cochlear Implantation. RadioGraphics, 2014 Sep 1,34(5):E133-49.