

A STUDY ON THE OUTCOME OF PAEDIATRIC COCHLEAR IMPLANTATION IN A TERTIARY CARE CENTRE

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ABSTRACT

BACKGROUND

Cochlear implantation is done in persons with severe to profound hearing loss, not benefitted with hearing aid. Best results are obtained if the surgery is done for children below three years, earlier the better. The aim of the study is to evaluate the results of the paediatric cochlear implantations done in Government Medical College, Trivandrum.

MATERIALS AND METHODS

Children were selected by standardised screening methods. Thirty six children underwent the cochlear implantation surgery. They were subjected to dedicated habilitation in the postoperative period. In this outcome study, we are comparing the preoperative and postoperative language age of all cases (both receptive and expressive language age).

RESULTS

Nine children are having near normal language age. 21 children are doing well with Auditory Verbal Therapy. Six are having poor response due to parent's inability to attend the habilitation regularly.

KEYWORDS

Cochlear Implantation, Electrically Evoked Compound Action Potential (ECAP), Habilitation, Auditory Verbal Therapy (AVT), Receptive Language Age (RLA), Expressive Language Age (ELA).

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BACKGROUND

Cochlear implantation is advisable in those persons having severe to profound sensorineural hearing loss without much benefit with hearing aid. Best results obtained in post-lingual deafness (if intervenes immediately after the onset of deafness). In pre-lingual children, earlier the detection and rehabilitation, better will be the outcome. First cochlear implantation was done on 1972. Single channel electrodes were used at that time. The advent of multichannel electrodes revolutionised the field. Electrodes are placed in the cochlea of inner ear and delivers sound directly to auditory nerve bypassing the damaged inner hair cells (Roseberry et al¹).

Cochlear implantation surgery was started in our institution under the government funded program exclusively for paediatric age group. Those children whose parents' annual income is below rupees 2 lakhs were eligible. An expert committee will screen the cases. So, children had to wait a period of 3-6 months before the surgery. First

surgery was done on November 2012. Here, we are evaluating the cases done till February 2016. Thirty six surgeries were done during this period of forty months.

AIM

To evaluate the results obtained for the paediatric cochlear implantation done in Government Medical College, Trivandrum.

MATERIALS AND METHODS

The cases considered for this study are the paediatric cochlear implantation surgeries done in Government Medical College, Trivandrum, from November 2012 to February 2016. Thirty six cases were done in forty months.

Inclusion Criteria

Children were selected based on the standardised preoperative evaluation. Children less than three years with severe or profound sensorineural hearing loss and not benefitted with hearing aid were preferred. However, children in the 3-5 age group were also considered where hearing loss was detected early and were on hearing aid and proper speech therapy. If government sanction was obtained before 5 years of age, implantation was carried out even if child was above 5 years at the time of surgery.

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Exclusion Criteria

Children having mental retardation, blindness or conditions, which contraindicate the surgery such as severe cardiac diseases, chronic middle ear infection, absent cochlear nerve or severely malformed cochlea were excluded. Children above five years also not considered during initial screening.

All 36 children were subjected to audiological evaluation to confirm the diagnosis. Conditioned Pure Tone Audiometry (for older children), Tympanometry, Otoacoustic Emission (OAE) and Brainstem Evoked Response Audiometry (BERA), Auditory Steady State Response Audiometry (ASSR) and Aided Audiometry were done. They had preoperative ophthalmological, psychological and paediatric evaluation to rule out any coexisting problems like blindness, mental retardation, which can affect the outcome of the surgery. Preoperative HRCT temporal bone and MRI brain were done to rule out any anomaly in cochlea, cochlear nerve, brain or anatomical variations like narrow facial recess, high jugular bulb.

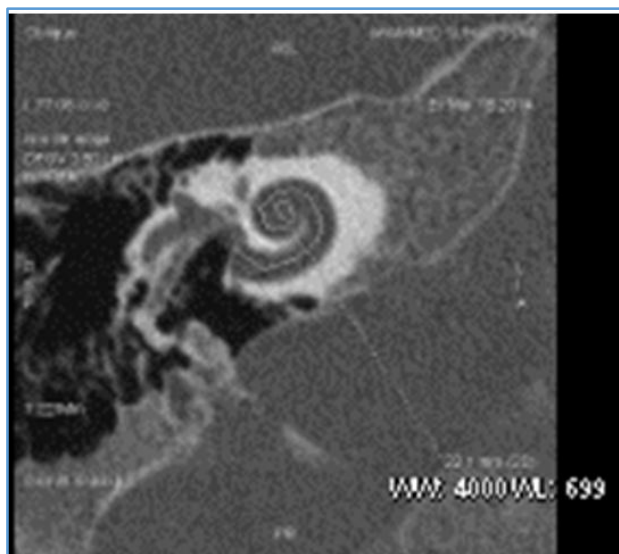


Figure 1. Reconstructed Images Showing Normal 2³/₄ Turns of Cochlea

All children were vaccinated against Pneumococcus and Haemophilus influenzae to prevent meningitis. Preoperative counseling regarding the surgery, care and maintenance of cochlear implant, importance of Auditory Verbal Therapy and parent involvement was given by a team of surgeon, psychologist, audiologist and speech pathologist.

Preanaesthetic fitness obtained. Right-sided implantation planned in 33 cases. In the remaining three cases, left side preferred due to anatomical variations. There was high jugular bulb on right side in two cases and rotated cochlea on right side in one case. All cases were done under general anaesthesia through modified postaural incision. Cortical mastoidectomy and posterior tympanotomy were done. Round window membrane exposed. In those cases where round window membrane could not be identified due to rotated cochlea, cochleostomy done. Electrodes inserted fully in all cases. Preoperative ECAP values were obtained in all. One case where HRCT showed dilated vestibular

aqueducts had perilymph gush during the surgery. But, surgery was completed successfully and perilymph gush subsided after electrode insertion and soft tissue plugging. The two cases where facial nerve was anteriorly placed in the HRCT temporal bone, facial nerve was just exposed while widening the posterior tympanotomy. Both cases developed facial nerve paresis in the postoperative period, which recovered fully in three weeks' time.

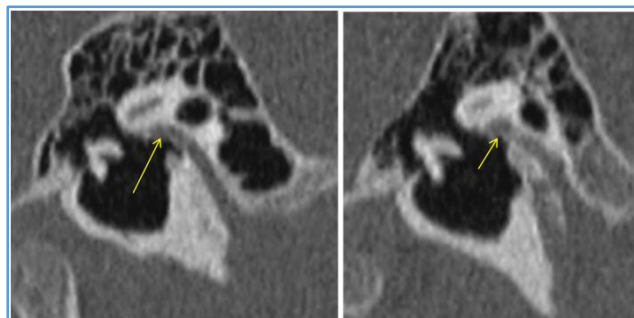


Figure 2. HRCT Temporal Bone Showing Narrow Facial Recess

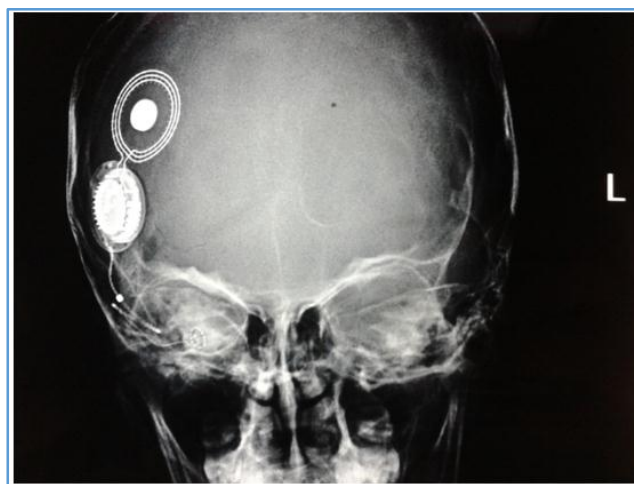


Figure 3. X-Ray showing Electrodes in the Cochlea

Postoperative digital x-ray was taken in all cases to confirm the position of electrodes in the cochlea. Prophylactic parenteral antibiotics were given for three days. Switch on was done after 3-4 weeks. No mechanical failure of the device noted. All children received 2-3 sessions of individual Auditory Verbal Therapy. 21 children attended therapy at our department while 15 children attended therapy at the National Institute of Speech and Hearing (NISH), Trivandrum. Target was to improve audition, language, cognition, speech and communication skills. All children were evaluated once in 3 months for improvement. Frequency of sessions shortened depending upon the improvement.

OBSERVATIONS

There were 36 children, of which 18 were males and 18 females giving a sex ratio of 1:1.

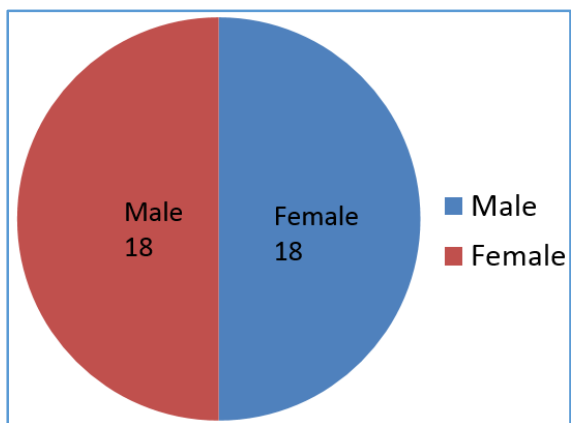


Chart 1. Sex Ratio of 1:1

Only one child was below 2 years of age. Eight were in the 2-3 years age group. Majority (eighteen) are in the 3-4 year age group while nine are in the >4 years group.

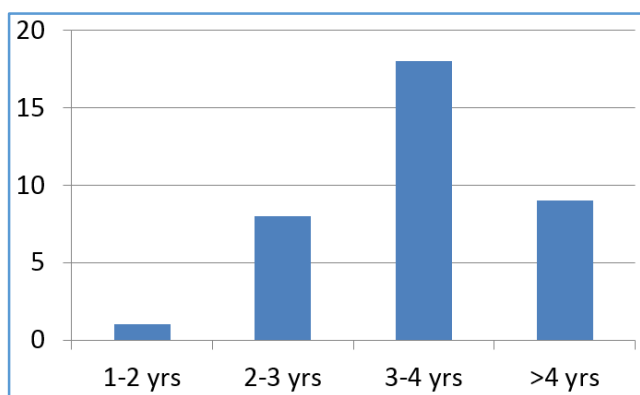


Chart 2. Age Wise Distribution of Cases

Year	Number of Surgeries
2012	2
2013	6
2014	15
2015	10
2016	3

Table 1. Number of Surgeries Done in Each Year (from November 2012 to February 2016)

Depending on the aetiology, 34 cases were having congenital deafness. Of these, 3 were familial and 2 were congenital rubella syndrome. Other two cases were having history of neonatal meningitis. Eleven cases were detected before one year, while 25 were detected at 1-2 years of age. 34 children were started on hearing aid trial before two years of age while the rest, 2 were started after 2 years of age. Most of the cases were in the 90-100 dB hearing loss category.

Hearing Loss (dB)	No. of Children
80-90	4
90-100	28
>100	4

Table 2. Severity of Deafness

All implanted children had standardised habilitation in the postoperative period. They can be divided based on the duration of auditory verbal therapy.

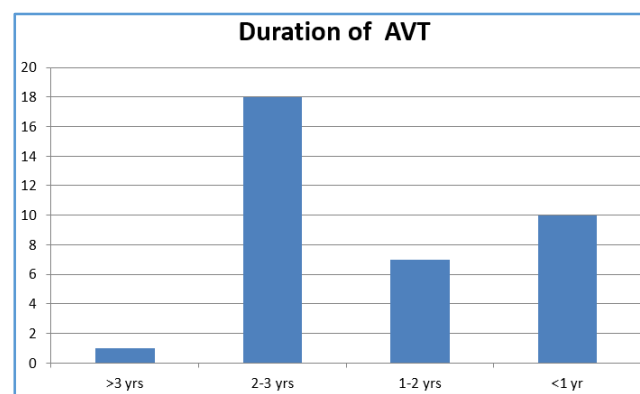


Chart 3. Duration of Auditory Verbal Therapy

All 36 children undergoing habilitation were evaluated in July 2016. Preoperative language age was compared with the present language age (both receptive and expressive language age). Average values of language age obtained for each group were noted.

Duration of AVT (Yrs.)	No. of Children	Preoperative Levels			Present Levels		
		Average Age (m)*	RLA** (m)*	ELA# (m)*	Average Age (m)*	RLA** (m)*	ELA# (m)*
>3	1	42	36-42	24-29	85	72-83	72-83
2-3	18	47	15-24	12-20	75	54-64	43-53
1-2	7	37	12-20	10-17	54	36-47	33-44
<1	10	44	11-22	7-17	51	25-36	18-29

Table 3. Average Language Age of Children Based on Duration of AVT

*m= months, **RLA= Receptive language age, # ELA= Expressive language age.

Depending on the individual responses, we can categorise the children into 3 groups- those having good response (near normal language age), those with moderate response and those with poor response even after adequate therapy. Those children on auditory verbal therapy for less than one year can't be considered a failure. They may improve with continuation of therapy.

Duration of AVT (In Years)	Good Response	Moderate Response	Poor Response
>3	1	-	-
2-3	6	7	5
1-2	2	4	1
<1	-	10	-
Total	9	21	6

Table 4. Response to AVT in Various Categories of Duration of AVT

DISCUSSION

We have done 36 paediatric cochlear implantations over a period of 40 months. Of these children, 18 were males and 18 were females giving a sex ratio of 1:1 (Chart 1). Of these cases, majority were under 3-4 years age group (Chart 2). A delay in surgery of 3-6 months is due to the fact that parents had to get the approval of government scheme. Implant is provided free of cost by the government.

Children who are on habilitation were divided into 4 main groups based on the duration of AVT (Chart 3). All 36 children who are on habilitation were evaluated on July 2016 by comparing their preoperative language age with the current language age, both receptive and expressive language age (Table 3). Nine children had near normal language age at present (Table 4). Studies by Tait et al,² Nicholas and Geers,³ Geers et al⁴ and Kramer Kara⁵ concluded that early intervention had a better outcome. Nicholas and Geers³ as well as Geers et al⁴ found better oral communication with early implantation. Connor and Zwolan⁶ and Archbold et al⁷ found a positive outcome for reading skills with younger age group. Geers et al⁴ concluded that age at implantation had an effect on Spoken Language Scores after gender, Intelligence Quotient (IQ) and parent's education level were held constant. In our study, since we included all paediatric implantation over a period of time, such a conclusion is not possible. We had a minimum delay in surgery of 3-6 months because child had to be selected by the screening committee. We also had better responses for younger children. Longer the duration of AVT, better is the response. But, those who had comparatively late implantation also catch up after 2 years dedicated therapy. This observation is comparable with other similar studies: - Dunn CC et al⁸ indicated that effect of age at paediatric implantation diminishes with time. According to Govaerts et al,⁹ it will take at least 2-3 years of postoperative therapy for 2-4 years age group children to attain normal level. Most of our children are in this age group and they are showing good results after 2-3 years of dedicated habilitation (Table 3, 4). Children having good preoperative therapy and language age had better response in postoperative habilitation. This observation is comparable with the study of Nicholas and Geers³ who noted that better language outcomes and faster language growth are associated with younger age at implant, better pre-implant-aided thresholds and longer duration of implant use.

Of these good responses, 5 children are having AVT from our institution and 4 from NISH. These responses are comparable as both institutes provide standard AVT.

In the good response group, 5 children are males and four are females. This finding that gender is not associated with any difference in outcome is similar to that of Merv Hyde et al.¹⁰ We could not compare the socioeconomic status of the parents as government program is limited to those who are below a particular income category. 6 children had poor response (Table 4). Of these, 3 are having habilitation from our institution and 3 from the other. No mechanical failure of device reported in any of the cases. Proper preoperative counseling was given to all parents. Still these six children were irregular in attending the habilitation. So, the single most deciding factor was parent's inability to attend the habilitation regularly.

Rest 21 children are yet to attain normal language age (Table 4). Most of them had shorter duration of habilitation. Ten children are in the <1 year postoperative period category. Most had better receptive language age. Their expressive language age may get better in the nearby future.

CONCLUSION

Cochlear implantation is advisable for prelingual children with severe to profound hearing loss, not benefitted with hearing aid. Best responses were obtained for early detection and intervention. Even if there was a minimum delay in surgery of 3-6 months, better responses can be attained with long-term dedicated Auditory Verbal Therapy. Those children irregular on AVT sessions had poor results.

LIMITATION

Reduced sample size and shorter duration of study. Procedures like cochlear implantation need minimum 3 years postoperative follow up of all cases.

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