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Candidacy of cochlear implantation for paediatric prelingual patients

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Abstract

Background: *Hearing loss is one of the most common paediatric health Conditions with moderate to profound bilateral hearing loss identified in 2-3 infants per 1000 births. Cochlear implant (CI) technology has markedly changed potential outcomes for children with moderately severe or worse sensorineural hearing loss by offering an opportunity for auditory stimulation.The objectives are to predicate the outcome of cochlear implant and to determine the factors that contribute for cochlear implant candidacy.*

Patients and method: *this is cross sectional study conducted at the department of Otolaryngology, Ghazi AL-Hariri Surgical Specialties Hospital, Medical City Complex, Baghdad. The study involved 45 patients with age ranged from 2 to 6 years with bilateral severe to profound hearing loss who were operated upon at our Department During the period from October 2010 through May 2011 and followed up 6 month post implantation.*

Results: *The highest age group was (60-72) months (51 %), while the lowest age was (36-47) months (13%). The mean age of the patients was 51.11 months. Most of them were male 64.4%. The highest rate of performance was seen in patient's age (24-59) months 100% and it decreased with increment of the age. The lowest rate of performance was seen in patient's aged (60-72) months 52.1%. It was found that none of patients of poor educational status of parent class recorded good rate of performance, while the patients of good educational status of parent class recorded the highest rate of performance 92.9%. According to speech therapy and programming the highest rate of performance100 % were recorded among regular patients, while those of irregular programming recorded the lowest rate of performance. Regarding the use hearing aid, those patients higher rate of good performance among patients using hearing aid 100%, than patient's not using it 56%.*

Conclusion: *The age of patients is very important factor in cochlear implant candidacy, the youngest age the best performance of children. The benefit of hearing aid between 3-6 months before cochlear implant play important role in candidacy. The speech therapy and programming after cochlear implant are the main stay of candidacy*

Keywords: *Cochlear implantation, pediatric prelingual patients, candidacy.*

Introduction

The cochlear implant is an electronic device that is implanted under the skin with electrodes positioned in the cochlea to stimulate the auditory nerve. Electrical currents induce action potentials in the auditory nerve fibres and these are transmitted to the brain. It thus bypasses damaged or missing hair cells within the cochlea that would normally code sound. It consists of a receiver-stimulator, which receives power and decodes instructions for controlling the electrical stimulation, and an electrode array, which has electrodes placed near the auditory nerve (generally in the cochlea) to stimulate residual auditory nerve fibres.

Hearing loss is one of the most common paediatric health Conditions with moderate to profound bilateral hearing loss identified in 2-3 infants per 1000 births. Cochlear implant (CI) technology has markedly changed potential outcomes for children with moderately severe or worse sensorineural hearing loss by offering an opportunity for auditory stimulation. Children with severe to profound sensorineural hearing loss who receive CIs have been shown to have marked improvements in auditory-oral performance as compared to their peers who use hearing aids.

As cochlear implants have achieved documented improvements in open-set speech recognition scores, FDA guidelines for implantation have been expanded. Initially, FDA guidelines suggested that potential recipients should have pure-tone averages (PTAs) of 90 dB or greater. The guideline has been lowered to 70 dB in recent clinical trials. It was initially suggested by the FDA that appropriate implant candidates should have hearing in noise test (HINT) sentence scores of less than 20% in

quiet. This criterion has now been substantially relaxed, and individuals with less than 50% correct responses to HINT sentences in quiet are considered appropriate candidates.

There is a move toward using consonant/ nucleus/consonant words as a criterion, primarily to avoid ceiling effects during postoperative evaluation.

Patients and Methods

This is Cross section study conducted at the Department of Otolaryngology/ Ghazi Al-Hariri Surgical Specialties Hospital, Medical City Complex, Baghdad.

The study involved 45 patients with age from 2 to 6 years of bilateral severe to profound hearing loss who were operated upon at our Department During the period from October 2010 through May 2011and followed up 6 month post implantation . The patients were submitted to:

1. Full history taking includes chronological age mean, duration of deafness, gender of patients ,age of amplification and duration of use hearing aids, comparison paediatric patients with normal children in developmental milestones, educational status of parents, family history of deafness, medical history of birth and early infancy including fever during pregnancy especially first trimester ,type of delivery either normal vaginal delivery or assistant vaginal delivery or caesarian section and also duration of delivery either prolonged or obstructed labor, duration of cyanosis at early delivery ,history of jaundice, history of meningitis, history of diarrhea, history of any ear diseases, drug history, programming of children after cochlear implant.

2. General physical examination and otolaryngological examination.

3. Audiological testing including ABR test to estimate the degree of hearing loss and tympanometry test.

4. Performance test of children after C.I. depend on speech intelligibility rate(SIR) and classified into two groups either poor group, involving categories one, two and three, or good group, involving categories four, five and six.

Definitions of speech intelligibility rate (SIR)

Category 1 Pre-recognizable words in spoken language

Category 2 The primary mode of communication is manual. The speech vocalization patterns which accompany the sign/gesture may give some additional information at the lip reading level.

Category 3 Speech unintelligible. All experienced listeners can follow a known topic via lipreading and context cues. It is not possible to follow an audiotape sample.

Category 4 Speech intelligible to a listener who concentrates and lip reads.

Category 5 Speech intelligible to listeners with little experience of the speech of a deaf speaker

Category 6 Speech intelligible to all listeners

Results

Table 1 Frequency distribution of study sample by age groups

Age in months	number	%
24-35	8	18
36-47	6	13
48-59	8	18
60-72	23	51
Total	45	100

Average =51.11 S.D=16.063

The mean of the patients age=51.11 and standard deviation=16.063. The high age rate group was seen in patients aged (60-72) months, (51 %), while the lowest group was seen in patients aged (36-47) months, (13%).

Table 2: Distribution of the patients according to the age and performance

Age in months	Performance				Total
	Good	%	Poor	%	
24-35	8	100	0	0	8
36-47	6	100	0	0	6
48-59	8	100	0	0	8
60-72	12	52.1	11	47.9	23
total	34	75.6	11	24.4	45

Chi-square=35.718 df=3 p.value=0.001

The highest rate of performance was seen in patient's age (24-59) months

Table 3: Distribution of the patients according to the gender and performance

Gender	Performance				Total
	Good	%	Poor	%	
Male	20	69	9	31	29
Female	14	87.5	2	12.5	16
Total	34	75.6	11	24.4	45

Chi-square = 1.918 df = 1 p. Value = 0.166

The highest rate of performance was seen in female group (14),(87.5%)

Table 4: Distribution of the patients according to the educational state of parent and performance

Education state	Performance				Total
	Good	%	Poor	%	
Good	26	92.9	2	7.1	28
moderate	8	66.7	4	33.3	12
poor	0	0	5	100	5
Total	34	75.6	11	24.4	45

Chi-square = 20.506 df = 2 p. Value = 0.001

Table5: Distribution of the patients according to the speech therapy and programming with performance

Speech therapy& programming	Performance				Total
	Good	%	poor	%	
Regular	34	100	0	0	34
Irregular	0	0	11	100	11
Total	34	75.6	11	24.4	45

Chi-square = 45.00 df = 1 p. Value = 0.001

Table 6: Distribution of the patients according to a use of hearing aid and performance

Hearing aid	Performance				Total
	Good	%	Poor	%	
Use	20	100	0	0	20
Not use	14	56	11	44	25
Total	34	75.6	10	24.4	45

Chi-square=11.647 df=1 p. Value =0.001

Table 7: Distribution of the patients according to a medical history and performance

Medical history	Performance				Total
	Good	%	Poor	%	
Positive	6	42.9	8	57.1	14
Negative	28	90.3	3	9.7	31
Total	34	75.6	11	24.4	45

chi-square = 11.765 df = 1 p. Value = 0.001

Discussion

A cross sectional study was conducted on 45 patients, according to their post cochlear implant performance was classified into two groups; 34 patients with good performance (75.6%) and11 patients with poor performance (24.4%). SPSS version 13 was used for all analysis.

The high rate was seen in patients aged (60-72) months, (51 %), while the lowest group was seen in patients aged (36-47) months, (13%).

In our study, the highest rate of performance was seen in patient's age (24-59) months, (100%) and it decreased with increment of the age, the lowest rate of performance was seen in patient's aged (60-72) months, (52.1%), yet it's statistically significant. The explanation of this result because of neural plasticity of the brain is better in lower age group of implanted patients, that is mean the inherent ability of the auditory system to modify or reorganize,. This result agrees with other studies (Kirkham *et al*.,2009; Wiley and Meinzen-derr,2009; Fitzpatrick etal.,2009; Edwards *et al*.,2009; MacDonald *et al* .,2004; C.Edwards,2003; Daya,1999) who found that the age group of (24-59) months was the highest age of benefit from cochlear implant.

The highest rate of performance was seen in female group, (87.5%) slightly higher than male group (69%). The distribution of patients in this study where found higher in the male (64.4%), than female (35.6%). Statistically, it was not significant between the gender and performance. The explanation of this result comparable to that of other studies (Wiley and Meinzen-derr,2009; C.Edwards,2003).

In Wiley and Meinzen-derr study was found correlation between the gender and performance while in regression statistic to this study was found no significant correlation between the gender and performance.

The patients who were enrolled in the study were classified according to educational status of their parent into three groups(Good-Moderate-Poor). It was found that poor educational status of parent recorded the lowest rate of patient's performance (0), (0%), while good educational status of parent recorded the highest rate of patient's performance, (26), (92.9%).Therefore, the rate of performance increased with the improvement of educational status of parent .The statistical analysis showed highly significant relationship between educational status of parents and performance (chi-square=20.506, p.Value=0.001). This finding is in agreement with what was found by other studies(Kirkham *et al*.,2009; Edwardsetal.,2009; MacDonldetal.,2004; C.Edwards,2003; Daya,1999;)

It was found that patients of regular programming recorded the highest rate of performance (34), (100%), while the patients of irregular programming recorded the lowest rate of performance(0), (0%). The statistical analysis showed highly significant relationship between programming and performance (chi-square=45.00, p.Value=0.001). This finding was comparable to those registered by other studies (Fitzpatrick *et al*.,2009; Edwards *et al*.,2009; MacDonald *et al* .,2004; C.Edwards,2003 ; Daya,1999)

According to the benefit from hearing aids the patients were classified into two groups (use hearing aid and not use hearing aid).

The distribution of patient's use or not use hearing aid according to this study was found (20), (44.4%), use hearing aid and (25), (55.6%) not use hearing aid. It was found that patients using hearing aid recorded highest rate of performance (20), (100%), while patient's not use hearing aid recorded (14), (56 %). The statistical analysis showed highly significant relationship between group of patient's use hearing aid and performance (chi-square=11.647, p.value =0.001). A finding which was

similar to that of other studies (Wiley and Meinzen-derr, 2009; Edwards *et al*.,2009; MacDonld *et al* .,2004; C.Edwards, 2003; Daya,1999).

The minority of patients had a positive history including fever during pregnancy especially first trimester ,type of delivery either normal vaginal delivery or assistant vaginal delivery or caesarian section and also duration of delivery either prolonged or obstructed labor, duration of cyanosis at early delivery, history of jaundice, history of meningitis ,history of diarrhea, history of any ear diseases (14), (31.2%) and this group of patients showed lower rate of performance (6), (42.9%), than the other group of patients with negative history (31), (68.8%), whom showed highly rate of performance (28), (90.3%).

The statistical analysis showed highly significant in group of patients had negative history (chi-square=11.765, p.value 0.001). This result was the same as that reported by other studies (Edwards *et al*.,2009; MacDonld *et al* .,2004; C.Edwards,2003; Daya,1999**).**

Conclusions

The factors that play important role in the candidacy for chochlear implant:

1-The age of patients, the youngest age the best performance of children.
2-Eductional status of family is another important factor correlated with increased performance of children after implantation.
3-The benefit of hearing aid between 3-6 months before cochlear implant play important role in candidacy.
4-The speech therapy and programming after cochlear implants are the main stay of candidacy.

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