Cochlear implantation in Bahrain: promising results

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Cochlear implantation (CI) has been established worldwide as an effective method of rehabilitation of the profoundly hearing impaired patient at any age.^{1,2} CI provides the possibility for the deaf to hear up to normal levels, for adults who had postlingual deafness to regain their speech, and for prelingually deaf children to develop speech and language if implanted at a suitable age and provided with appropriate rehabilitation. The CI program started in the Kingdom of Bahrain in 2001, at Salmaniya Medical Complex (SMC), and was supported by the Ministry of Health. The CI surgeries on the program stopped in years 2003 and 2004 due to financial reasons, and restarted in 2005. This study was designed to evaluate the result in relation to hearing gain and speech development after rehabilitation of CI surgeries performed in Bahrain in the years 2001 and 2002.

PATIENTS AND METHODS

All CI surgeries performed in SMC in 2001 and 2002, were included in this study. Cases referred for CI were evaluated at the Hearing Impaired Children Clinic (HICC) by a team including an ENT consultant CI surgeon, an audiological physician, speech therapists and a pediatric developmental physician. Children had an otolaryngological and audiological assessment, a CT scan of the temporal bone and an MRI of the inner ear and brain. Psychiatric evaluation was requested when needed.

Selection criteria to implant children were (1) prelingual deafness aged ≤ 5 years of >90 dB hearing loss of average 0.5, 1, 2 and 4 KHz without speech development, and no benefit from hearing aid, or (2) prelingual deafness aged 6 to 15 years with residual hearing of 90 dB, but with residual speech and limited benefit from hearing aid, or (3) postlingual deafness aged up to 15 years with a hearing level of ≥ 90 dB, after acquiring speech. The surgeries were performed from May 2001 to October 2002. The CI device used was a Med El, Combi 40+.

Programming was performed 6 weeks after surgery. Rehabilitation was provided for periods of one to two years, on individual and in nursery setting sessions at Prince Sultan Bin Abdul Aziz Hearing and Speech Development Center of the Bahraini Child Development Society. The patients were called to the clinic (HICC) in November and December 2005 for a post-CI hearing and speech evaluation. According to the age of the child, hearing was evaluated by free-field or pure tone audiometry in the frequencies 0.5, 1, 2, and 4 KHz. Speech and language perception and production were tested by monosyllabic and bisyllabic word list based on the Ashoor Arabic speech audiometry list^{3,4} and by a closed set list of 10 sentences in Arabic created at our center. Words or sentences were presented by the testing person standing at 1-meter distance behind the child. This is similar to the method described by Vaewvichit et al.⁵

RESULTS

CI surgeries were performed on 15 children, including 10 females (67%), and 5 males (33%). Thirteen (87%) had prelingual deafness, including 9 (60%) of age 5 years or less (mean age, 3.6 yrs) and 4 (27%) of 11-15 years (mean age, 14.7 years). The remaining 2 cases (13%), one male and one female, had postlingual deafness and were aged between 6-10 years (mean age, 9.5 years). The overall mean age for the 15 cases was 7.0 years.

Hearing level before implantation according to testing by free field, pure tone audiometry, and acoustic brain reflexes (ABR) showed no responses in 11 cases (73%), and a hearing level of 90-100 dB in 4 cases (27%). The etiological factors were hereditary in 6 cases (40%), all having consanguinity of the parents and a family history of deafness. The causes were anoxia at birth in 2 cases (13%), meningitis in 1 case (7%) and renal failure in 1 case (7%). The remaining 5 cases (33%) were of unknown etiology. Postimplantation and after acquiring auditory skills of sound detection, all children had hearing responses at levels from 20 dB to 45 dB.

Table 1. Fifteen patients by age, sex and post-implantation hearing and speech results.

Age at Surgery (years)	Sex	Hearing Loss (dB)		Recognition (%)	
		Preoperative	Postoperative	Words	Sentences
15	F	90-100	20- 30	100	100
9	M	NR	30- 40	100	100
5	F	NR	20 – 30	100	90
14	F	90-100	20-40	100	100
3	F	90-NR	25-30	100	100
11	F	100-110	25-30	100	100
4	F	NR	25-30	100	100
6	M	NR	30-45	0	0
15	F	90-110	30-40	100	100
14	F	90-100	20-40	50	40
2	M	90-100	20-40	100	100
1	M	NR	20-40	100	100
2	F	NR	35-45	50	40
3	M	NR	30-45	0	0
2	F	90-100	20-40	70	50

NR = No response to hearing tests. Cases listed according to time sequence of CI surgery.

The poorer responses were in the two children who had poor speech development as indicated below.

Thirteen children (87%) had satisfactory to excellent responses on the words and sentences closed set lists. Ten (77%) had excellent responses of 90% to 100%, and 3 (23%) had satisfactory responses between 40% to 70%. All have joined normal nursery or school (Table 1). The remaining 2 cases (13%) failed to respond to acceptable levels without lip reading. These 2 cases were considered failures in speech development. They were re-evaluated and diagnosed as having poor cognitive function.

There were no major surgical complications. In one patient who had thick skin over the receiver, the wound was reopened and the skin was thinned 3 months after surgery. Two patients (13%) had technical failure of the internal device. One had the failure in 2002, one year postimplantation. The other child, who was implanted in 2001, at age 15 years, had failure of the device after 5 years of implantation, in March 2006. In both cases the device was replaced with a new internal device from the same firm.

DISCUSSION

The etiological factors in the implanted deaf children in

this study are comparable to other studies on deafness and implantation, such as our study on the etiology of sensorineural hearing loss in children in Bahrain,⁶ and other studies^{7,8} indicating that the major factor is genetics, presenting as congenital hereditary deafness in 40% and deafness of unknown etiology in 33%. Both factors are related to the high rate of consanguineous marriage. Our selection criteria for CI in deaf patients were comparable to other studies and to standards of selection of patients in traditional textbooks.⁹

As indicated by Gysin et al,⁷ complications of CI include major complications (4%), minor complications (3%) and device failure (2%). Operative and postoperative complications range from cerebral infarct or cardiac infarct and death, meningitis, facial nerve injury, chorda tympani injury, and tympanic membrane injury to iatrogenic cholesteatoma, inappropriate electrode insertion, wound infection and other complications, for an overall rate of 11.8%.^{1,2} In our study, complications were rare except for device failure in two cases for a failure rate of 13.3%. The high percentage of device failure in our study is due to the small number of cases.

Sound detection and awareness, along with word recognition of different test lists, has been shown to vary among implanted patients with various factors as-

sociated with the outcome. Duration of deafness and to a lesser extent, age at implantation, are the most significant predictors of outcome. The shorter the duration of deafness, the better is speech understanding with the implant. Most recent studies emphasize the importance of implantation at an early age for better performance.¹⁰ In most studies, no clear relationship has been found between etiology and postoperative performance, while patients with meningitis were more frequently in the poorer performing groups of implant users.¹¹

Postimplantation results show variable levels of speech perception, including a poor response for the House 3M device and responses from chance (4%) up to excellent (92%) in nucleus device patients.⁵ Lenarz et al¹² stated that "on average, auditory performance improved over time up to 18 months after implantation, closed set test increased by 25% to 55% in 18 months, open

set score began to show improvement between 6 and 12 months postoperatively" in 18 children using a Clarion 1.2 device. On the other hand, Kiefer et al¹³ indicated that all children had a clear benefit from implantation, and that 10 of 21 prelingually deaf or hearing impaired children had reached some degree of open set speech understanding only 15 months postoperatively. In their study they used Med El Combi 40/Combi 40+.

We conclude that the 15 children implanted in 2001 and 2002 as first group of children on the CI program in Bahrain had overall improvement in 13 (87%) in relation to hearing gain and speech perception and development of satisfactory to excellent levels. These children were able to integrate into the normal schools and nurseries. The remaining 2 cases (13%) failed to respond to acceptable levels without lip reading, a failure related to poor cognitive function.

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