

Surgical Difficulties of Cochlear Implantation in Children

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ABSTRACT:

BACKGROUND:

Cochlear implantation is a recent surgical treatment of deaf children, surgical difficulties may arise and has impact on outcome of implant.

OBJECTIVE:

To define the difficulties encountered during surgery and how the surgeon deals with them.

METHODS:

120 patients of bilateral severe to profound hearing loss who all had implantation in the department of otorhinolaryngology, medical city, during the period from July 2010 to September 2011. All of them received the Nucleus Freedom cochlear implant with Contour Advance Electrode, model C124RE.

They are classified into two groups according to difficulty arises during surgery :(group a) those identified during access to cochlea.(group b) those associated with difficult electrode insertion.

RESULTS:

Difficulties encountered during access occurred in 8 patients (6, 66%); Difficulties encountered during insertion of electrode occurred in 16 patients (13.33%).

CONCLUSION:

We concluded that although cochlear implant (C.I.) surgery is now well practiced , and difficulties during surgery are infrequent, the Surgical management of certain obstacles encountered during surgery demands expert knowledge of surgical technique for successful implantation .

KEYWORDS: cochlear implant, deafness in children.

INTRODUCTION:

Difficulties arising in surgery of cochlear implant are important to be studied and assessed its impact on surgery and possibly on outcome of implant. Congenital dysplasia require thorough evaluation, careful operative planning, and a candid discussion with the parents due to increased risk of perilymph fistula , facial nerve injury , partial electrode insertion and less than optimum benefit from the implant.⁽¹⁾

The obliterated cochlea, usually the result of meningitis and labyrinthitis ossificans, also represents a challenge as finding of patent scala tympani may be difficult.⁽¹⁾

Inflammation of middle ear mucosa and middle ear effusion also add difficulty to the surgery as round window niche may be obscured by inflamed mucosa and granulation tissue which may be difficult to be removed.⁽²⁾

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PATIENTS AND METHODS:

A Prospective study involves 120 patients of bilateral severe to profound hearing loss who all had implantation at the department of Otolaryngology / Hospital of Specialized Surgeries –Medical City Teaching Complex, during the period from July 2010 to September 2011 . All of them received the Nucleus Freedom cochlear implant with Contour Advance Electrode, model C124RE.

The patients were submitted to:

- 1.Full history taking includes chronological age, mean duration of deafness, gender of patients , duration of use hearing aids , family history of deafness, antenatal history, medical history of birth and early infancy, history of jaundice, meningitis, diarrhea, history of any ear diseases, history of fever or admission to hospital ,drug history.
2. General physical examination and otolaryngological examination.
3. Audiologic testing including ABR test to estimate the degree of hearing loss and tympanometry test. (All patients have from severe to profound hearing loss).

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4. Radiological testing including CT scan +/- MRI. The operation is carried out using standard surgical techniques of minimal access approach.
5. Other general blood investigations, ECG, Echo, chest X-ray, X-ray of postnasal space which are requested by anesthetist. The patients are classified into two groups according to difficulty arises during surgery :(group a) those identified during access to cochlea.(group b) those associated with difficult electrode insertion.
6. Paediatric and Neurological assessment.

RESULTS:

Table 1: Frequency distribution of study sample by age groups.

Age in months	Number	%
12-23	3	2.5
24-35	22	18.3
36-47	38	31.7
48-59	26	21.7
60-71	20	16.6
72-83	11	9.2
Total	120	100.0
Range (16-78) ;Mean 48.01 ;S.d 14.85		

Patients distribution according to their age illustrated in table one, show that the mean of patients age = 48.01 and standard deviation =14.85. The highest age group rate was seen in patients aged (36-47) months, (31.7%) ,while the lowest rate was seen in patients aged (12-23) months, (2.5%).

Table 2: Difficulties encountered during access in cochlear implant surgery and their management. (group A).

No. of cases	difficulty	management
2	Anterior displaced sigmoid sinus	1-First case managed by removal of the incus bone and incus bar with thinning Of posterior canal wall. 2.In the other case, difficult access necessitate operation on the other ear at the same session.
5	Middle ear granulation tissue	1-granulations tissue successfully removed and implantation completed in four cases. 2-In one case difficulty in removal of granulation tissue and identification of round window niche leading to failure to complete the surgery. Other ear showed same findings with inability to complete surgery.
1	Aberrant facial nerve	Difficult to identify the cochleostomy site and operation continued on the other ear.

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Table 3: Difficulties encountered during insertion of electrode in cochlear implantation and their management. (group B).

No. of cases	Difficulty	management
7	CSF gusher	1. In two cases ,the gusher stopped by head elevation (wait for 2 minute). 2. In five cases the gusher stopped by head elevation, decrease intracranial pressure by anesthetist (hypotensive technique), mannitol and packing of cochleostomy site.
9	Intracochlear ossification	1- In seven cases successful insertion of the electrode achieved through further drilling in basal turn of cochlea in spite CT scan showed ossification. 2- In two cases , patent scala tympani was not found inspite of further drilling in the basal turn of cochlea.

Table 4: Distribution of the patients according to the age groups and surgical difficulties.

Age group (months)	Difficulties		
	During access	During insertion	No.of cases without difficulty
12-23	0	0	3
24-35	3	4	15
36-47	3	4	31
48-59	2	4	20
60-71	0	3	17
72-83	0	1	10
Total	8	16	96
Chi-square:2.511 ; p value:0.775			

Distribution of the difficulties according to the patients age group illustrated in table five, show no significant correlation as p value = 0.775.

DISCUSSION:

Our study tried to focus on the special surgical obstacles which may be faced during the surgery of C.I .

Group A patients:

- Granulation tissue in the mastoid cavity and the middle ear makes certain difficulty in the access to facial recess and identification of round window niche .

- In our study, five cases (4.16%) were defined of which four cases proceeded with successful implantation after removal of granulation tissue to identify the round window and underwent cochleostomy . One case associated with failure to complete surgery as a result of a large amount of granulation tissue which impeded

the access to the middle ear. The other ear also explored and showed the same findings that impeded the surgery. This patient was explored after few months of medical treatment(intranasal steroid) and the same granulation tissue was found .

When we compare with other researches that studied the effect of granulation tissue on C.I surgery we found:

- Luntz M^[3] in his study described the effect of otitis media on surgery and he divided the children in his study into otitis –prone group and non-otitis- prone group according to history of current or recent episodes of otitis media at referral for cochlear implant and he

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found that mastoid pneumatization to be significantly smaller in otitis media –prone group but the facial recess was not smaller in this group . furthermore, he found also that in otitis –prone group , the round window niche is often obscured by inflamed mucosa which necessitate its removal for identification of round window membrane .

- Papsin^[4] *et al* , described the role of using grommet prior to cochlear implantation in patients with OME in whom middle ear effusion and granulations are present . they advised that management of these patients now aims at placing grommets such that they are patent at the time of implantation to reduce this granulation.

- Gao X^[5] *et al* on his study on 26 patients advised to proceed for surgery of C.I according to the standards of the indications and surgery time without delay for full management of OME. In his study nonsurgical treatment was conducted for OME before the following implantation and during the process of surgery operation , related lesions of OME (effusion and granulations) were completely removed and proper drainage was then constructed.

- Anterior displaced sigmoid sinus is a rare finding that may interfere with access to facial recess and in our study two cases were identified account for (1.6%) , one of them managed by removal of incus bone , incus bar and thinning of posterior canal wall to gain access to facial recess. Other case was more difficult and no access can be achieved to facial recess necessitate operating the other ear.

When comparing our result to others:

- Ma X^[6] *et al* found that significant sigmoid sinus antedisplacement which cause the operation more difficult represent (0.74%) in their study and they successfully complete their operation through removal of the incus and abrasive reduction of the posterior wall of bony external acoustic meatus.

- Carfrae MJ^[7] *et al* , described the role of canal wall down procedure for difficult cochlear implant . Three cases where the implantation via standard facial recess approach was not possible due to middle ear fibrosis and one case had anterior displaced sigmoid sinus, were successfully implanted via canal wall down, intact posterior canal wall skin technique.

- One case of aberrant facial nerve identified in our study and this represented (0.83%) which is a rare finding .

When comparing to other studies:

- Kim LS^[8] in his large study on 212 children underwent C.I identified only two cases of aberrant facial nerve (0.94%) which is comparable to our study.

- Another large series of cases in a study conducted by Arnoldner C^[9] defined aberrant facial nerve to be a rare finding occur in (2.9%).

- Sennaroglu L^[10] studied C.I in inner ear malformations and said that there are two main difficulties in the surgery of inner ear malformations; gusher and facial nerve abnormalities and he discussed the radiological features of malformations necessary to identify these problems preoperatively .

Group B patients:

- CSF gusher identified in 7 patients in our study (5.83%) , two of them stopped spontaneously by head elevation by allowing the pressured fluid to drain off , while the remaining five patients required head elevation, decrease intracranial pressure by anesthetist (hypotensive technique) , mannitol and packing of cochleostomy site with several small pieces of temporalis fascia after electrode insertion.

Previously the CSF gusher was considered by some surgeons as a complication of surgery , but the majority consider it as intra operative finding that makes certain difficulty and many researchers studied this surgical finding and describes certain lines of management when it encountered during surgery.

-Wooten CT^[11] *et al* found that the incidence of CSF gusher is low , encountered in approximately 1% of patients underwent C.I surgery and is seen in equal incidence in children and adults in their series. Preoperative CT scan was predictive in only 50% of cases. intraoperative management may require complete packing of the middle ear space in addition to cochleostomy site to control CSF leak . Lumbar drain rarely necessary. they concluded that gusher can be encountered in cochlear malformations and in cochlea without apparent malformations.

- Papsin BC^[12] in his study reported a relatively high incidence of perilymph leak (6.7 %) and

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he correlated this with the incidence of anomalous cochleovestibular anatomy .

- Kim LS^[8] *et al* reported such high incidence of gusher in his large series over 10 years on 212 children and estimate the incidence of gusher at (10.37 %).

- Arnoldner C^[9] *et al* in a large series of 342 operation at Vienna hospital from 1994-2003 found that the gusher occurred in (2.53%) of patients.

For such studies , there is difference in incidence , amount and severity of CSF gusher which can be managed from simple elevation of the head of the patient to more difficult cases requiring lumbar drain .

- Intracochlear ossification varies widely between cases and may be simple new bone formation at site of cochleostomy to more severe type when the cochlea is entirely ossified.

In our study we encountered 9 patients (7.5%) with intracochlear ossification , 7 of them successfully implanted through further drilling the basal turn of cochlea till reach patent scala tympani . In the other two patients, patent scala tympani was not found inspite of further drilling in basal turn of cochlea.

Intracochlear ossification mentioned in many studies and its incidence varies widely:

- Arnoldner C^[9] in his study reported incidence of intracochlear ossification of (10.23%).

- Johann K^[13] *et al* studied the complications of C.I surgery in 366 patients and obliteration of cochlea found in (18%) in his study.

- Luetje CM^[14] *et al* considered in their study that the most common obstacle in C.I surgery was ossification which was present in 40% of cases and this is a high percent in comparable to our study.

- Ito J^[15] *et al* mentioned the complications associated with C.I surgery to include difficulty in drilling the ossified cochlea , electrode displacement and insufficient insertion of the electrode

CONCLUSION:

- C.I surgery is now well practiced , and difficulties during surgery are infrequent for example :anterior displaced sigmoid sinus, middle ear granulation tissue, aberrant facial nerve, CSF gusher and intracochlear ossification.
- Most of these difficulties can be effectively managed during surgery and only a small percent associated with failure to implantation.

• Surgical management of certain obstacles encountered during surgery demands expert knowledge and surgical technique for successful implantation. for these reasons we recommend to have

preoperative imaging with HRCT and MRI , and to increase skills of the surgeons by attending international meetings and advanced training courses .

• Well preparation of the patient decreases the difficulty during surgery.

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