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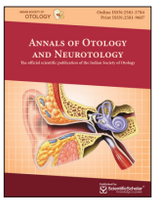

Original Article

Cochlear Implantation in Chronic Otitis Media

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ABSTRACT

Objectives: The objective of our study was to analyze outcomes and complications following staged cochlear implant (CI) surgery in patients with preexisting chronic otitis media (COM).

Material and Methods: Medical records of all consecutive patients who underwent CI surgery between October 2004 and May 2013 were retrospectively reviewed from two tertiary units -Breach Candy hospital and Hinduja hospital Mumbai, India. Patients who were found to have a history of COM preceding cochlear implantation were enrolled in the study. Those patients who had missing preoperative, intraoperative or post-operative details and those in which post-operative hearing outcomes were not available were excluded. Clinical charts were reviewed for medical history, aetiology of hearing loss, type of cochlear implant and electrode, surgical management of implanted ear and post-operative complications. A staged CI surgery was performed in all cases. Patients were followed up for 2 years to assess audio-logical performance as assessed by Category of audio-logical perception scale (CAP) score.

Results: During October 2004 and May 2013, 1506 patients underwent cochlear implantation. Fourteen patients (0.9%) were identified with COM. The median (IQR) age at implantation was 15 (6.4–33). All 14 patients had a successful switch on. Post-operatively, one patient developed post-aural stitch abscess and another had temporary facial palsy. Both patients were treated and they recovered well. The hearing outcome as assessed by CAP score at 2 years was good; median (IQR) 12 (8.5–12).

Conclusion: Staged cochlear implantation is possible in patients with COM if appropriate measures are taken to prepare the ear for implantation to minimize the potential risk of complications and yield good results in terms of restoration of hearing.

Key words: Category of audio-logical perception scale score, Chronic otitis media and Cochlear implantation.

INTRODUCTION

Chronic otitis media (COM) results from chronic inflammation of the middle ear and mastoid cavity. It is reportedly one of the most common preventable causes of deafness, especially in developing countries.[1] Sensori-neural hearing loss can occur as a secondary effect resulting from complications or sequelae of COM, such as serous or suppurative labyrinthitis, labyrinthine fistula, or cholesteatoma invading the labyrinth.[2]

Cochlear implant (CI) surgery helps to restore hearing in patients with sensori-neural hearing loss.[3,4] However, historically, the presence of otitis media or a history of chronic or recurrent otitis media has represented a relative risk factor for increased complications after CI surgery.[5] Most surgeons fear that the introduction of a foreign device in an infected mastoid cavity or middle ear puts the patient at risk for possible intracranial spread of infection following cochlear implantation.[6] However, in the recent past, there have been some published reports of CI surgery being performed in COM using different techniques, and the results are variable.[7,8] Data demonstrating the safety and efficacy of cochlear implants in patients with chronic otitis media are inadequate, especially from developing countries like ours. We reviewed all patients with COM and profound hearing loss in whom CI surgery was done from October 2004 to May 2013 in our CI program. The study aimed to analyze the outcomes and complications following staged CI surgery in patients with preexisting COM.

MATERIAL AND METHODS

Medical records of all 1506 consecutive patients who underwent CI surgery between October 2004 and May 2013 were retrospectively reviewed from two tertiary units—Breach Candy Hospital and Hinduja Hospital, Mumbai, India. Out of these, 18 patients were found to have COM either as the cause

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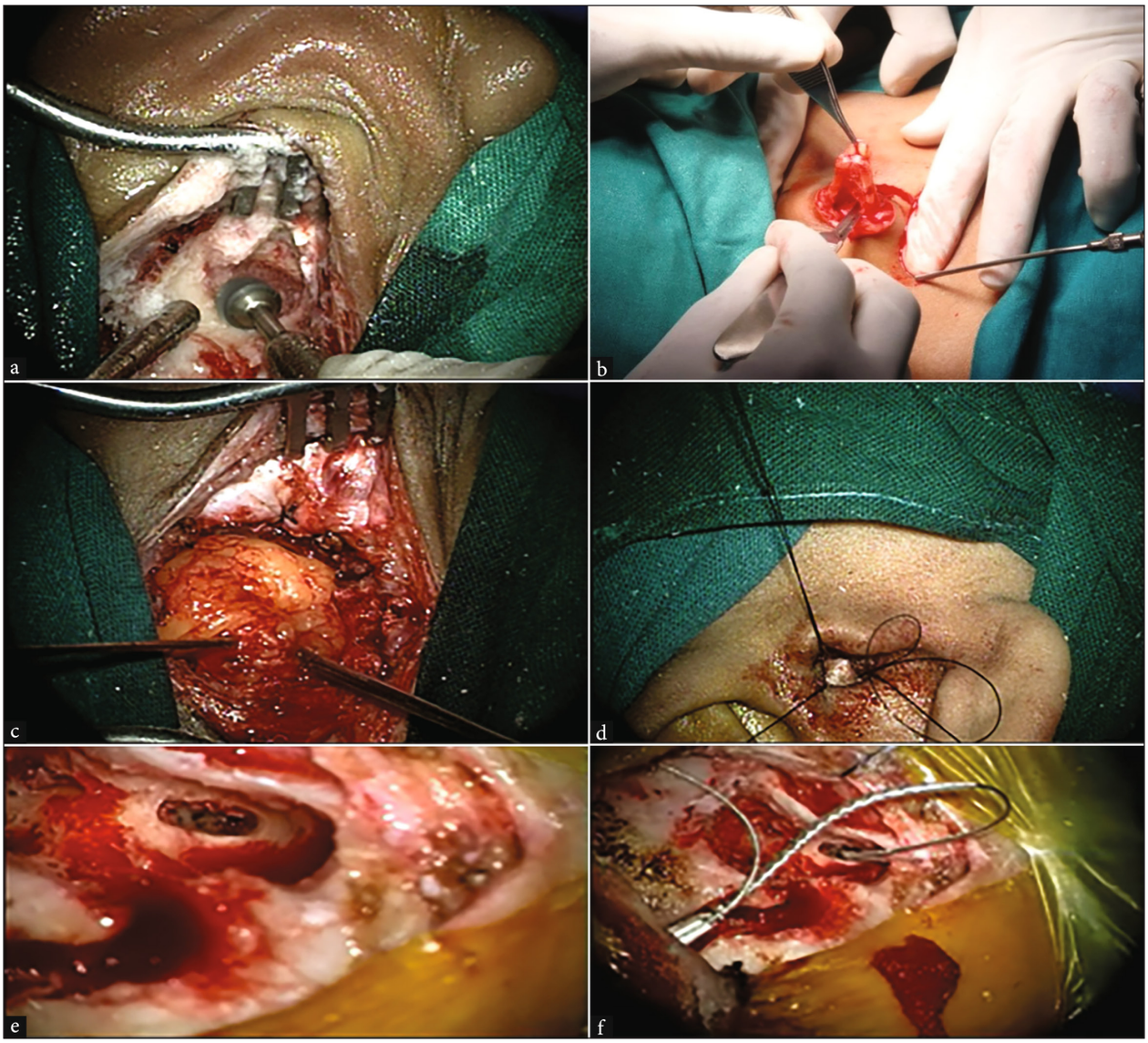

Figure 1: Surgical technique. (a) Canal wall-down mastoidectomy. (b) Harvesting the abdominal fat. (c) Obliteration of the mastoid cavity with abdominal fat. (d) Blind sac closure of the external auditory canal. (e) Cochleostomy and (f) Insertion of cochlear implant.

of profound hearing loss or as an incidental finding. Patients who were found to have a history of COM preceding Cochlear implantation were enrolled in the study. Those patients who had missing preoperative, intraoperative, or postoperative details and those in which postoperative hearing outcomes were not available were excluded. Clinical charts were reviewed for medical history, etiology of hearing loss, type of cochlear implant and electrode, surgical management of implanted ear, and postoperative complications.

All surgeries were performed by the same surgical team. Preoperative evaluation, including otologic examination, Computerised tomography scan or magnetic resonance imaging, pure tone audiometry, and speech audiometry with and without hearing aids, was carried out as per protocol. All our patients were vaccinated against Haemophilus influenza type B and Streptococcus.

Surgical Technique

In this study, two-stage modified CI was performed in most cases in the following order [Figure 1];

1. First Stage: The first stage of the modified CI surgery involved the following steps: (a) retroauricular incision with development of a musculo-periosteal flap; (b) canal wall-down mastoidectomy; (c) obliteration of the eustachian tube opening; (d) identifying the round

Table 1: Demographic characteristics of the patients.

Characteristics	Data (n = 14)
Age (years)*	15 (6.4–33)
Duration of hearing impairment (years)*	5.8 (2–8)
Laterality (*n*)	
Right	9
Left	4
Bilateral	1

*Signifies median (Inter-quartile range).

Table 2: Outcomes and complications.

Patient parameters	Data (n = 14)
Successful switch on, *n* (%)	14 (100%)
Complications	
Facial nerve palsy	1
Infection	1
CNS complication	0
Device failure	0
CAP scores*	12 (8.5–12)

CAP scores [*Signifies Median (Inter-quartile range)]. CNS-Central nervous system, CAP-Category of audio-logical perception.

window and placing cartilage over it; (e) obliteration of the tympanomastoid cavity with abdominal fat; and (f) blind sac closure of the external auditory canal.

2. Second Stage: The second stage of the modified CI surgery involved the following steps: (a) identification of the previously drilled mastoid cavity and removal of fat; (b) removal of cartilage over a round window; (c) cochleostomy and insertion of a cochlear implant; and (d) closure of subcutaneous soft tissue and skin in two layers.

We did a radical mastoidectomy with blind sac closure in thirteen patients. In one patient, underlay tympanoplasty type I was performed, followed by a cochlear implant after 1 year.

Follow-up

All patients received peri-operative antibiotics and were followed up for complications such as post-operative infection, facial palsy, any central nervous system (CNS) complication, device extrusion or displacement, and failed switch-on. Patients were asked to follow up as per the standard schedule of our program—once weekly for 3 months, then once fortnightly for 3 months, and then once monthly for the next 6 months. Mapping was done as per standard protocol. Category

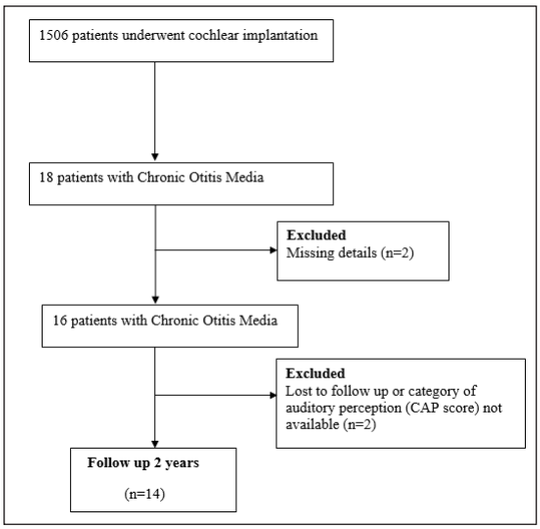

Figure 2: Study flow.

of Auditory Perception Scale (CAP) Scores of the Shepherd Centre's revised version, based on the Nottingham CI Program, 1995, was used to assess objectively the audiological performance of the patients on follow-up at 2 years post-surgery. CAP is an index consisting of twelve performance categories relating to auditory perception. It is arranged in a hierarchy of skills that increase in difficulty, for example, from the ability to perceive environmental sounds right up to using the telephone. It is widely used in the range of current research on children with cochlear implants and is an easy-to-use tool for monitoring progress.

Statistical analysis

The results were analyzed using SPSS software, version 19.0. Mean standard deviation (SD), median interquartile range (IQR), and range were calculated as applicable.

RESULTS

During October 2004 and May 2013, 1506 patients underwent cochlear implantation [Figure 2]. Fourteen patients (0.9%) were identified with COM. The demographic profile of patients with COM and the type of implant is summarised in Table 1. The study group consisted of 12 males and 2 females. The median (IQR) age at implantation was 15 (6.4–33) years. There was a wide variation in the age distribution of patients [Figure 3]. All 14 patients had a successful switch on Table 2. The complications we encountered were minor: one patient developed a post-aural stitch abscess, which healed with systemic antibiotics and topical application. Another patient had temporary post-OP facial palsy, for which systemic steroids were started immediately. The patient was also advised of facial exercises, and he recovered completely. The hearing outcome, as assessed by the Category of Auditory Perception

Table 3: Case series and characteristics of patients.

Patient	Age (years)	Sex	Duration of illness	Implant side	Surgery	Date of surgery
1	12	Male	6 years	Right	2 staged tympano plasty, followed by CI	December 2003–July 2004
2	52	Female	Child-hood	Right	2 staged blind sac closure, followed by CI	March 2005–July 2005
3	32	Male	15 years	Left	2 staged blind sac closure, followed by CI	June 2004–December 2004
4	36	Male	1 year	Right	2 staged blind sac closure, followed by CI	June 2005–April 2006
5	24	Male	3 years	Right	2 staged blind sac closure , followed by CI	October 2006–June 2008
6	8	Male	7 years	Right	2 staged blind sac closure, followed by CI	May 2010–May 2011
7	55	Female	5.5 years	Right	2 staged blind sac closure, followed by CI	June 2011–February 2012
8	18	Male	6 months	Left	2 staged blind sac closure, followed by CI	March 2013–September 2013
9	11	Male	Birth	Right	2 staged blind sac closure, followed by CI	August 2011–November 2011
10	6.5	Male	Birth	Bilateral	Bilateral 2 staged surgery—Blind sac closure followed by CI	Right blind sac May 2010, CI September 2010 Left blind sac October 2011, CI February 2012
11	3	Male	2.5 years	Right	2 staged blind sac closure, followed by CI	January 2013–April 2013
12	25	Male	2 months	Left	2 staged blind sac closure, followed by CI	April 2013–October 2013
13	3	Male	6 years	Right	2 staged blind sac closure, followed by CI	April 2013–October 2013
14	6	Male	Birth	Left	2 staged blind sac closure, followed by CI	May 2013–November 2013

CI-Cochlear implant.

Scale (CAP) score at 2 years, was good; median (IQR) 12 (8.5–12). The case series is depicted in Table 3.

DISCUSSION

Most surgeons would prefer to avoid Cochlear implantation in patients with COM. Insertion of an electrode in a potentially infected field is fraught with the risk of infecting a space that communicates intracranially. Most surgeons prefer a staged procedure for implantation in patients with purulent COM or cholesteatoma.[9,10] In the case of a COM, a CI can be placed after a delay of 3–6 months if the disease is eradicated. In our study, we did a radical mastoidectomy with blind sac closure in 13 patients with COM. We performed underlay tympanoplasty type I followed by cochlear implant after 1 year in 1 patient. We found that with this staged technique of Cochlear implantation in patients with pre-existing COM, good hearing outcomes, as assessed by CAP scores, were achieved.

For patients with COM or existing mastoid cavities, blind sac closure and cavity obliteration an effective technique to facilitate safe cochlear implantation. Both single-staged (elimination of inflammation and CI performed simultaneously) and staged approaches (elimination of inflammation through tympanoplasty, tympanomastoidectomy, or subtotal petrosectomy, followed by implantation of electrode in the inflammation-free cavity 3–6 months later) have been adopted. Incesulu et al.[10] in 6 patients, Yoo et al.[11] in 8 patients, and Kojima et al.[12] in 7 patients with COM reported the feasibility of single-stage or staged CI depending on active inflammation without major complications. In a retrospective study by Yoon et al.,[13] a total of 36 patients with COM underwent single-staged or

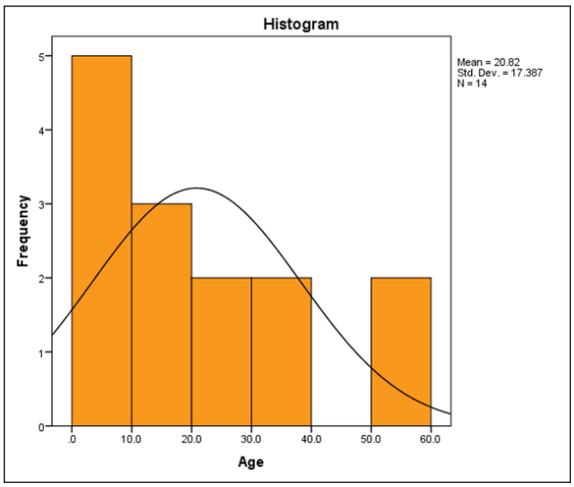

Figure 3: Age (in years) distribution of patients.

staged CI. The authors used the CAP score to assess hearing outcomes, and the average follow-up was 3.1 years (range 0.5–9.2 years). The authors also analyzed the outcomes of 25 patients who underwent subtotal petrosectomy and external auditory canal closure with cavity obliteration using abdominal fat. In contrast to our study, single-staged CI was performed in these cases, but similar results of an improvement in post-operative CAP scores were reported.

Some authors have reported the feasibility and complications of single-staged CI in COM. In a retrospective study, Vashishth et al.[14] enrolled 35 patients with COM, of whom 31 underwent single-staged subtotal petrosectomy with CI. A higher rate of device extrusion (4%) reported was explained by the authors to be a result of wound retraction following obliteration of the mastoid cavity with fat. The authors, however, did not report hearing outcomes. We also used abdominal fat for cavity obliteration but did not find device extrusion in any patient, probably because we did a staged CI, and that allowed time for healing of the wound, diminishing the possibility of wound retraction. Another study on single-staged CI that included 24 patients with COM reported no postoperative complications except a device extrusion at 5 months. The authors reported that in patients without cochlear ossification, the speech perception of disyllabic words in quiet on follow-up at 6 months was comparable to other indications of CI.[15] Similarly, El Kashlan et al., in a retrospective case series, evaluated surgical techniques and complications associated with the external auditory canal (EAC) closure in single-staged cochlear implant surgery. A total of 28 patients underwent multichannel cochlear implantation with EAC closure and were followed up for complications for 1–10 years. No hearing outcome was assessed. Postoperatively, cholesteatoma developed in the implanted ear in two patients.[16]

Staged CI in COM has also been successfully described, similar to our study. Xenellis et al.[17] studied blind-sac closure of the external ear canal without obliteration followed by CI after 6 months in 9 patients (4 patients with adhesive otitis media and 5 with radical mastoid cavities) and reported no major complications. Nevertheless, in this small case series, hearing outcomes were not reported. In the largest case series published,[18] 39 CI patients whose deafness was attributed to COM, eight were staged, and 31 patients were implanted at a single stage. In the staged cases, two patients had tympanoplasty, and six patients had radical mastoidectomy with fat obliteration and blind sac closure of the external auditory canal before CI. Twenty-four out of the 31 non-staged implantation patients already had radical cavities, and these were implanted with cavity obliteration. The remaining seven cases were radicalized at the same stage as implantation. Early surgical complications reported in two patients were skin flap breakdown and slippage of electrode towards the temporomandibular joint (TM) joint. In seven cases, a late complication of disruption of cavity epithelium was observed. The authors reported satisfactory hearing results in all patients except one at 1–5 years after implantation speech discrimination score (SDSv) with monosyllabic word list between 59 and 89%, median 67.4%). Whereas in the above study by Olgon et al.,[18] only 8 CI were staged, in our study, we reported satisfactory hearing outcomes in 14 staged CI: 13 patients following radical mastoidectomy, blind sac closure with obliteration, and 1 after tympanoplasty. In another series of 17 patients, Leung R et al.[19] evaluated the results of mastoid obliteration, and CI performed as a two-stage procedure in 10 patients and as a single-stage procedure in 7. Two patients required revision of the mastoid obliteration. At follow-up, all patients had stable obliterated cavities. Fifteen patients obtained significant improvement in speech discrimination scores, whereas 2 patients obtained some benefit from the cochlear implant through the perception of environmental sounds.

There are no randomized-controlled trials that have systematically evaluated the hearing outcomes and complications of staged vs. single-stage CI. In a retrospective study conducted on patients with COM, Jang et al.[20] evaluated long-term speech performance as assessed objectively by open-set sentence score percentage in 17 patients in whom single-stage surgery was performed and 13 who underwent two-stage surgery. No patient in either group developed recurrent infections, cholesteatoma, or any intracranial complication. Both groups exhibited statistically similar speech scores at 1, 2, 3, and 5 years follow-up. However, at every time point, patients in the two-stage group showed higher scores than the single-stage group, but the difference did not reach statistical significance. Interestingly, the difference in speech scores between the two groups decreased over time. Although this is a small retrospective study, it generates a good hypothesis to conduct a randomized controlled trial in selected patients of COM to compare the efficacy of single-staged vs. staged surgery.

The above literature suggests considerable variability in the approach of surgeons in treating COM, with some adopting one-stage surgery while others recommending two-stage surgery. Most surgeons, however, recommend two-stage surgery, especially when inflammation in COM is active. We performed a two-stage procedure in all patients, as a matter of abundant precaution to avoid complications of doing CI in a cavity with possible infection. The strength of our study is that it is one of the largest case series that has addressed the issue of performing staged CI in COM. We followed a uniform protocol in all patients, and to the best of our knowledge, this is the first case series from India that describes the immediate postoperative outcomes of CI in patients with COM as well as auditory outcomes at 2 years following surgery as assessed by CAP scores. The limitation of our study is its retrospective nature and small sample size.

CONCLUSION

We conclude that staged cochlear implantation is possible in patients with chronic otitis media if appropriate measures are taken to prepare the ear for implantation to minimize the potential risk of complications and yield good results in terms of restoration of hearing.

Ethical approval: The research/study approved by the Institutional Review Board at PD Hinduja Hospital and Medical Research Centre, dated 8th January 2025.

Declaration of patient consent: Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest: There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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