

ORIGINAL ARTICLE

Postoperative Complications Following Cochlear Implantation: a Descriptive Cross-Sectional Study on a Novel Program at a Tertiary Care Hospital

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ABSTRACT

Objective: To determine the frequency and types of postoperative complications in patients undergoing cochlear implantation at a tertiary care hospital.

Study Design: Retrospective descriptive study.

Place and Duration of Study: This study was conducted at the Department of ENT, Combined Military Hospital (CMH), Rawalpindi, Pakistan, from April 2017 to May 2022.

Methods: All patients who underwent cochlear implantation during the study period were included. Surgeries were performed by three surgeons with comparable experience using a standardized postauricular transmastoid approach and a uniform perioperative and postoperative protocol. Patients were assessed for immediate and delayed complications during hospitalization and follow-up visits. Complications were classified as major (requiring surgical intervention or device replacement) or minor (managed conservatively). Data were analyzed using SPSS version 23, and descriptive statistics were used to calculate frequencies and percentages.

Results: A total of 324 patients underwent cochlear implantation. Of these, 190 (58.6%) were below 5 years of age, 122 (37.6%) were between 5–12 years, and 12 (3.7%) were older than 12 years. Postoperative complications were observed in 41 patients (12.65%). Major complications occurred in 19 patients (5.86%), and minor complications in 22 patients (6.79%). Device failure was the most common major complication occurring in 4 patients (1.23%). The most frequent minor complications were tympanic membrane perforation and minor wound infection, each occurring in 4 patients (1.23%). No cases of meningitis or mortality were reported.

Conclusion: Cochlear implantation is a safe and effective surgical procedure for auditory rehabilitation in patients with profound hearing loss. The overall complication rate in this study was 12.65%, with most complications being minor and manageable. Careful surgical technique and standardized perioperative protocols help minimize complications and improve patient outcomes.

Keywords: Cochlear Implants, Postoperative Complications, Infections, Device Failure.

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Introduction

Cochlear implantation (CI) is a well-established

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surgical intervention for the management of severe-to-profound sensorineural hearing loss (SNHL) in patients who derive limited benefit from conventional hearing aids. Since the first clinical applications of cochlear implantation, advances in implant design, electrode arrays, surgical techniques, and perioperative care have substantially improved auditory outcomes and reduced complication rates. By directly stimulating the auditory nerve and bypassing damaged cochlear hair cells, cochlear implants have revolutionized

auditory rehabilitation, significantly improving speech perception and quality of life in both pediatric and adult populations.¹

Despite its proven efficacy and safety, cochlear implantation, like all surgical procedures involving implantation of a foreign device, carries a risk of postoperative complications. These complications range from minor, self-limiting conditions such as wound infection and transient vertigo to more serious events, including device failure, flap necrosis, facial nerve injury, and, rarely, meningitis.²

Postoperative complications are commonly categorized into major and minor types. Major complications are defined as those requiring surgical intervention, device explantation or reimplantation, or prolonged hospitalization, while minor complications are those that can be managed conservatively without the need for surgical intervention. This classification is useful for clinical decision-making and for comparing outcomes across different centers.³⁻⁵

Although several studies have reported complication rates ranging from 10% to 20%, there is limited data from newly established cochlear implant programs in developing healthcare settings. Evaluating outcomes from such programs is essential for assessing safety, identifying potential areas for improvement, and ensuring adherence to international standards of care.

The present study aims to evaluate the frequency and spectrum of postoperative complications in patients undergoing cochlear implantation at our institution since the initiation of our cochlear implant program. By analyzing these outcomes, we seek to contribute to the existing body of evidence and support the continued optimization of surgical and postoperative management protocols.

Methods

This retrospective descriptive study was conducted at the Department of ENT, Combined Military Hospital (CMH), Rawalpindi, Pakistan, from April 2017 to May 2022, after obtaining approval from the hospital's Ethical Committee vide letter no: 507, dated: 05th March 2017.

Patients of either gender aged between 1 and 50 years who underwent cochlear implantation during the study period were included. Patients younger than one year or older than 50 years, those with

cochlear abnormalities, significant comorbid conditions, or incomplete medical records were excluded from the study. For analysis, patients were divided into three age groups: Group A, below 5 years; Group B, 5–12 years; and Group C, above 12 years. All patients received pneumococcal vaccination before surgery.

All patients underwent a comprehensive preoperative assessment, including clinical examination, audiological evaluation, routine laboratory investigations, and radiological assessment with computed tomography and magnetic resonance imaging of the temporal bone. Radiological imaging was performed to assess cochlear anatomy, surgical suitability, and associated anatomical or neurological abnormalities. Anesthesia fitness was obtained in all cases. Written informed consent was taken from adult patients or from parents/guardians in pediatric cases.

Patients were admitted one day before surgery. Prophylactic antibiotics were administered according to institutional protocol. Surgeries were performed by three surgeons with comparable experience in cochlear implantation. Implants from Med-El, Advanced Bionics, and Cochlear were used. A standard postauricular transmastoid approach was followed in all cases. After cortical mastoidectomy and posterior tympanotomy, the receiver-stimulator was placed in a prepared bony well, and the electrode array was inserted into the cochlea. Intraoperative neural response telemetry was performed to confirm electrode function.

Postoperatively, a pressure dressing was applied, and radiological confirmation of electrode placement was performed. Patients were monitored during hospital stay for immediate postoperative complications. Follow-up visits were carried out at one week for wound assessment and suture removal, at six weeks for implant activation, and subsequently for mapping and monitoring of delayed complications. All patients were followed for at least one year after surgery.

Postoperative complications were classified as major or minor. Major complications were defined as those requiring surgical intervention, explantation, reimplantation, or prolonged hospitalization. Minor complications were defined as those managed conservatively without surgical intervention or

prolonged admission.

Data were analyzed using SPSS version 23. Descriptive statistics were calculated, and categorical variables were presented as frequencies and percentages.

Results

A total of 324 patients underwent cochlear implantation during the study period. The cohort included 182 males (56.2%) and 142 females (43.8%) (Figure 1).

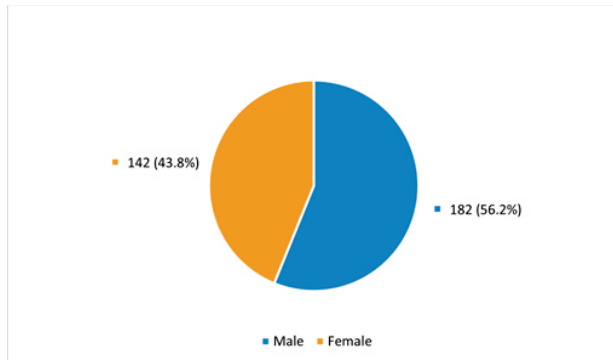


Fig.1: Gender Distribution of Patients N (%)

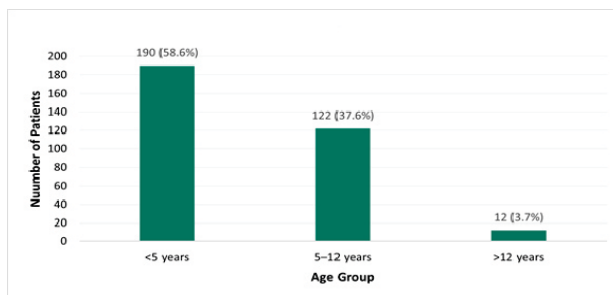


Fig.2: Age Distribution of Study Population N (%)

The majority of patients were below 5 years of age (190; 58.6%), followed by 122 patients (37.6%) aged

between 5 and 12 years, and 12 patients (3.7%) older than 12 years (Figure 2).

The mean age of patients was 3.48 ± 1.19 years in the 1–5 years group, 6.28 ± 1.70 years in the 5–12 years group, and 27.71 ± 10.01 years in the adult group. Most patients were pre-lingual (307; 94.7%), while 17 patients (5.3%) were post-lingual.

Postoperative complications were observed in 41 patients, giving an overall complication rate of 12.65%. Of these, 19 patients (5.86%) experienced major complications, while 22 patients (6.79%) had minor complications.

Among major complications, device failure was the most common occurring in 4 patients (1.23%). Other major complications included facial nerve paralysis in 3 patients (0.92%), flap necrosis in 3 patients (0.92%), electrode-related issues (misplacement/retraction and extrusion) in 4 patients (1.22%), cerebrospinal fluid leakage in 1 patient (0.30%), and hematoma/seroma in 4 patients (1.23%).

Among minor complications, tympanic membrane perforation and minor wound infection were the most frequently observed, each occurring in 4 patients (1.23%). Other minor complications included transient facial paresis (3; 0.92%), pain (3; 0.92%), otitis media (2; 0.61%), headache (2; 0.61%), vertigo (2; 0.61%), chorda tympani discomfort (1; 0.30%), and hemifacial swelling (1; 0.30%).

No cases of meningitis, persistent facial nerve stimulation, or mortality were observed during the study period. Detailed distribution of complications is presented in Tables 1 and 2.

Table 1: Major Complications Found Postoperatively After Cochlear Implantation

S/No	Complications	Frequency	Treatment
1.	Device Failure	4 (1.23%)	Explantation and a new implant were placed
2.	Facial Nerve Paralysis	3 (0.92%)	Steroids and physiotherapy; partial recovery in two patients
3.	Flap Necrosis	3 (0.92%)	Explantation and revision surgery after 06 months
4.	CSF Leakage	1 (0.30%)	Managed conservatively
5.	Misplaced/retraction of the electrode	2 (0.61%)	Picked up early, exploration, and reinsertion
6.	Extrusion of electrode	2 (0.61%)	Corrected by cartilage tympanoplasty
7.	Hematoma/seroma	4 (1.23%)	Aspiration and antibiotics
	Total	19 (5.86%)	

Table 2: Minor Complications Found Postoperatively After Cochlear Implantation

S/No	Complications	Frequency	Treatment
1.	Tympanic membrane perforation	4 (1.23%)	Temporalis fascia grafting
2.	Minor wound infection	4 (1.23%)	Antibiotics
3.	Transient facial paresis	3 (0.92%)	Conservative treatment
4.	Otitis media	2 (0.61%)	Antibiotics and decongestants
5.	Pain	3 (0.92%)	Analgesics and reassurance
6.	Headache	2 (0.61 %)	Analgesics and reassurance
7.	Vertigo	2 (0.61%)	Vestibular sedatives
8.	Chorda tympani discomfort	1 (0.30%)	Conservative treatment
9.	Hemifacial swelling	1 (0.30%)	Analgesics and reassurance
	Total	22 (6.79%)	

Discussion

Post-operative complications of cochlear implantation have been categorized into major and minor complications, depending on the severity of the condition. Major complications are those that cause significant medical issues (e.g., meningitis), events that lead to additional surgery (e.g., exploration, admission, explantation), or permanent disability (e.g., facial nerve paralysis, stimulation, persistent tinnitus). Minor complications are defined as issues that do not require admission or active surgical intervention, such as minor infection, tympanic membrane perforation, transient facial paresis, hemifacial swelling, temporary headache, vertigo, or tinnitus.

In our study, 41 patients (12.65%) experienced postoperative complications. The incidence of postoperative complications in various studies ranges from 10% to 20%. Dankuc D et al. reported a 10.5% incidence; Ahmed J et al., 10.4%; and Halawani R et al., 10.5%, while Castro GR et al. reported 15.5%, Sefein IK, 18.75%, and Farinetti A et al., 19.9%. Therefore, the overall complication rate in our series is comparable to that reported in the literature.^{3,6-10}

Device failure was the most common major complication in our study. We had 4 cases of device failure (1.23%), identified at different intervals after activation when the device stopped functioning. All cases underwent successful reimplantation. The incidence of device failure in our study is comparable to previously reported rates, including 0.8% by Ahmed J et al., 1.5% by Elfeky AE et al., 1.01% by Dankuc D et al., and 1.1% by Garrada M et al. and Lane.^{6,7,11-13}

We also encountered 3 cases (0.92%) of

postoperative facial nerve paralysis. Treatment was initiated with steroids and physiotherapy; two patients showed partial recovery, while one patient did not show improvement after 6 months. Our results are comparable to other studies, where the incidence of facial nerve paralysis was reported as 2.1% by Sahai I et al., 1.4% by Garrada M et al. and 4.8% by Halawani R et al.^{6,12,14}

In two cases (0.61%), the electrode was found to be malpositioned and retracted. This was detected early on postoperative imaging, and both patients were re-explored with successful reinsertion of the electrode. The incidence of electrode retraction in previous studies has been reported as 1.78% by Sefein IK and 1.5% by Elfeky AE et al., which is slightly higher than that observed in our series.^{9,11}

In two patients (0.61%), extrusion of the electrode into the external auditory canal was identified through a perforated tympanic membrane, in which the bony wall of the external auditory canal was thinned or damaged. Both patients were managed by cartilage tympanoplasty, and the electrodes were safely repositioned. Although electrode extrusion is an uncommon complication, early recognition is important to preserve implant function and prevent further morbidity.

We also faced 3 cases (0.92%) of flap necrosis. Two cases began as postoperative infections and progressed to flap necrosis with implant exposure, while one case presented after one year with implant infection and flap necrosis. All cases were treated with explantation, leaving the electrode array in the cochlea, and, where required, skin grafting and reimplantation after 6 months in the opposite ear. AlKhtoum N et al. reported a 2.3% incidence of flap infection; Abdulbaset reported less than 1%; and

Ahmed J et al. reported 0.8%.^{7,15,16}

One case of CSF gusher was encountered and managed by sealing the cochleostomy site with fat and muscle tissue, followed by conservative management. Previous studies have reported the incidence of CSF gusher to range from 0.4% to 5.58%, while Garrada M et al. reported an incidence of 1.4%.¹² The low incidence in our study may reflect careful preoperative radiological assessment and exclusion of patients with significant inner ear malformations.^{9,17}

We encountered 4 patients (1.23%) who developed postoperative seromas or hematomas. These were managed conservatively with a pressure dressing, while one patient required aspiration, followed by a pressure dressing and broad-spectrum antibiotic cover. All patients recovered without further surgical intervention.

Among the minor complications, tympanic membrane perforation and minor wound infection were the most common, with 4 cases (1.23%) each. Tympanic membrane perforation occurred during posterior tympanotomy and was detected intraoperatively. All such cases were managed by grafting with the temporalis fascia. Minor wound infections were managed with injectable antibiotics for 5–7 days. Similar minor wound-related complications have been reported in previous cochlear implant series, and most are successfully managed with early antibiotic therapy and local wound care.¹⁸⁻²⁰

Transient facial paresis was observed in 3 patients (0.92%) and resolved after a short course of steroids and physiotherapy. Postoperative acute otitis media was seen in 2 patients (0.61%) and was managed with antibiotics and decongestants. These findings are consistent with published studies in which transient facial weakness and middle ear infections are described as uncommon but recognized postoperative complications that usually respond well to conservative treatment.¹⁸⁻²⁰

Postoperative vertigo was observed in 2 patients (0.61%), both adults, and was managed with bed rest and vestibular sedatives. Both patients recovered uneventfully after one week. The frequency of vertigo in our study was lower than in several reported series, in which vestibular symptoms were described more frequently, particularly among adult

recipients. This difference may be related to variation in age distribution, surgical technique, reporting methods, and duration of follow-up.

This study highlights the spectrum of postoperative complications associated with cochlear implantation and emphasizes the importance of meticulous surgical planning, comprehensive patient education, and vigilant postoperative monitoring. Our findings are comparable with previously published studies, which suggest that although complications may occur, most are minor, manageable, and do not compromise the overall safety and effectiveness of cochlear implantation when standardized care protocols are followed.

This retrospective single-center study may have limited generalizability. The absence of a control group and variations in follow-up duration among patients may have influenced the detection of delayed complications.

Conclusion

Cochlear implantation is a safe and effective surgical intervention for the rehabilitation of patients with profound sensorineural hearing loss. In this study, conducted within a newly established cochlear implant program, the overall postoperative complication rate was 12.65%, which is comparable to international standards. The majority of complications were minor and could be managed conservatively, while major complications were infrequent and successfully addressed with appropriate intervention.

These findings highlight that with standardized surgical techniques, adherence to perioperative protocols, and structured follow-up, favorable outcomes can be achieved even in emerging cochlear implant programs. Continuous monitoring and refinement of surgical and postoperative practices remain essential to further minimize complications and optimize patient outcomes.

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Conflict of Interest: The authors declare no conflict of interest

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Author Contributions

MA: Conception, design of the work, and approval for final submission

MRK: Manuscript writing for methodology design, investigation, and approval for final submission

KOKN: Data acquisition, curation, statistical analysis, and approval for final submission

KZM: Validation of data, interpretation, write-up of results, and approval for final submission

UAM: Revising, editing, supervising for intellectual content, and approving for final submission

JA: Writing the original draft, proofreading, and approval for final submission

MA is the nominated guarantor and takes full responsibility for the overall content and integrity of the work