CASE REPORT

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Perioperative nursing care for cochlear implantation in children with congenital ear malformations: A case study

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ABSTRACT

Background: Cochlear implantation in children with congenital ear malformations presents unique perioperative challenges due to anatomical variations. Comprehensive perioperative care is essential for optimal outcomes, yet literature on nursing management for these complex cases remains limited.
Objective: To document the perioperative nursing approach for cochlear implantation in a pediatric patient with congenital ear malformation and establish evidence-based protocols for similar cases.
Case: A 9-year-old child diagnosed with bilateral profound sensorineural hearing loss with Mondini malformation (incomplete partition) underwent left cochlear implantation. The patient had previously undergone right cochlear implantation two years prior with successful outcomes. Perioperative management included comprehensive preoperative assessment with special attention to craniofacial anomalies, intraoperative monitoring for cerebrospinal fluid leakage and facial nerve function, and postoperative care focusing on pain management, infection prevention, and family education. Despite anatomical challenges, the procedure was successfully completed with 10 of 12 electrodes functioning properly, and the patient was discharged on postoperative day two without complications.
Conclusion: Successful cochlear implantation in children with congenital ear malformations requires a multidisciplinary approach with specialized perioperative nursing care. This case demonstrates that with proper preoperative planning, intraoperative vigilance, and comprehensive postoperative management, good functional outcomes can be achieved despite complex anatomical challenges. Standardized protocols for perioperative care in these cases can significantly improve patient safety and surgical outcomes.

Keywords: cochlear implantation; congenital ear malformation; mondini malformation; perioperative nursing; pediatric

INTRODUCTION

Cochlear implantation is a complex procedure that is the primary choice for managing patients with severe to profound bilateral hearing loss unresponsive to conventional hearing aids (Derdzakyan et al., 2024). In cases of congenital ear malformations in children, cochlear implantation presents unique

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- *Specialized perioperative nursing care, supported by standardized protocols and team-based approaches, optimizes outcomes in children with congenital ear malformations.*
- *Multidisciplinary collaboration is essential, with perioperative nurses ensuring patient safety through preparation, intraoperative support, and postoperative management.*
- *Evidence-based interventions—including infection prevention, hypothermia control, multimodal pain management, discharge education, and complication monitoring—are vital for safe recovery.*

challenges for the surgical and perioperative teams. Congenital ear malformations encompass a wide spectrum of abnormalities, ranging from outer ear, middle ear, to inner ear defects, which can affect the cochlear implantation process (Vijendren et al., 2020). Comprehensive perioperative care is crucial for the success of this procedure, particularly in pediatric patients with abnormal anatomy (Bahja et al., 2022).

The prevalence of congenital ear malformations is reported to occur in approximately 1 in 3,000 live births. Data from the Indonesian Central Bureau of Statistics (BPS) in 2019 indicated that the population of Indonesia was estimated at 268,074,600, with a prevalence of congenital deafness at 0.1%, implying that around 268,074 Indonesians suffer from congenital deafness. The birth rate in Indonesia is 2.4% per year, leading to an estimated increase of 60,000 cases of congenital deafness over the past decade. This condition is often associated with significant sensorineural hearing impairment, which, if not addressed promptly and appropriately, can impact a child's language, communication, cognitive, and psychosocial development (Truong et al., 2024). Early cochlear implantation has been shown to yield better outcomes in hearing rehabilitation; however, the anatomical complexities in cases of congenital malformation require a different perioperative approach compared to cases of hearing impairment without malformations (Kalra et al., 2025).

Perioperative care for cochlear implantation in pediatric patients with congenital ear malformations necessitates a multiprofessional collaboration involving Ear, Nose, and Throat (ENT) surgeons, audiologists, anesthesiologists, and perioperative nurses (Killeen et al., 2022). The role of perioperative nurses is crucial in ensuring patient safety, preparing optimal conditions before surgery, supporting the surgical procedure, and managing postoperative care (Kay-Rivest, Friedmann, et al., 2022). A deep understanding of pathological anatomy, cochlear implant technology, and the specific needs of pediatric patients with congenital malformations is essential for perioperative nurses to provide comprehensive care (Kant et al., 2022).

Challenges in perioperative care for these cases include adequate pain management, prevention of complications, and minimizing psychological trauma for the child (Häussler et al., 2021). Comprehensive preoperative assessment involves evaluating the child's physical and psychological conditions, conducting supportive examinations, and educating parents/caregivers about the upcoming procedure. During the intraoperative phase, close monitoring of vital signs, hemodynamic status, and effective coordination with the surgical team are primary focuses. Postoperative care includes pain management, complication monitoring, wound care, and family education regarding ongoing care (Biever et al., 2022).

Literature on perioperative care for cochlear implantation in children with congenital ear malformations is still limited. This case report aims to document clinical experiences and perioperative approaches in a specific case of cochlear implantation in a pediatric patient with congenital ear malformation. The findings from this case report are expected to provide new perspectives in developing comprehensive, evidence-based perioperative care protocols for similar cases in the future. Additionally, this case report may serve as a learning resource for perioperative nurses to enhance the quality of nursing care in complex cochlear implantation cases within the pediatric congenital population.

CASE

Pediatric Patient, Male, 9 Years Old, diagnosed

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with bilateral profound sensorineural hearing loss, is scheduled for left cochlear implantation. The patient has a history of right cochlear implant surgery two years prior, with successful postoperative outcomes, including the ability to engage in two-way communication.

Preoperative phase

The preoperative phase for cochlear implantation in a pediatric patient with congenital ear malformation begins with a comprehensive assessment of the patient's health history, including a thorough physical examination with special emphasis on craniofacial anomalies that may accompany congenital ear abnormalities. The perioperative nurse verifies the results of diagnostic examinations such as temporal CT scans, head MRI, and hearing tests to obtain a clear picture of the degree of malformation and the anatomical structures involved.

Therapeutic communication with an age-appropriate approach is conducted to reduce the child's anxiety, while detailed informed consent is provided to parents covering the implantation procedure, risks, potential complications, and postoperative prognosis. The nursing team performs physical preparation of the patient including vital signs assessment, hydration status, weight measurement, and implementation of fasting protocols in accordance with pediatric anesthesia guidelines.

The perioperative nurse coordinates with the anesthesia team to identify specific challenges related to airway management in children with craniofacial malformations, ensuring the readiness of emergency equipment and medications. Intraoperative positioning is planned considering protection of malformation areas and prevention of peripheral nerve injury, while hypothermia protocols are implemented given the typically long duration of surgery in congenital malformation cases.

Preoperative laboratory examinations include complete blood count, renal function, electrolytes, bleeding time, and blood type to anticipate transfusion needs during surgery. The perioperative nurse ensures the availability of compatible blood units and performs a double-check of the cochlear implant along with special microscopic surgical equipment required for cochlear malformation cases. Education for parents and children about post-operative infection control protocols is provided considering the high risk of infection in implantation cases with abnormal anatomy.

Specific preparation related to the surgical area includes examination of the skin around the ear, minimal hair shaving at the planned incision site, and marking of the ear side to be operated on according to patient safety protocols. The perioperative nurse prepares appropriate antiseptic solutions for surgical site preparation, considering pediatric skin sensitivity, and ensures the ear area is cleaned with proper technique to prevent contamination of the ear canal. Prophylactic antibiotics are administered according to institutional protocol, typically 30-60 minutes before skin incision.

Coordination with the audiology team is conducted to ensure readiness for intraoperative examinations such as Neural Response Telemetry and electrodes appropriate to the patient's anatomical condition. The perioperative nurse also prepares intraoperative medical records and special forms for cochlear implantation, including the serial number and specifications of the implant to be used. Final assessment before transfer to the operating room is performed using a safety checklist that includes patient identification, surgical side, equipment and team readiness, and confirmation of informed consent, thus ensuring a safe transition from the preoperative to the intraoperative phase.

Intraoperative phase

The intraoperative phase of cochlear implantation in a pediatric patient with congenital ear malformation begins with careful transfer and positioning of the patient on the operating table. The perioperative nurse coordinates with the anesthesia team to ensure smooth intubation and anesthetic induction, with special anticipation for possible difficult airway in patients with craniofacial anomalies. After successful anesthetic induction, the circulating nurse assists in positioning the patient's head with rotation to the contralateral side of the ear to be operated on and slight elevation to facilitate venous drainage and reduce intraoperative bleeding.

Preparation of the surgical site is performed with strict aseptic technique using 0.5% chlorhexidine gluconate antiseptic solution in 70% alcohol, taking care to prevent antiseptic fluid from entering the ear canal. The perioperative nurse ensures a sufficiently large sterile area covering the entire ipsilateral side of the head, face to the midline, and the area behind the ear to the neck in anticipation of harvesting temporalis fascia or muscle grafts.

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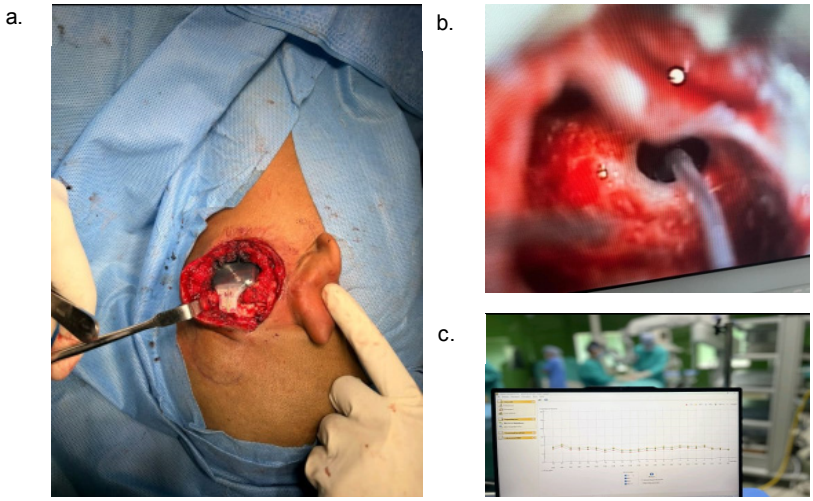

Figure 1. (a) The implant template is inserted; (b) Electrode implant placement; (c) NRT Monitoring

Draping is done by placing suction tubing near the operative area and ensuring adequate fixation to maintain the sterile field throughout the procedure, which is estimated to last 3-4 hours.

The scrub nurse prepares special microsurgical instruments for cochlear implantation according to the procedural sequence: incision and flap set, mastoidectomy set, posterior tympanotomy set, and electrode insertion set. The perioperative nurse also reverifies the cochlear implant with the audiologist, performs implant integrity checks, and ensures electrode compatibility with the patient's cochlear malformation condition. In this case of Mondini-type cochlear malformation (incomplete partition), the surgical team selects a straight electrode that is more suitable for the abnormal anatomy compared to a perimodiolar electrode.

During the surgical procedure, the circulating nurse actively participates in monitoring the patient's physiological parameters in collaboration with the anesthesia team, meticulously documenting surgical steps and abnormal findings related to malformation anatomy. The perioperative nurse strictly monitors fluid balance due to the higher risk of cerebrospinal fluid leakage (gusher) in patients with congenital ear malformations, especially during cochleostomy opening. Complication anticipation is carried out by preparing gelfoam sponges, muscle fascia, and fibrin glue for immediate management in case of perilymphatic gusher.

A critical intraoperative stage occurs during cochlear implant integrity testing and electrode impedance testing with Neural Response Telemetry (NRT), which is performed after electrode insertion. The perioperative nurse coordinates with the audiologist in preparing the testing equipment and documenting impedance measurement results and neural responses from each electrode. In this patient, test results showed impedance within normal limits for 10 of 12 inserted electrodes with neural responses detected in 8 electrodes, indicating adequate electrode positioning despite abnormal anatomy (Figure 1).

Before wound closure, the perioperative nurse assists in the careful application of a compressive head dressing to ensure implant fixation without pressing on the skin flap area, and performs meticulous counting of instruments, needles, and gauze. Intraoperative documentation includes procedure duration (3 hours 45 minutes), estimated blood loss (minimal, <50ml), administered fluids (Lactated Ringer's 350ml), abnormal anatomical findings (cochlea having only 1.5 turns compared to the normal 2.5 turns), type of implant and electrodes used (with serial number), and results of electrode impedance testing and NRT. The intraoperative phase concludes with the transfer of the patient to the post-anesthesia care unit (PACU) in stable condition,

with attention to head positioning to prevent pressure on the implant area.

Post-operative phase

The post-operative phase of cochlear implantation in a pediatric patient with congenital ear malformation begins with the patient's admission to the Post-Anesthesia Care Unit (PACU). The perioperative nurse conducts a comprehensive handover to the PACU nurse including patient identification information, type of procedure performed, type of implant installed, abnormal findings related to malformation anatomy, intraoperative hemodynamic status, fluid balance, and special considerations related to comorbidities. Immediately upon arrival at the PACU, a primary assessment is conducted using the airway, breathing, circulation, disability, exposure method with results showing patent airway post-extubation, adequate respiration with oxygen saturation of 98% on 2 liters/minute nasal cannula, stable vital signs with blood pressure 90/55 mmHg, pulse 95 beats/minute, and temperature 36.5°C.

Post-operative pain management is conducted with a multimodal approach according to pediatric analgesia protocols, with the administration of intravenous paracetamol 15 mg/kg as baseline analgesia and ketorolac 0.5 mg/kg as an adjunct. Pain evaluation is performed periodically using the Face, Legs, Activity, Cry, Consolability Pain Scale appropriate for the patient's age and communication level, with a pain score result of 3 (mild pain). The perioperative nurse closely monitors signs of post-operative nausea and vomiting (PONV) that could endanger the integrity of the surgical flap, with implementation of prophylactic antiemetic protocols in the form of intravenous ondansetron 0.1 mg/kg and age-appropriate non-pharmacological techniques such as aromatherapy and distraction.

Monitoring for specific complications of cochlear implantation is conducted every 15-30 minutes including: evaluation of the head dressing for signs of bleeding or hematoma, inspection of the surgical area for cerebrospinal fluid leakage, examination of facial nerve function manifested by facial symmetry when the patient cries or smiles, and assessment for signs of meningitis or infection (temperature, leukocytosis, neck stiffness). The patient shows good facial symmetry, no signs of fluid leakage, dry and intact dressing, and no signs of increased intracranial pressure post-operation.

The perioperative nurse provides education to the patient's parents as soon as conditions permit, including explanation of the surgical results, wound and dressing care, sleeping position (head elevation 30° and avoidance of sleeping on the operated side), activity restrictions, and follow-up and implant activation schedule. Education is delivered gradually with a combination of verbal explanations, demonstrations, and written materials to ensure parental understanding. Special emphasis is given to signs of complications that should be promptly consulted, such as fever >38°C, clear fluid draining from the ear or surgical wound, severe pain unresponsive to oral analgesia, and facial asymmetry.

Discharge planning begins immediately with an interdisciplinary approach involving the ENT physician, audiologist, and rehabilitation nurse. Discharge criteria include hemodynamically stable condition for at least 6 hours, pain controlled with oral analgesia, adequate drinking and eating tolerance, no signs of acute complications, and adequate parental understanding of home care. In this case, the patient is discharged on the second day post-operation after meeting all criteria with prescriptions for oral analgesics (paracetamol), prophylactic antibiotics, and advised to return for follow-up 7 days post-operation for wound evaluation and 30 days post-operation for initial activation of the cochlear implant. Before discharge, the perioperative nurse ensures parents have emergency contacts and access to healthcare services in case of complications, and facilitates referrals to speech and hearing therapists in preparation for rehabilitation after implant activation.

Perioperative nursing diagnoses

In the preoperative phase, primary diagnoses include Risk of Infection related to congenital malformation and invasive procedures. The expected outcome is controlled infection risk [Standar Luaran Keperawatan Indonesia (Indonesian Nursing Outcomes Standards) SLKI 0902], with indicators of absence of infection signs such as fever or redness. Interventions performed according to Standar Intervensi Keperawatan Indonesia / Indonesian Nursing Interventions Standards (SIKI) 3520 (Infection Management) include prophylactic antibiotic administration and education about infection signs for parents. Anxiety also frequently arises in patients and parents due

to uncertainty about the surgical procedure. The targeted outcome is reduced anxiety (SLKI 1301), with preoperative education interventions (Peker et al., 2021) using visual media to enhance understanding. Additionally, Knowledge Deficit about surgical preparation requires health education interventions (SIKI 5602) to ensure fasting compliance and anesthesia preparation.

During the intraoperative phase, Risk of Injury due to anatomical malformation becomes the main focus. The expected outcome is absence of injury (SLKI 1901), with protection from injury interventions (SIKI 6540) through facial nerve neuromonitoring. Risk of Hypothermia also needs to be anticipated due to the effects of general anesthesia, with stable body temperature as the outcome (SLKI 0801) and temperature management interventions (SIKI 3900) using warm blankets.

In the postoperative phase, Acute Pain post-surgery becomes the priority diagnosis with controlled pain as the outcome (SLKI 1403). Pain management interventions (SIKI 2300) are implemented through analgesic administration and pain scale monitoring. Risk of Skin Integrity Impairment in the implant area requires wound care (SIKI 3540) to prevent tissue necrosis, with wound healing without complications as the outcome (SLKI 1102). Patients are also at risk of experiencing Impaired Physical Mobility due to post-surgery vertigo, necessitating mobilization therapy interventions (SIKI 3200) to aid in balance recovery.

DISCUSSION

Congenital ear malformation in this case (Mondini type with incomplete partition) created significant technical challenges during the implantation procedure. The selection of a straight electrode proved appropriate to accommodate the abnormal anatomy, as recommended in the literature (Schaumann et al., 2024). The surgical team's experience in handling these anatomical variations was a decisive factor in the procedure's success, with the need for modifications in surgical techniques to minimize the risk of cochlear trauma. This case highlights the critical importance of close collaboration among perioperative nurses, ENT surgeons, audiologists, and the anesthesia team. The perioperative nurse played a central role by ensuring the readiness of specialized equipment, including microscopic instruments and NRT systems, while facilitating effective interprofessional coordination throughout the procedure. Such contributions were pivotal to the smooth execution of the surgery. These findings align with previous research (Eldesoky et al., 2019), which demonstrated that procedure-specific cochlear implantation checklists are effective in minimizing complications.

The implementation of evidence-based protocols for infection prevention, hypothermia, and multimodal pain management showed optimal results. The use of prophylactic antibiotics (cefazolin) according to guidelines, strict aseptic techniques, and close monitoring of vital signs successfully prevented infectious complications in this case. The pain management approach using paracetamol and ketorolac, as recommended by Bahja et al. (2022), proved effective with controlled Face, Legs, Activity, Cry, Consolability scores. The psychological aspects of the patient and family received special attention in this case. An educational approach using visual media and age-appropriate therapeutic communication successfully reduced anxiety, supporting findings by (Kay-Rivest, Schlacter, et al., 2022). Comprehensive postoperative education on wound care and signs of complications was key to the success of early discharge (on the 2nd postoperative day). Close monitoring during the intraoperative phase (including NRT and electrode impedance) as well as comprehensive postoperative evaluation (facial nerve function, signs of infection) enabled early detection of complications. Test results showed that 10 out of 12 electrodes functioned well, indicating technical success of the procedure despite the anatomical malformation.

Based on the experience in this case, the authors recommend the use of standardized protocols for cochlear implantation in children with congenital malformations to enhance patient safety and surgical outcomes. Specialized training for perioperative nurses is essential to strengthen their knowledge of abnormal anatomy and specific techniques required in these complex cases. In addition, the development of visual educational materials can improve patients' and caregivers' understanding, reduce anxiety, and support effective home care. Finally, the implementation of structured follow-up programs is crucial to ensure long-term monitoring, early detection of complications, and sustained rehabilitation outcomes. This case strengthens the evidence that a standardized, team-based perioperative

approach can yield good outcomes even when facing complex anatomical challenges. This experience can serve as a reference in developing local protocols for similar cases.

CONCLUSION

Cochlear implantation in pediatric patients with congenital ear malformations requires a comprehensive, evidence-based perioperative approach that addresses the unique anatomical and surgical challenges of this population. Multidisciplinary collaboration between ENT surgeons, anesthesiologists, audiologists, and perioperative nurses is essential, with nurses playing a central role in preoperative assessment, intraoperative monitoring, and postoperative care. The application of standardized protocols for infection prevention, hypothermia management, and pain control, combined with family-centered education, was shown to be effective in ensuring patient safety and facilitating early recovery in this case. Despite the complexities of Mondini malformation, favorable functional outcomes were achieved through meticulous planning, vigilant intraoperative support, and structured postoperative management. This case underscores the critical role of perioperative nursing in improving outcomes for high-risk pediatric patients and highlights the importance of developing structured, evidence-based nursing guidelines to support safe and effective cochlear implantation in children with congenital ear malformations.

Declaration of Interest

The authors declare that no conflicts of interest exist.

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Data Availability

The data that support the findings of this study are not publicly available due to privacy restrictions but are available from the corresponding author upon reasonable request

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