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Outpatient Cochlear Implantation in Adults and Children: Insights From a Retrospective Review on 282 Consecutive Cases Since Its Introduction

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ABSTRACT

Otologic surgery has evolved into day case surgery due to improvements in surgical technique, anesthesia, and postoperative surveillance. The primary aim of this study was to assess barriers and opportunities toward outpatient cochlear implantation (CI) in adults and children. A retrospective review was conducted on a consecutive series of patients undergoing CI since the introduction of outpatient surgery in January 2020 at the Antwerp University Hospital (UZA). A total of 282 cases were identified, including 207 adults and 75 children. Out of these, 97 cases were performed as outpatient procedures. The 14-day readmission rate after day-case surgery was 1.8%. Performing CI as an outpatient procedure is feasible and safe in a carefully selected patient population.

Keywords: Auditory, aural rehabilitation, cochlea, cochlear implants, hearing disorder, presbycusis

Introduction

Cochlear implantation (CI) has proven its effectiveness in the management of severe-to-profound sensorineural hearing loss today. Traditionally, CI surgery has been performed as an inpatient stay for postoperative monitoring and care.[1] However, data available from other countries suggest that CI can be performed safely and effectively as an outpatient procedure. In the UK, Mawby et al[2] demonstrated the feasibility of day-case CI surgery in carefully selected patients. Their research indicates that suitable candidates for day-case CI include adults and pediatric patients who are undergoing unilateral CI. Additionally, these patients should have an American Society of Anesthesiologists grade of 1 or 2, which suggests a low probability of needing admission for medical reasons. French researchers, Hugel et al,[3] add to this by stating that children must be older than 3 months and have parental consent. Uziel highlighted the benefits of day-case major otological surgery, emphasizing its contribution to modernizing healthcare institutions and generating substantial savings for the healthcare system.[4] However, a study conducted in the Netherlands found no significant difference in healthcare-related costs between a day-case and an inpatient approach within their hospital.[5] Moreover, outpatient pediatric CI has demonstrated its success, with high levels of parental satisfaction, while in adults, outcomes are comparable to inpatient surgery, with no significant differences in quality of life, patient satisfaction, hearing outcomes, or postoperative complications.[3,6,7]

Several advantages have been attributed to outpatient CI surgery, including shorter waiting times, reduced infection risks, and improved social rehabilitation.[2,4] This shift toward outpatient surgery has become particularly significant during and after the COVID-19 pandemic. The Belgian Health Care Knowledge Centre (KCE) report reveals that in 2018, only 13% of CI surgeries in Belgium were conducted as day-case

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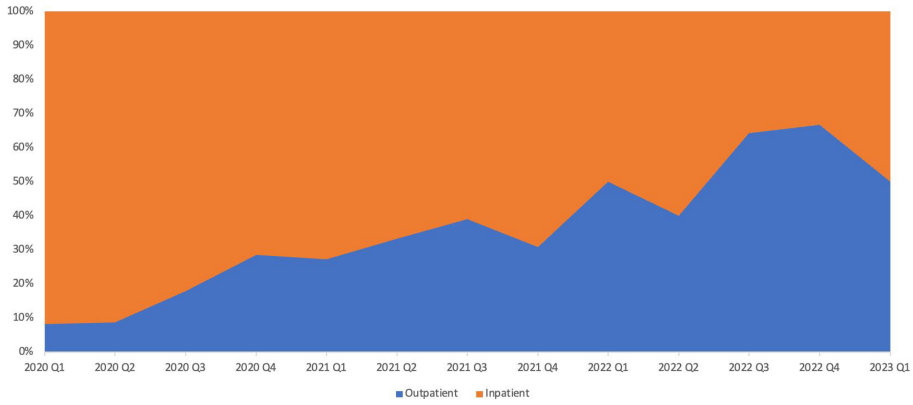

Figure 1. Graphical representation of the change in proportions of inpatient and outpatient cases over the quarters of the year.

procedures, while the majority (87%) still required inpatient stays.[8]

The primary aim of this study was to evaluate the safety and readmission rate on 1 hand and to discuss potential barriers associated with outpatient CI surgery in adults and children at a tertiary referral center for CI.

Materials and Methods

A retrospective review was performed starting January 2020 (up to May 2023) on all CI surgeries performed at the Department of Otorhinolaryngology and Head and Neck Surgery of the Antwerp University Hospital. All procedures/interventions were performed by 3 CI surgeons (V.V.R., M.L., V.T.). Demographic details, including the patient's age at implantation, etiology of hearing loss, and complexity of the CI surgery, were recorded. All postoperative adverse events requiring an unscheduled overnight stay or 14-day readmission to the hospital were reviewed. Additional data were gathered on the hospital length of stay, the starting hour of the surgical procedure, and anticipation of postoperative vertigo. All patient data were anonymized to maintain confidentiality. The study only reports on results that are part of the routine clinical assessment. Therefore, the study was conducted in accordance with the recommendations of the ethics committee of the Antwerp University Hospital that waived the need to obtain informed consent for this study (2024-6296).

Results

The retrospective data collection from January 2020 to May 2023 included 282 CI surgeries. Of these interventions, there were 262 unique CI patients; among them, 16 individuals received implants on the contralateral side, and 4 cases involved device revision or reimplantation during this period. The age ranged from 8 months to 87 years. Figure 1 presents the quarterly distribution of inpatient vs. outpatient CI surgery. In 2020, it started at 8.3% in Q1 and increased to 28.6% in Q4. By 2022, it surged to 50.0% in Q1 toward 66.7% in Q4.

Main Points

- Outpatient cochlear implantation is both feasible and safe in carefully selected adults and children, with a low 14-day readmission rate of 1.8%.
- Patient selection for day-case CI should consider etiology of deafness, surgical complexity, and risk of postoperative vertigo.
- Unilateral CI is the most suitable for outpatient surgery, while complex procedures—including syndromic etiologies, vestibular risk, and combined operations—appropriately warrant inpatient admission.

Scheduled Inpatient Cochlear Implantation Surgery

While the majority of CI surgeries can be performed as day cases, there are certain situations that warrant planning for an overnight stay. In this study, patients stayed at least 1 night in the hospital after surgery in 185 of the 282 cases (65.6%) (Figure 2). Therefore, various factors were considered when determining the need for an overnight stay.

Etiology of deafness: The analysis of the etiology of deafness in the study revealed distinct prevalence patterns between pediatric and adult cases, presented in Table 1. In children, causes were mostly genetic (49%), with pathogenic variants in the *GJB2* gene, also known as connexin 26, being the most frequent genetic etiology in 26.7% of cases. In contrast, idiopathic causes were most common in adults (58.5%).

Notably, certain etiologies have been associated with the need for inpatient CI surgery, particularly all genetic syndromes that require inpatient care due to their complexity and postoperative management. In contrast, outpatient procedures were deemed more suitable for certain genetic non-syndromic causes and idiopathic cases, in case of normal inner ear anatomy.

Complexity of surgery: More complex CI surgeries, such as bilateral simultaneous CI (3.5%, n = 10), CI operations involving the simultaneous resection of vestibular or intracochlear schwannoma and CI (5.3%, n = 15), and simultaneous subtotal petrosectomy and CI (2.8%, n = 8), usually require inpatient admission as well as robotic-assisted CI in a research setting (5.0%, n = 14). It is the complexity, size, and potential complications associated with these specific operations that influence inpatient admission decisions.

On the other hand, unilateral CI, the most common type of surgery, accounted for the majority of cases (78.7%, n = 222) and was typically performed as day-case surgery. Other surgeries suitable for outpatient admission included revision and

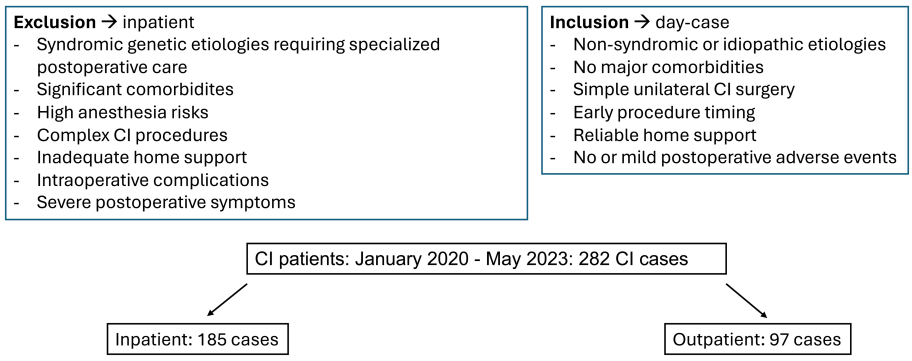

Figure 2. Flowchart: inclusion and exclusion criteria for day-case cochlear implantation.

reimplantation of defective implants (5.3%, n = 15) and simultaneous surgeries involving meatoplasty/tympanoplasty with CI (0.7%, n = 2).

Anticipation of postoperative vertigo: Before surgery is planned, a careful evaluation is performed to anticipate the likelihood of vertigo and associated symptoms. This evaluation includes a review of the patient's medical history, specifically searching for indications of Menière's disease, history of vertigo, dizziness, postural instability, vestibular migraine, and enlarged vestibular aqueducts.

Of the assessed cases, 46 (16.3%) were found to be at risk of vertigo. For cases with a higher risk of postoperative dizziness, inpatient surgery is planned to ensure appropriate monitoring (e.g. by using videonystagmography or video head impulse testing) and adequate symptom management.

Miscellaneous: In the study, 57 surgeries (20.2%) were scheduled to start at 2 PM or later. In such cases, patients received inpatient status due to the need for recovery from anesthesia. The decision to schedule these procedures later in the day is usually influenced by criteria of ineligibility for day-case

Table 1. Overview of Distribution of Deafness Etiology by Age Group and Scheduling Preference

Genetic non-syndromic cause (including pathogenic mutations in the *GJB2* (connexin 26), *MYO15A*, *OPA1*, *PJVK* genes, and pathogenic variants in the *COCH*, *ATP6V1B1*, *POU4F3*, *TMPRSS3* genes)	**42 (14.9%)**	**25 (33.3%)**	**17 (8.2%)**	**Outpatient**
Genetic Syndromic Causes (includes BOR, Gradenigo, Jervell and Lange Nielsen, MELAS, Microphthalmia, Pendred, Polymalformative, Usher, Waardenburg, William's syndromes)	**21 (7.4%)**	**12 (16.0%)**	**9 (4.3%)**	**Inpatient**
Middle ear pathology (includes cholesteatoma, chronic otitis, cystic mass, otitis media, and peripartal sepsis)	**15 (5.3%)**	**2 (2.7%)**	**13 (6.3%)**	**Inpatient:** Cystic mass **Outpatient:** Cholesteatoma, chronic otitis, otitis media, and peripartal sepsis
Inner ear pathology (includes congenital CMV, labyrinthitis, large vestibular aqueduct syndrome, Menière's disease, Meningitis, otosclerosis, and osteogenesis imperfecta)	**33 (11.7%)**	**12 (16.0%)**	**21 (10.1%)**	**Inpatient:** Large vestibular squeduct Syndrome, Menière's disease, meningitis, and osteogenesis imperfecta **Outpatient:** Congenital CMV, labyrinthitis, and otosclerosis
Nerve pathology (includes intracochlear/vestibular Schwannoma)	**15 (5.3%)**	**0**	**15 (7.2%)**	**Inpatient**
Retrocochlear pathology (includes auditory neuropathy, brain hemorrhage, progressive demyelinating polyneuropathy, and cerebrum atrophy)	**7 (2.5%)**	**2 (2.7%)**	**5 (2.4%)**	**Inpatient:** Auditory neuropathy and brain hemorrhage **Outpatient:** Progressive demyelinating polyneuropathy and cerebrum atrophy
Trauma (includes noise-induced hearing loss, head trauma, and iatrogenic complications after middle ear surgery)	**6 (2.1%)**	**1 (1.3%)**	**5 (2.4%)**	**Outpatient**
Vascular (includes chronic cutaneous leukoplastic vasculitis)	**1 (0.4%)**	**0**	**1 (0.5%)**	**Outpatient**
Idiopathic	**142 (50.4%)**	**21 (28.0%)**	**121 (58.5%)**	**Outpatient**

procedures. These criteria include not only the previously mentioned factors but also additional aspects such as social reasons, visual impairment, patients with special needs, wheelchair assistance, health status, medications, geographical location, and patient preferences.

Postoperative Adverse Events

In some CI surgery cases, postoperative complications require overnight hospitalization for monitoring and treatment. Symptoms like severe vertigo, nausea, and dizziness were observed in 21 patients (7.5%). The 14-day readmission rate after surgery was 1.8% (n = 5). Readmissions were due to unrelated infections (n = 3) (e.g., pyelonephritis, gastroenteritis), severe dizziness (n = 1), and hyponatremia (n = 2). The rate of anesthesia-related adverse events was 0.7% (n = 2), indicating the overall safety of anesthesia during CI operations.

Discussion

The findings imply that the pre-existing criteria for patient eligibility for day-case CI surgery should be supplemented by factors such as patient preference, risk of postoperative vertigo, complexity of surgery, and the etiology of the deafness.

Adding to the existing evidence on outpatient CI surgery, the study is consistent with findings from other hospitals that it is practical and safe.[1-10] The most common complication remains vertigo and dizziness, with an incidence of 7.5%. Sivam et al[10] show that the results of the chart review complement the research and state that the most common complications are nausea, vomiting, dizziness, and balance disorders and that these can usually be treated on an outpatient basis, even in the youngest populations. To achieve the best possible results and avoid more complex complications, careful patient selection, thorough preoperative evaluation, and reliable postoperative care remain necessary.

This retrospective study has limitations, particularly the inability to quantify the reference of older patients' preference for overnight stays due to inadequate home care. Surgeons emphasize this aspect in planning outpatient surgery, but it was not included in the analysis of medical histories. To improve the evaluation of the safety and effectiveness of outpatient CIs, future studies should adopt a prospective design. Long-term outcomes, including patient satisfaction and hearing outcomes in both adults and children receiving CIs should be collected.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of University of Antwerp (Approval no: 2024-6296; Date: 13/2/2024).

Informed Consent: The ethics committee waived the need for informed consent.

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