

The Outcomes of Cochlear Implantation in Patients with Solid Organ Transplant

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Abstract

Introduction:

As far as it is known, long-lasting immunosuppressive therapy might put patients with solid organ transplantation (SOT) at increased risk for severe to profound sensorineural hearing loss, eventually leading to cochlear implantation (C.I). So, the main aim of the present study is to evaluate their auditory perception performance after cochlear implantation.

Materials and Methods:

This case-series study assessed the auditory perception performance of our center's six cochlear-implanted patients who had undergone solid organ transplantation before. The patients' age range was between 3 to 68 years old. Two participants (Female/ male) had received liver transplantation, and the rest (two males and two females) had undergone kidney transplantation. The assessment was conducted through the CAP (Categories of Auditory Performance) test in the first month of cochlear implantation and 12 months later.

Results:

Except for one patient (A 3-year-old girl) who has recently received a cochlear implantation device, and her rehabilitation program is in progress, the auditory perception performance of others improved from 2 to at least six scores. Also, no wound infection, mastoiditis, or bacterial meningitis occurred after cochlear implantation.

Conclusion:

Immunosuppressive therapy, hemodialysis, infections, and long-lasting medication might lead to severe to profound sensory neural hearing loss in organ-transplanted patients. In recent years, cochlear implantation has been considered a final solution to help this group of patients to hear and communicate better.

Keywords: Cochlear implantation, Immunosuppressive therapy, Solid organ transplantation.

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Introduction

Solid organ transplantation is the standard procedure for treating end-stage liver or kidney diseases. In 1967, the first renal transplantation from an a living-related donor was performed in Iran. Various factors, such as increasing public awareness, the presence of experienced surgeons, and social media advertising, have increased organ donations (1,2). Despite increasing long-term survival, the side effects following immunosuppressive therapy might hurt the patient's quality of life. One of the most known side effects is cardiovascular problems, which are known to be involved in the pathophysiology of hearing disorders (3).

The cardiovascular side effects mainly occur in patients receiving calcineurin inhibitors. Neurotoxicity is also another side effect of calcineurin inhibitors that may cause various degrees of hearing loss. The underlying cause for hearing loss following transplantation is still not clear. The inner ear vascular changes after steroid therapy, ototoxic drugs, or severe renal disease might lead to severe to profound sensory neural hearing loss in these patients (4, 5). Many years ago, the only way to receive sound in patients with severe to profound sensorineural hearing loss was the use of hearing aids. Cochlear implantation is the best procedure that effectively provides hearing ability for patients with hearing loss (6,7). It improves the quality of life and facilitates the process of language acquisition, speech perception, and production skills. Hearing acquisition following C.I. is critical in patients with additional problems, such as organ failures, who have undergone organ transplantation (8-10).

A case study in 2019 in India illustrated the cochlear implantation outcomes in a 37-year-old woman who had experienced hemodialysis following renal transplant failure (11). Despite renal failure after almost ten years of transplantation, she is doing well in auditory perception and speech intelligibility according to her achieved CAP and SIR (Speech intelligible reliability) scores.

Another study in 2016 in the USA evaluated the auditory and speech performance of 7 patients receiving immunosuppressive therapy following solid organ transplantation (12). Since the cochlear implantation results indicated open-set speech perception ability

and good oral communication in more than half of the patients of this study, the authors declared that the history of solid organ transplantation alone should not be a contraindication to cochlear implant candidacy criteria. However, studies of this kind are very few. Firstly, because of this group of patients' limited frequency and not referring for cochlear implantation due to their other side issues. Also, their probable short lifespan is another reason for limited studies in this field.

Considering the factors mentioned earlier, we decided to conduct a study to assess the auditory perception performance of all cochlear-implanted patients of our center who had undergone organ transplantation.

Materials and Methods

We have gathered the data of this case-series study through the cochlear implantation registry software with the ethics code of IR.SUMS.REC.1397.631.

The present study was performed on six organ-transplanted patients. 4 out of 6 had received kidney transplantation and long-term medical therapy by Aminoglycoside injection, and hemodialysis was carried out for them at least eight months before cochlear implantation. 2 other patients had received liver transplantation. The auditory perception performance of the transplanted patients was assessed in the first month of cochlear implantation and 12 months later.

All the patients were unilaterally implanted, and normal inner ear anatomy was confirmed in the selected patients according to their temporal bone CT scan findings. Post-streptococcal glomerulonephritis was the main reason for renal failure in kidney-transplanted patients. All four kidney transplant patients were on hemodialysis for almost eight months to 1 year before transplantation. It seems that receiving ototoxic drugs following infection led to the acceleration of these patients' bilateral progressive sensorineural hearing loss.

Nonalcoholic fatty liver disease happens from metabolic syndrome caused by conditions such as hyperlipidemia and hypertension (13), which were the main factors that caused liver failure in two other patients who received liver transplantation. To prevent organ rejection, immunosuppressive therapy, as well as other medications such as antibiotics, anti-

hypertension, diabetes medication, or heart medical therapy, were taken in both kidney and liver transplanted patients, depending on their needs. The surgeon fully inserted the electrode array through the round window in all six patients. After four weeks of cochlear implantation, the patients came for switch-on and mapping.

Then, the auditory training program started depending on each patient's age range and language development.

Since only six patients with a solid organ transplant were found, we did no specific statistical analysis.

Results

The patient's characteristics are illustrated in Table 1. Two participants had undergone liver transplants, and the rest received kidney transplants. All organ-transplanted patients received immunosuppressive therapy before cochlear implantation.

Table 1: Demographic characteristics of the subjects

Subject	Sex	Age (yrs.)	Medical history	Organ transplanted	Age organ transplant (yrs.)	Onset of Deafness	Age C.I (yrs.)
1	F	61	Diabetes, Hypertension	Kidney	40	Post-lingual	55
2	M	19	Heart valve replacement	Kidney	18	Pre-lingual	4
3	M	65	Coronary artery bypass grafting (CABG)	Kidney	55	Post-lingual	61
4	F	45	Diabetes, Hypertension	Kidney	14	Post-lingual	34
5	F	47	Hyperlipidemia Hypertension	Liver	40	Post-lingual	46
6	F	4.5	Metabolic syndrome	Liver	3	Pre-lingual	4.2

Following C.I. surgery, no complications such as cerebrospinal fluid (CSF) leak or wound infections occurred in our patients. Also, meningitis, mastoiditis, or skin flap necrosis did not happen in the patients demonstrated in

Table 1. Table 2 depicts the level of auditory perception performance in the first month of cochlear implantation and 12 months after receiving the external part of the cochlear implantation device.

Table 2: The level of auditory perception performance in the first month of cochlear implantation and 12 months later.

Subjects	Organ transplantation type	CAP Score (the first month of C.I)	CAP Score (12 months later)
1	Kidney	2	7
2	Kidney	2	6
3	Kidney	3	7
4	Kidney	2	6
5	Liver	4	7
6	Liver	2	The rehabilitation program is in progress.

The comparison between the results of auditory performance indicates an improvement in the patient's ability in hearing perception during the time.

Discussion

Hearing loss is one of the most known complications in patients undergoing immunosuppressive treatment following solid organ transplantation (14). Cochlear implantation is a safety procedure through which hearing and auditory perception ability will be provided. Despite the non-prevalence of the risk of infection in cochlear implanted patients (15), organ transplantation might encounter patients with an increased risk of infections because of long-term immunosuppressive therapy to prevent graft rejection. In the present study, we had six organ-transplanted patients with sensorineural hearing loss. According to their hearing status, cochlear implantation was the best choice to help them acquire hearing ability. In order to reduce the risk of delay in wound healing and infection, the necessary precautions, such as performing the cochlear implantation of our organ-transplanted cases meticulously with more emphasis on factors that might aggravate infection during the surgery, were considered. To achieve this goal, a standard protocol was used in C. I surgeries, including sterile surgical techniques and intravenous antimicrobial prophylaxis, might decrease infection risk.

The results of the present study indicated an improvement in the auditory perception performance of the patients. Moreover, full electrode insertion presented neuro-response telemetry (NRT), and no surgical complications were observed during and after the surgery.

According to the prevalence of bacterial meningitis following immunosuppressive therapy in solid organ transplanted patients, it is recommended that pediatric SOT recipients receive a vaccination to prevent pneumococcal disease (16,17).

Bacterial meningitis is a common infectious complication in cochlear implant users (18). Nowadays, the Centers for Disease Control and Prevention (CDC) guidelines recommend the PCV13 vaccine for C. I candidates of all ages to prevent bacterial meningitis (18). Vaccination was also done in our center in the same

direction to reduce the chances of contracting bacterial meningitis.

Since the number of published articles concerning cochlear implantation in solid organ transplanted patients is limited, the present study, in which six organ-transplanted patients have been evaluated, can be considered a large case series. The most important limitation of our study was the difference in the age range of the participants and its effect on the patient's auditory perception and language development. Finally, the differences in the patients' medical history demonstrated in Table 1 might interfere with the results obtained from their cochlear implantation and its post-up rehabilitation. So, following the patients' auditory perception performance in the coming months is recommended.

Conclusion

Despite complicated problems or the possibility of a shorter life span of transplanted patients than other people, solid organ transplants should not be considered as a limitation for doing C.I. surgery in patients with severe to profound sensorineural hearing loss.

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