Cochlear implantation and outcomes in a resource–limited setting: experience from Tanzania

Aveline Aloyce Kahinga[1], Zephania Saitabau Abraham[2], Shaban Mawala[3] and Edwin Liyombo[3]

1. Department of Otorhinolaryngology, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania
2. Department of Surgery, School of Medicine and Dentistry, University of Dodoma, Dodoma, Tanzania
3. Department of Otorhinolaryngology, Muhimbili National Hospital, Dar es Salaam, Tanzania

Correspondence:
Aveline A. Kahinga
avelynek@yahoo.co.uk

Submitted: January 2022
Accepted: March 2022
Published: May 2022

Citation: Kahinga et al. Cochlear implantation and outcomes in a resource –limited setting: experience from Tanzania. South Sudan Medical Journal 2022;15(2):50-53 DOI: https://dx.doi.org/10.4314/ssmj.v15i2.3

ABSTRACT

Introduction: Cochlear Implant is a small medical electronic device that is surgically inserted partially in the cochlear (inner ear) to restore some hearing in patients with severe to profound hearing loss. Cochlear implantation is considered a rehabilitative measure of choice that positively impacts on the quality of life of patients.

Objective: The objective was to describe the clinico-demographic characteristics of cochlear implantees and the outcomes of the intervention among the implantees at Muhimbili National Hospital (MNH) in Tanzania.

Method: This was a hospital based cross-sectional study which involved a total of 39 patients who underwent cochlear implantation from July 2017 to May 2021 at MNH. Clinico-demographic characteristics and outcomes of the intervention among the implantees were collected using structured questionnaires and data were analysed using Statistical Package for Social Sciences Version 20. Results were then presented in frequency tables and figures.

Results: This study recruited 39 patients with bilateral hearing loss with their ages ranging from 2 to 55 years. Their mean age was 4.7 years and median of 3 years. More than half, 24(61.5%) of implantees aged 2-3 years. Males predominated with male to female ratio of 1.2:1. Majority 37(94.9%) had pre lingual hearing loss and 36 (92.3 %) had bilateral profound sensorineural hearing loss. Ototoxicity was the commonest cause of hearing loss among the implantees contributing 16(41%) followed by birth asphyxia, 8(20.5%). A total of 37(94.9%) of these patients were implanted with a single cochlear device due to the high cost associated with this type of intervention.

Conclusion: Cochlear implantation in limited resource settings is possible and cost effective if there is enough support from the government and other charitable organisations. The availability of rehabilitative services remains key for better outcome after cochlear implantation.

Keywords: Cochlear implantation, resource limited, Tanzania.

INTRODUCTION

The World Health Organisation (WHO) estimated that about 466 million people in the world have hearing loss of greater than 35dB in the better hearing ear of which 432 million are adults and 34 million are children. Up to 80% of them live in low- and middle-income countries (LMICS).[1] There is also high prevalence of adult and childhood onset of hearing impairment in low-income regions, especially in sub-Saharan Africa and in South and Southeast Asia.[2] The causes of hearing loss can be congenital or acquired, however almost 60% of the causes are preventable in children.[1]

Hearing loss whether conductive or sensorineural requires treatment/rehabilitation since it has socio-economic impacts in the life of an individual. Hearing loss in

children results in a communication barrier and delayed language development which is later associated with poor academic performance hence reduction in employment opportunity later in life. On the other hand, adults with hearing loss have significant social and emotional stress leading to loneliness, isolation, frustration and early onset of dementia.[1, 3]

Introduction of multichannel cochlear implants in 1984, has changed lives of individuals with severe to profound hearing loss through restoring their hearing ability and therefore improved speech reception threshold. [4] Cochlear implantation is seen to be an expensive treatment option for patients in the LMICs compared to high income countries due to device related expenses, lack of rehabilitation services, and trained personnel.[5]

Tanzania is among one of the sub-Saharan countries referring patients abroad for cochlear implantation, especially those with prelingual onset hearing loss. Such referrals were done to those patients who did not benefit from hearing aid devices. This practice of referrals existed until June 2017 when the cochlear implantation program was established in the country. Initiation and support of the cochlear implantation program by the government of Tanzania has made this program cost effective as compared to patient being referred abroad. All services from hearing screening, candidacy evaluation, cochlear implantation, post implant care and rehabilitation are now available in the country at Muhimbili National Hospital.

This study describes the clinico-demographic characteristics of cochlear implantees and the outcomes of the intervention among the implantees at Muhimbili National Hospital (MNH) in Tanzania

METHOD

This was a hospital based descriptive cross-sectional study conducted at MNH, the main National referral hospital in Tanzania. Ethical clearance was obtained from the Research and Publications Committee of MNH. The department of otorhinolaryngology (ORL) receives patients from all the regional referral hospitals and is the only one performing cochlear implant surgeries in the country since July 2017.

A total of 39 patients who underwent cochlear implant surgery from July 2017 to May 2021 were included in this study. Data were collected using structured questionnaires. The information collected included: age, sex, age of onset and severity of hearing loss, causes of hearing loss and laterality of cochlear implantation. Pure tone audiometry (PTA), otoacoustic emissions (OAE), auditory brainstem response (ABR), computed tomography (CT) scan of the temporal bone and the magnetic resonance imaging for the evaluation of inner ear malformation and surgical planning were the hearing assessments and imaging modalities employed for evaluation and eligibility of candidacy selection for cochlear implantation. Data were analysed using the Statistical Package for Social Sciences (SPSS) version 20 for descriptive analysis and results were presented in frequency tables and figures.

RESULTS

This study involved 39 patients with bilateral hearing loss and their ages ranged from 2 to 55 years. Their mean age was 4.7 years and median of 3 years. More than half, 24(61.5%) of implantees were in the age group of 2-3 years. Males predominated with male to female ratio of 1.2:1. Majority of them 37(94.9%) had pre lingual hearing loss. (Table 1).

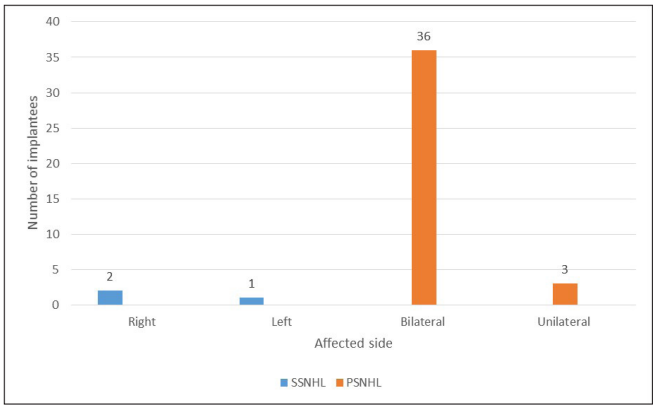
Characterization of severity of hearing loss of cochlear implantees by laterality.

The majority of cochlear implantees, 36(92.3%) had bilateral profound sensorineural hearing loss (PSNHL), (Figure 1).

Distribution of the causes of hearing loss among cochlear implantees.

Table 1. Clinico-demographic characteristics of cochlear implantees (N=39).

Variable		n (%)
Age group(years)	2-3	24 (61.5)
	4-5	13 (33.3)
	>5	2 (5.1)
Sex	Male	21 (53.8)
	Female	18 (46.2)
Age at onset of hearing loss	Pre lingual	37 (94.9)
	Post lingual	2(5.1)



KEY: SSNHL- Severe sensorineural hearing loss, PSNHL-Profound sensorineural hearing loss

Figure 1. Severity of hearing loss of the cochlear implantees by the affected side.

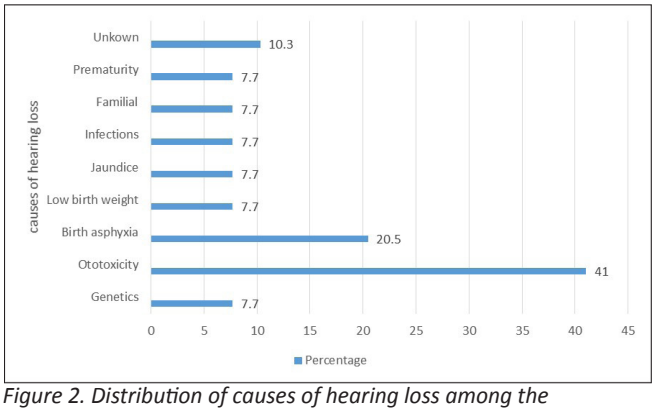


Figure 2. Distribution of causes of hearing loss among the implantees

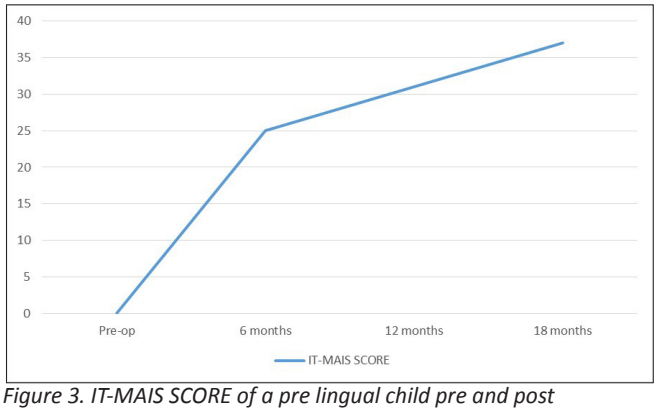


Figure 3. IT-MAIS SCORE of a pre lingual child pre and post implantation

Ototoxicity was the commonest cause of hearing loss among the implantees contributing 16(41%) followed by birth asphyxia, 8(20.5%). (Figure 2).

Lateralization of cochlear implantation among cochlear implantees.

The study has found that the majority of the implantees, 37(94.9%) to have been implanted with one device.

Complications post cochlear implantation among the implantees.

Facial weakness, 3 (7.7%) was the most encountered complication among the implantees.

Post-operative auditory and speech performance of one of the pre lingual after cochlear implantation.

The Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS) was used to follow up some patients, and assess their auditory development. MAIS scores for one such patient demonstrates the benefit observed post-operatively. This child was implanted at the age of two years and six months, and followed up over eighteen months. The questionnaire was scored out of 40 points, and a great improvement from 0/40 pre-operatively to 36/40 eighteen months post-operatively has been observed (Figure 3).

DISCUSSION

The study aimed to describe the clinico-demographic characteristics of the cochlear implantees and the outcomes of the intervention in our setting as the first novel findings since the establishment of in - country cochlear implantation programme. Majority of the implantees had pre lingual hearing loss and were in the age group of 2 -3 years. This could be due to the fact that, majority of parents realise that their children could not talk as their peers at this age and this is attributed to lack of neonatal screening in most of our settings as compared to high income countries where such children with hearing loss are detected early in life and prompt intervention.[6]

In our cochlear implantation programme, which is supported by the government, the age limit has been set at 5 years of age and this led almost 95% of our implantees being those with pre lingual hearing loss. Bilateral severe to profound hearing loss has been another criterion for cochlear implantation in our setting and thus more than 90 % of the implantees had bilateral profound hearing loss and such patients had been on hearing aid machines for at least 3 months without improvement.[7]

The most common causes of hearing loss in this study were due to ototoxicity (gentamicin, quinine and streptomycin) and birth asphyxia. According to WHO these causes of hearing loss can be prevented in 60% of the population. Several workshops have been conducted with gynaecologists and paediatricians in our setting to address these challenges and design policies on judicious use of antibiotics and other drugs. Our study on the most common causes of hearing loss concurs with similar studies in literature.[8-12] Other causes included genetics, familial, jaundice, infections and unknown aetiologies. Among the candidates implanted one was a case of Waardenburg and the other incomplete partition of cochlear type 3 (IPT3) which suggested genetic mutations.

The Tanzanian government pledged to support each of the candidates with one cochlear implant, except in two cases where the implantees received two devices. This was because of the cost implications related to the cochlear implantation device. In the developed countries bilateral cochlear implantation is an encouraged policy to ensure binaural hearing and continuous nerve stimulation. However in some cases with unilateral cochlear implantation, hearing aid device can be used in the other ear though studies are ongoing to ascertain its benefit as compared to the former (bilateral cochlear implantation).[13, 14]

Complications that arose post cochlear implantation included facial weakness, which was the commonest,

followed by skin infection at the surgical site which led to extrusion of the device. Other complications such as meningitis, was not reported and this could be attributed to the provision of pneumococcal polysaccharide vaccine (pneumovax 23) and Haemophilus influenzae vaccines prior surgery.

Currently, some of the children who underwent surgery in 2017 to 2019 are attending mainstream schools alongside with their hearing peers and some are bilingual.

CONCLUSION

Cochlear implantation in resource – limited settings is possible and cost effective if there is a great support from the government, device manufacturers and mentor surgeons from other countries who are advanced in cochlear implantation. Availability of rehabilitative services is very important for the better outcome of cochlear implantation. There is a great need for all the stakeholders in the developing countries to work together and address hearing loss, since 80% of the cases with hearing loss are preventable.

Conflict of interest: None

Source of funding: None

Authors' contributions: AAK designed the study, collected data, performed data analysis and prepared this manuscript. ZAS, SM and EL contributed to study design, analysis and comments to the manuscript drafts. All authors have read and approved this manuscript.

Acknowledgements: We thank all the participating patients, the cochlear implant team of Tanzania, Mentor surgeons from Egypt and India, MED-EL Company and MNH for permission to conduct this study.

References

1. World Health Organization. Deafness and hearing Loss. http://www.who.int/pbd
2. Stevens G, Flaxman S, Brunskill E, Mascarenhas M, Mathers CD, Finucane M; Global Burden of Disease Hearing Loss Expert Group. Global and regional hearing impairment prevalence: an analysis of 42 studies in 29 countries. Eur J Public Health. 2013 Feb; 23(1):146-52. Doi:10.1093/eurpub/ckr176. Epub 2011 Dec 24. PMID: 22197756.
3. Childhood Hearing Loss WHO/ World Health Organization http://www.who.int
4. Amieva H, Ouvrard C. Does Treating Hearing Loss in Older Adults Improve Cognitive Outcomes? A Review. Journal of Clinical Medicine. 2020; 9(3):805. https://doi.org/10.3390/jcm903080
5. Magro I, Emmett SD, Saunders J. Cost-effectiveness of CI in developing countries. Curr Opin Otolaryngol Head Neck Surg. 2018 Jun; 26(3):190-195. Doi: 10.1097/MOO.0000000000000451. PMID: 29528875
6. De Raeve L, Wouters A. Accessibility to cochlear implants in Belgium: state of the art on selection, reimbursement, habilitation, and outcomes in children and adults. Cochlear Implants Int. 2013; 14(Suppl 1):S18-S25. doi:10.1179/1467010013Z.00000000078
7. De Raeve L, van Hardeveld R. Prevalence of cochlear implants in Europe: What do we know and what can we expect? Journal of Hearing Science. 2013; 3(4):9-16.
8. Poonual W, Navacharoen N, Kangsanarak J, Namwongprom S. Risk factors for hearing loss in infants under universal hearing screening program in Northern Thailand. J Multidiscip Healthc. 2015 Dec 24; 9:1-5. Doi: 10.2147/JMDH.S92818. PMID: 26766912; PMCID: PMC4699512.
9. Maqbool M, Najar BA, Gattoo I, Chowdhary J. Screening for Hearing Impairment in High Risk Neonates: A Hospital Based Study. J Clin Diagn Res. 2015; 9(6):SC18-SC21. doi:10.7860/JCDR/2015/14509.6104
10. Lakshmi T, Zaheera Sultana S, Brid S. V. "Brainstem Auditory Evoked Potentials in Birth Asphyxia Infants". Journal of Evolution of Medical and Dental Sciences 2014;3(49):1749-11754, DOI: 10.14260/jemds/2014/3543
11. Pawar R., Illalu S., Fattepur S.R. A study on prevalence of hearing impairment in newborns with birth asphyxia admitted to neonatal intensive care unit. Int J Pediatr Res. 2019;6 (01):42-49. doi:10.17511/ijpr.2019.i01.07
12. Anggraeni, R., Wijana, & Rachyanti, P. (2021). Neonatal Asphyxia as a Risk Factor for Sensorineural Hearing Loss in Indonesian Children. Indian Journal of Forensic Medicine & Toxicology, 15(3), 3920–3926. https://doi.org/10.37506/ijfmt.v15i3.15909
13. Litovsky RY, Jones GL, Agrawal S, van Hoesel R. Effect of age at onset of deafness on binaural sensitivity in electric hearing in humans. The Journal of the Acoustical Society of America.2010; 127(1):400-414. Doi: 10.1121/1.3257546. PMID: 20058986
14. Litovsky RY, Johnstone PM, Godar SP. Benefits of bilateral CIs and/or HAs in children. Int J Audiol. 2006; 45(Suppl 1): S78–S91. doi:10.1080/14992020600782956