



HEARING EVALUATION IN PATIENTS WITH CHRONIC KIDNEY DISEASE UNDERGOING HEMODIALYSIS

ENT

Dr Ankita Singh	Post Graduate Student In Department Of ENT And Head And Neck Surgery, Gandhi Medical College, Bhopal (M.P.)
Dr Smita Soni	Professor And Head, Department Of ENT And Head And Neck Surgery, Gandhi Medical College, Bhopal (M.P.)
Dr Himanshu Sharma	Associate Professor Nephrology Department Of Medicine, Gandhi Medical College, Bhopal (M.P.)
Dr Aditya Goel	Senior Resident In Department Of ENT And Head And Neck Surgery, Gandhi Medical College, Bhopal (M.P.)
Dr Abhishek Rajagopal*	Post Graduate Student In Department Of ENT And Head And Neck Surgery, Gandhi Medical College, Bhopal (M.P.). *Corresponding Author

ABSTRACT

Introduction: Chronic kidney disease (CKD), affects many organ systems. Accumulation of uremic toxins and prolonged hemodialysis affects almost every tissue, including auditory system. There is defect in microcirculation within the inner ear which principally causes the electrolytic imbalance resulting in the impairment of endocochlear potential and sensory transduction. **Material and Method:** an observational study was conducted in our tertiary care hospital in CKD patients on hemodialysis compared with non-CKD patients, from January 2021 to November 2022. Pure Tone Audiometry (PTA) was done at regular 3-month intervals. The results of PTA for each ear was recorded and type of hearing impairment was observed by the tracings on the audiogram. **Results**– In our study we reported prevalence of sensorineural hearing loss in 51.16% patients of CKD compared to normal participants in group where the prevalence was 11.63%. The hearing loss was bilateral (86.36%) and the degree of hearing loss was mild type in 30.23%, and we reported that 40.9% had high frequency hearing loss. It was noted that 10 (45.4%) out of 22 patients with hearing loss had stage 5 kidney disease. **Conclusion**- This study showed that hearing loss was more prevalent among patients with CKD on hemodialysis. In majority of the patients, the hearing loss was mild, bilateral, sensorineural, and mostly affecting higher frequencies.

KEYWORDS

CKD- Chronic Kidney Disease, SNHL- Sensorineural Hearing Loss, PTA- Pure Tone Audiometry, HD- Hemodialysis

INTRODUCTION

Each kidney comprises millions of nephrons which are responsible for filtration of blood plasma. Almost 1200 ml of blood enters into the kidneys per minute and substances such as wastes, drugs, water and ions are filtered out. By this process of urine formation, the kidneys maintain the blood pH by excreting out H⁺ and preserving HCO₃⁻, also maintains the levels of ions like sodium, potassium, calcium, chloride and phosphate. The kidneys also maintain blood volume by conserving or eliminating water. Kidneys' dysfunction therefore leads to imbalance of electrolytes and accumulation of waste products in blood. This leads to damage of tissues and organ systems. Chronic kidney disease (CKD), affects many organ systems. Accumulation of uremic toxins and maintenance hemodialysis affects almost every tissue, including auditory system. The kidney and the stria vascularis of cochlea have similar physiological, ultrastructural, and antigenic similarities that explains the association between CKD and hearing loss.^(1,2)

This hearing loss is of sensory–neural type usually and is diagnosed in long term CKD patients and progresses with time. Several variables may contribute to the etiopathogenetic mechanisms of hearing loss in CKD including factors related to the severity and duration of the disease, electrolyte imbalance, loss of hair cells, disruption of endolymphatic space, edema and atrophy of auditory cells, ototoxic drugs, age, certain comorbid conditions like diabetes mellitus and hypertension, and hemodialysis.^(3,4,5)

In the present study, we aimed to determine the prevalence and degree of hearing loss in CKD patients on maintenance hemodialysis, and to identify the association between hearing loss and factors like duration of CKD compared to normal population by measuring PTA (pure tone audiometry).

MATERIALS AND METHOD

The present Observational study was conducted in the department of Otorhinolaryngology, Gandhi Medical College, Bhopal and associated Hamidia Hospital from January 2021 to November 2022. The study was conducted on chronic kidney disease patients undergoing hemodialysis >6months. Ethical committee and Institutional approval was obtained before the commencement of study.

Inclusion Criteria

Group A-Known case of CKD on hemodialysis for >6months, Age group 15-55 year, No history of ear disease or alternative causes of hearing impairment

Group B-Patients with normal kidney functions, Age group 15-55 year, No history of ear disease or alternative causes of hearing impairment

Exclusion Criteria

Local ear disease, Previous otological trauma or surgery, family history of hearing impairment, Definite exposure to any ototoxic drugs by taking careful drug history, Habitual exposure to hazardous noise like exposure to explosions, people who work in electric generation machines, Patients not giving consent and Patients below fifteen year and patients above fifty-five year.

Equipment used-ALPS AD2100 Diagnostic Audiometer

METHODOLOGY

Patients with known case of chronic kidney disease attending the nephrology OPD undergoing hemodialysis were interviewed regarding their elaborate medical history, complete general physical examinations to rule out any co morbid conditions, examination of ear, nose and throat to rule out any existing structural deformity or pathology.

Audiometric assessment using pure tone audiometry (PTA) done to identify hearing threshold levels in patients to see the degree and type of hearing loss.

Similarly examination was done for group B, age and sex were matched as per group A and audiometric assessment using pure tone audiometry (PTA) was done.

All eligible patients, according to the inclusion and exclusion criteria were enrolled and their informed consent was taken. Patients were followed up for regular three-month intervals and repeat PTA was done for total of three times throughout the study.

The results of PTA for every ear was recorded separately. The hearing threshold was observed using WHO criteria of hearing loss. Sound frequencies between 4000–8000 Hz was considered as high frequencies.

OBSERVATION AND RESULT

During the study 72 patients of known cases of CKD on maintenance hemodialysis visiting the nephrology OPD for hemodialysis during the study period.

Out of which 12 patients were aged >55 years and were excluded from the study, 4 patients had history of ototoxic drugs and 13 patients were lost to follow up and thus were excluded from the study and final study includes 43 patients in group A and group B also includes 43 participants with age and sex matched.

TABLE- Comparison of hearing loss based on PTA at visit 1,2 and 3

Hearing loss based on PTA at visit	Group A (n=43)	Group B (n=43)	Total	P value
Hearing loss based on PTA at visit 1				
Patients with hearing loss	19 (44.19%)	5 (11.63%)	24 (27.91%)	0.0008†
Patients without hearing loss	24 (55.81%)	38 (88.37%)	62 (72.09%)	
Hearing loss based on PTA at visit 2				
Patients with hearing loss	20 (46.51%)	5 (11.63%)	25 (29.07%)	0.0004†
Patients without hearing loss	23 (53.49%)	38 (88.37%)	61 (70.93%)	
Hearing loss based on PTA at visit 3				
Patients with hearing loss	22 (51.16%)	5 (11.63%)	27 (31.40%)	<.0001†
Patients without hearing loss	21 (48.84%)	38 (88.37%)	59 (68.60%)	

*Fisher's exact test, † Chi square test

We observed that patients with hearing loss in group A were initially 19(44.19%) during the first visit and increased to 22(51.16) by third visit however in group 2 patients with hearing loss remained constant 38(88.37%) in all visits.

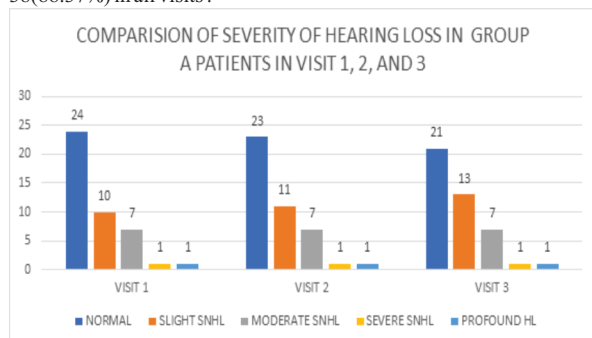


FIG-Comparison of hearing loss in group A patients in visit 1, 2, and 3

It was observed that in group A number of patients with slight SNHL increased from 10(23.26%) to 13(30.23%) by the third visit and however the number of patients with hearing loss in group B remained constant in all the visits.

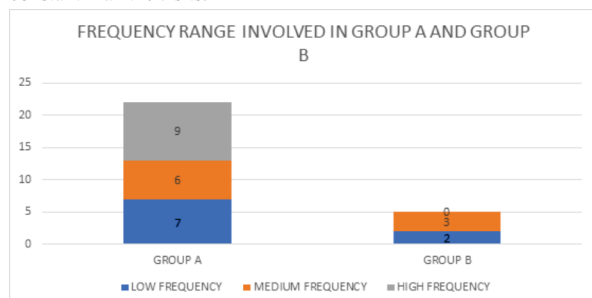


FIG-Frequency range involved in group A and group B

It was observed that in group A patients with hearing loss, 40.9% patients had high frequency hearing loss, followed by 31.81% had low frequency and 27.2% had medium frequency hearing loss, in comparison to group B where no patients had high frequency hearing loss, having p value of 0.31.

DISCUSSION

Hearing impairment, particularly SNHL, has commonly been observed in CKD patients and is a common finding in many studies about the influence of renal failure on hearing. Electrolyte disturbances, sodium, water imbalance, hypertension, elevated serum urea levels, Vitamin D deficiency, are proposed mechanisms for hearing impairment in patients with CKD.

In our study we reported prevalence of sensorineural hearing loss in 51.16% patients of CKD compared to normal participants in group where the prevalence was 11.63% which was statistically significant having p value <0.001. Similar to our study Mohd Bello et al⁽⁶⁾ and Rahman et al⁽⁷⁾ reported similar finding of 57.5% and 54% respectively. However in study conducted by Jamaldeen et al⁽⁸⁾ and R Meena et al⁽⁹⁾ reported prevalence of 41.7% and 28% respectively.

The hearing loss was bilateral (86.36%) in patients with hearing loss, similar to studies by Reddy et al (61%)⁽¹⁰⁾, and Bello et al (91.7%)⁽⁶⁾. The higher incidence of bilateral hearing impairment noted in CKD may be explained by vascular, biochemical, fluid, and electrolyte changes as well as immunological changes in the inner ear leading to bilateral cochlear pathology.

Most of the patients with hearing loss in our study the degree of hearing loss was mild type in 30.23% of CKD patients similar to studies by Mohd Bello et al (75.4%)⁽⁶⁾, Reddy et al (50%)⁽¹⁰⁾, and Jamaldeen et al (23.3%)⁽⁸⁾. However studies by Bendo et al⁽¹¹⁾ and Rahman et al⁽⁷⁾ reported moderate to severe degree of hearing loss. In our study we reported that 40.9% of CKD patients with hearing loss had high frequency hearing loss similar to studies by Peyvandi et al⁽¹²⁾, Mohd. Bendo et al⁽¹¹⁾, Haider et al⁽¹³⁾ and Reddy et al⁽¹⁰⁾. While studies by Jamaldeen et al⁽⁸⁾ observed hearing loss in all frequencies. The reason for high-frequency hearing loss may be because of the involvement of basal turn of the cochlea which is thought to be vulnerable to certain diseases.

It was noted that 10 (45.4%) out of 22 patients with hearing loss had stage 5 kidney disease and 83.3% patients of stage 5 kidney disease had sensorineural hearing loss similar to study conducted by Rezwanur et al⁽⁷⁾ where they had 60% with hearing loss in stage 5 kidney disease.

CONCLUSION

CKD is commonly associated with sensorineural type of hearing loss. We conducted an observation study from January 2021 to November 2022 which included group A, forty three patients of Chronic kidney disease (CKD) on hemodialysis under the age group 15-55yr, attended the hemodialysis unit for >6months during the period of study and Group B, forty three patients with normal kidney function coming in ENT OPD.

In our study the reported prevalence of sensorineural hearing loss was 51.16%. PTA is a non-invasive procedure which was employed to detect CKD patients suffering from any hearing loss. The hearing loss was bilateral (86.36%) in patients. 30.23% of them had mild degree of hearing loss. We reported that 40.9% of CKD patients with hearing loss had high frequency hearing loss. 83.3% patients of stage 5 kidney disease had sensorineural hearing loss.

This study showed that, the hearing loss was more prevalent among the patients with CKD and majority of them had hearing loss of mild type, bilateral, sensorineural, and mostly affecting higher frequencies.

LIMITATIONS

1. Due to covid 19 pandemic the actual sample size couldn't be met. Due to lockdown and shutting of transport services, many patients were lost to follow up.
2. As CKD is a chronic disease and often associated with other comorbidities, it takes longer time for symptoms and longer treatment, study duration was not sufficient to collect the required amount of information's and very limited information were collected and studied.

Conflict Of Interest: Authors declared. There is no conflict of interest.

Ethical Issues: This study was ethical approved by Institutional Ethical Committee

REFERENCES

1. Cosgrove, D., Samuelson, G., Meehan, D. T., Miller, C., McGee, J., Walsh, E. J., & Siegel, M. (1998, July). Ultrastructural, physiological, and molecular defects in the

- inner ear of a gene-knockout mouse model for autosomal Alport syndrome. *Hearing Research*, 121(1–2), 84–98. [https://doi.org/10.1016/s0378-5955\(98\)00069-0](https://doi.org/10.1016/s0378-5955(98)00069-0)
2. Lopez, P. S., Silva, D. P., Martin, L. C., & Montovani, J. C. (2014). Could the type of treatment for chronic kidney disease affect the auditory system? *Brazilian Journal of Otorhinolaryngology*, 80(1), 54–59. <https://doi.org/10.5935/1808-8694.20140012>.
 3. Ozturan, O., & Lam, S. (1998, November). The effect of hemodialysis on hearing using pure-tone audiometry and distortion-product otoacoustic emissions. *ORL Journal for Oto-Rhino-Laryngology and its Related Specialties*, 60(6), 306–313. <https://doi.org/10.1159/000027615>
 4. Albertazzi, A., Cappelli, P., Di Marco, T., Maccarone, M., & Di Paolo, B. (1988). The natural history of uremic neuropathy. *Contributions to Nephrology*, 65, 130–137. <https://doi.org/10.1159/000415758>
 5. Pirodda, A., Cicero, A. F., & Borghi, C. (2012). Kidney disease and inner ear impairment: A simpler and closer pathogenic analogy? *Internal and Emergency Medicine*, 7(Suppl. 2), S93–S95. <https://doi.org/10.1007/s11739-011-0703-7>
 6. Fufore, M. B., Kirfi, A. M., Salisu, A. D., Samdi, T. M., Abubakar, A. B., & Onakoya, P. A. (2019). Prevalence and pattern of hearing loss in patients with chronic kidney disease in Kaduna, Northwestern Nigeria. *Indian Journal of Otology*, 25(4), 201–205
 7. Rahman, R., Akhtar, N., Khanam, A., & Alam, M. R. (2016). Prevalence and patterns of hearing loss among chronic kidney disease of various stages in Bangladeshi patients. *American Journal of Medical Sciences and Medicine*, 4(3), 53–58. <http://doi:10.12691/ajmsm-4-3-2>
 8. Jamaldeen, J., Basheer, A., Sarma, A. C., & Kandasamy, R. (2015, February 28). Prevalence and patterns of hearing loss among chronic kidney disease patients undergoing haemodialysis. *Australasian Medical Journal*, 8(2), 41–46. <https://doi.org/10.4066/AMJ.2015.2258>
 9. Meena, R. S., Aseri, Y., Singh, B. K., & Verma, P. C. (2012, December). Hearing loss in patients of chronic kidney disease: A study of 100 cases. *Indian Journal of Otolaryngology and Head and Neck Surgery*, 64(4), 356–359. <https://doi.org/10.1007/s12070-011-0405-5>.
 10. Reddy, E., Surya Prakash, D., & Rama Krishna, M. K. D. (2016) Proportion of hearing loss in chronic renal failure: Our experience. *Indian Journal of Otology*, 22(1), 4. <https://doi.org/10.4103/0971-7749.176503>
 11. Bendo, E., Resuli, M., & Metaxas, S. (2015). Hearing evaluation in patients with chronic kidney disease. *JOAD*, 4, 51–53. [https://doi.org/10.1016/S2221-6189\(14\)60083-4](https://doi.org/10.1016/S2221-6189(14)60083-4)
 12. Peyvandi, A., & Roozbahany, N. A. (2013, December). Hearing loss in chronic kidney disease patient undergoing hemodialysis. *Indian Journal of Otolaryngology and Head and Neck Surgery*, 65(Suppl. 3), 537–540. <https://doi.org/10.1007/s12070-011-0454-9>.
 13. Saeed, H. K., Al-Abbasi, A. M., Al-Maliki, S. K., & Al-Asadi, J. N. (2018, October–December) Sensorineural hearing loss in patients with chronic renal failure on hemodialysis in Basrah, Iraq. *Ci Ji Yi Xue za Zhi = Tzu-Chi Medical Journal*, 30(4), 216–220. https://doi.org/10.4103/tcmj.tcmj_149_17