International Journal of Otorhinolaryngology and Head and Neck Surgery
*Thakur J et al. Int J Otorhinolaryngol Head Neck Surg. 2021 Nov;7(11):1744-1749*
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20214224

**Original Research Article**

# Hearing impairment in patients of renal failure

**Joshna Thakur*, Kavita Sachdeva**

Department of ENT, NSCB Medical College, Jabalpur, Madhya Pradesh, India

**Received:** 01 October 2021
**Revised:** 20 October 2021
**Accepted:** 21 October 2021

***Correspondence:**
Dr. Joshna Thakur,
E-mail: joshnathakur58@gmail.com



## ABSTRACT

**Background:** Kidney diseases are emerging public health problems in developing countries. A common complication of renal failure is sensorineural hearing loss which is leading to poor quality of life. The aim of the study was to determine the prevalence of hearing loss in renal failure patients and to see the correlation of dialysis, ototoxic drugs, and creatinine levels.
**Methods:** This observational study was conducted at the department of otorhinolaryngology, tertiary care center, Jabalpur (Madhya Pradesh) for a period of 18 months i.e.; from March 2019 to August 2020. 70 patients with renal failure were registered for study. In all patients hematological tests include hemoglobin, urea, creatinine, random blood sugar, serum electrolytes and pure tone audiometry was done.
**Results:** Out of 70 patients, 51 patients (72.9%) of renal failure had sensorineural hearing loss. Hypertension and diabetes mellitus as comorbidity play important role in hearing loss in renal failure patients. Acoustic reflex was absent in 14.3% of cases which signifying a profound hearing loss and these patients had creatinine level above 6 mg/dl.
**Conclusions:** Senorineural hearing loss is more prevalent in renal failure patients. Significant association was present between raised creatinine level and sensorineural hearings loss. Diabetes mellitus and hypertension were the common comorbidities that have a significant role in hearing loss in renal failure patients. All patients having renal failure have a risk of developing sensorineural hearing loss. So, these patients should be kept under follow up by doing regular pure tone audiometry and taking preventive measures, so that the hearing loss doesn't occur.

**Keywords:** Hearing loss, Creatinine level, Renal failure, Dialysis, Ototoxic drugs

## INTRODUCTION

Kidney diseases are emerging public health problems in developing countries. The study was conducted in 2015, GBD (Global burden of disease) estimated that, in 2015, 1.2 million people died from renal failure, an increase of 32% since 2005.[1]

Kidney disease is associated with a tremendous economic burden. High-income countries typically spend more than 2-3% of their annual healthcare budget on the treatment of end-stage kidney disease. Sensorineural hearing loss is more common in patients having chronic renal failure. Thus, leading to poor quality of life.

The prevalence of sensorineural hearing loss is more in renal failure patients which later on become bilateral. Bazzi et al found an incidence of 77% including patients with mild hearing loss in 1995.[2] Bergstrom et al reported hearing loss in 40% of the CRF patients on hemodialysis in 1980.[3] Ozturan et al found a moderate to severe hearing loss in 46% of the chronic renal failure patients in 1998.[4]

The exact pathophysiological mechanism underlying the presence of hearing loss among CKD patients is unknown although the most accepted hypothesis is that, there are also certain anatomic similarities at an ultrastructural level in both cochlea and kidney leading to similar

antigenicity that could explain the association between CKD and hearing loss.[5-7] Thus suggesting the hypothesis that the cochlea is affected by the systemic metabolic, hydro electrolytic, and hormonal alterations that are associated with CRF.[8]

The aim of the study was to determine the prevalence of hearing loss among patients with renal failure in mid India and also determine the type and severity of hearing impairment in these patients. In this study we also determined the association of hearing impairment with various comorbidities.

## METHODS

### *Study design*

Study was prospective observational study.

### *Inclusion criteria*

All patients with renal failure with the recent development of hearing loss.

### *Exclusion criteria*

Patients with known hearing loss before renal failure and patients with middle ear disorder (safe and unsafe chronic suppurative otitis media, tympanosclerosis, otosclerosis, etc).

### *Collection of data*

The study was conducted in a tertiary care centre in the period between March 2019 to August 2020.

70 patients were enrolled in this study. Enrolled patients were interviewed using a proforma which include name, age, gender, risk factor, socioeconomic status, duration of use of ototoxic drugs and associated comorbidities. Routine blood investigations with renal profile, including urea and creatinine and detailed ENT examination was done. Patients hearing was evaluated by tunning fork and pure tone audiometry.

This was further supplemented by impedance audiometry and speech audiometry. Detailed history of patients for treatment of renal failure like frequency of dialysis were also included in this study.

### *Statistical analysis*

Data was compiled using Microsoft (MS) excel after feeding/recorded into the computer and after its proper validation and then analysed using IBM statistical package for the social sciences (SPSS) software version 20. Statistical tests such as Student's t-test and Fischer exact test for categorical data were applied. All numerical data are expressed as mean and standard deviation and the proportion as in percentage.

Considering audiological reports as standard and haematological reports (renal function test) were compared on the basis of sensitivity, specificity and accuracy.

Sample size was calculated using Right-size (China-Uganda-Zimbabwe, version 2.0.0.2) statistical software.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## RESULTS

A total of 70 patients with renal failure was evaluated with a mean age of 46.9±8.51 years and male: female ratio of 3.6:1. Patients of age from 16 to 60 years were included in this study. The majority of patients belonged to an age range of 41 to 50 years (38.6%). In the present study, male preponderance was observed. About 78.6% patients with renal failure with hearing loss were males. whereas only 21.4% patients were females. In this study, all the patients with recent onset of hearing loss were enrolled. Among them, the onset of hearing loss was insidious and progressive in 87.1% patients and only 12.9% were reported sudden onset.

Out of 70 patients, 72.9% had sensorineural hearing loss. Along with renal failure as a risk factor for sensorineural hearing loss, certain independent risk factor was also present like 43.1%patients were giving a history of intake of drug ibuprofen and having sensorineural hearing loss, similarly 39.2% patients were taking furosemide (lasix) having sensorineural hearing loss. Occurrence of hearing loss was observed to be significantly associated with furosemide and ibuprofen ($p<0.05$). However, no such association was observed for other drugs like vancomycin, chloroquine and aminoglycosides ($p>0.05$). Table 2 reveal a positive association between sensorineural hearing loss along with these comorbidities in patients with renal failure. Hypertension and diabetes mellitus were having statistically significant association with hearing loss ($p<0.05$). However, other comorbidities were not significantly associated with hearing loss($p>0.05$).

The majority of patients with sensorineural hearing loss had raised creatinine levels. It was observed that the majority of patients with sensorineural hearing loss had creatinine level more than 6 mg/dl whereas those patients who had creatinine level below 6 mg/dl had no hearing loss. Among the patients having creatinine level between 6 to 12 mg/dl, 51% cases have developed sensorineural hearing loss. However, patients having creatinine level above 16 mg/dl, most of these patients developed sensorineural hearing loss. Hence, the observed association was statistically significant ($p<0.01$). As per the Table 4 there was an association present between the

longer the duration of ototoxic drug uses, more was the hearing loss, but when the statistical tool was applied were not coming to be significant. So, in this study, we could not get the significant association between the duration of use of ototoxic drug and proportionate hearing loss.

**Table 1: Association between hearing loss and ototoxic drugs.**

| Ototoxic drugs | Hearing loss | | | | $\chi^2$ | P value |
|---|---|---|---|---|---|---|
| | Absent (n=19) | | Present (n=51) | | | |
| | N | % | N | % | | |
| **Lasix** | 2 | 10.5 | 20 | 39.2 | 5.3 | 0.02 |
| **Aminoglycoside** | 2 | 10.5 | 9 | 17.6 | 0.53 | 0.47 |
| **Ibuprofen** | 2 | 10.5 | 22 | 43.1 | 6.5 | 0.01 |
| **Chloroquine** | 0 | 0.0 | 1 | 2.0 | 0.38 | 0.54 |
| **Vancomycin** | 0 | 0.0 | 4 | 7.8 | 1.58 | 0.21 |

**Table 2: Association of comorbidities with hearing loss.**

| Co-morbidities | Hearing loss | | | | $\chi^2$ | P value |
|---|---|---|---|---|---|---|
| | Absent (n=19) | | Present (n=51) | | | |
| | N | % | N | % | | |
| **Hypertension** | 6 | 31.6 | 31 | 60.8 | 4.74 | 0.03 |
| **Diabetes** | 6 | 31.6 | 28 | 54.9 | 3.01 | 0.049 |
| **UTI with BPH** | 0 | 0.0 | 1 | 2.0 | 1.62 | 0.185 |
| **CAD** | 1 | 5.3 | 3 | 5.9 | 0.96 | 0.98 |
| **Cardiac failure** | 0 | 0.0 | 1 | 2.0 | 1.62 | 0.185 |
| **COPD** | 0 | 0.0 | 1 | 2.0 | 1.62 | 0.185 |
| **CVA** | 0 | 0.0 | 5 | 9.8 | 2.78 | 0.35 |
| **Hyperthyroidism** | 3 | 15.8 | 0 | 0.0 | 15.4 | 0.45 |
| **Hypothyroidism** | 2 | 10.5 | 2 | 3.9 | 0.6 | 0.25 |
| **PCKD** | 1 | 5.3 | 0 | 0.0 | 2.4 | 0.24 |
| **Pleural effusion** | 0 | 0.0 | 1 | 2.0 | 1.62 | 0.185 |
| **Pulmonary edema** | 0 | 0.0 | 1 | 2.0 | 1.62 | 0.185 |
| **Seizures** | 0 | 0.0 | 2 | 3.9 | 1.84 | 0.21 |
| **Anemia** | 0 | 0 | 6 | 11.8 | 2.45 | 0.11 |
| **TB (pulmonary)** | 2 | 10.5 | 3 | 5.9 | 0.45 | 0.50 |
| **Diabetic nephropathy** | 0 | 0.0 | 1 | 2.0 | 1.62 | 0.18 |
| **TB nephropathy** | 1 | 5.3 | 1 | 2.0 | 2.2 | 0.23 |

**Table 3: Association between serum creatinine level and hearing loss.**

| Creatinine | Hearing loss | | | | P value |
|---|---|---|---|---|---|
| | Absent (n=19) | | Present (n=51) | | |
| | N | % | N | % | |
| **<2** | 1 | 5.3 | 3 | 5.9 | |
| **2 to 6** | 9 | 47.4 | 6 | 11.8 | |
| **6 to 12** | 3 | 15.8 | 26 | 51 | 0.01 |
| **12 to 16** | 0 | 0 | 2 | 3.9 | |
| **>16** | 6 | 31.6 | 14 | 27.5 | |

**Table 4: Distribution of hearing loss according to duration of ototoxic drugs.**

| Duration of ototoxic drugs (in years) | Hearing loss | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mild | | Mod | | Mod severe | | Severe | |
| | N | % | N | % | N | % | N | % |
| **1-2** | 1 | 50 | 5 | 55.6 | 1 | 14.3 | 0 | 0 |
| **3-5** | 0 | 0 | 4 | 44.4 | 4 | 57 | 3 | 50 |
| **6-10** | 1 | 50 | 0 | 0 | 2 | 28.6 | 3 | 50 |
| **P=0.16** | | | | | | | | |

**Table 5: Association of number of dialysis with hearing loss.**

| Number of dialysis | Hearing loss | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mild | | Mod | | Mod severe | | Severe | |
| | N | % | N | % | N | % | N | % |
| **1-3** | 6 | 75 | 4 | 40 | 2 | 25 | 1 | 12.5 |
| **4-6** | 2 | 25 | 4 | 40 | 3 | 37.5 | 3 | 37.5 |
| **7-10** | 0 | 0 | 1 | 10 | 3 | 37.5 | 3 | 37.5 |
| **>10** | 0 | 0 | 1 | 10 | 0 | 0 | 1 | 12.5 |
| **P=0.265** | | | | | | | | |

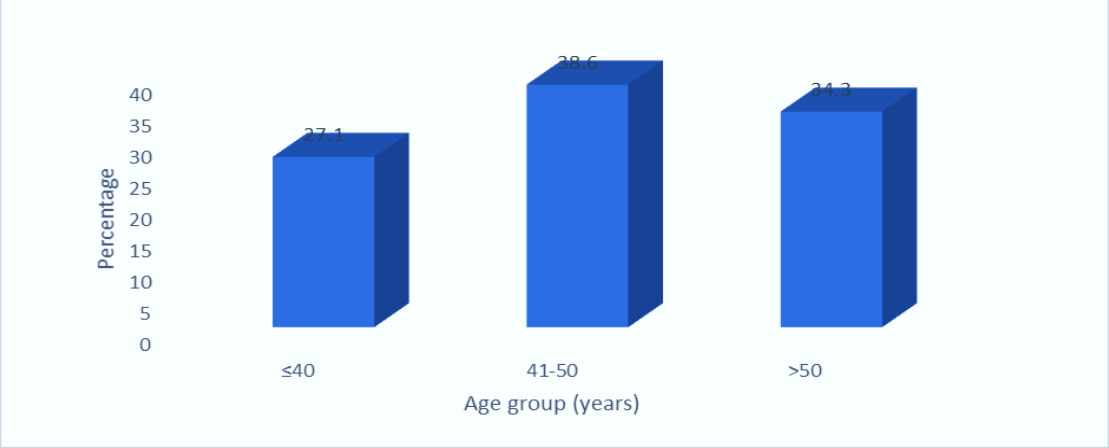


**Figure 1: Distribution of patient according to age.**

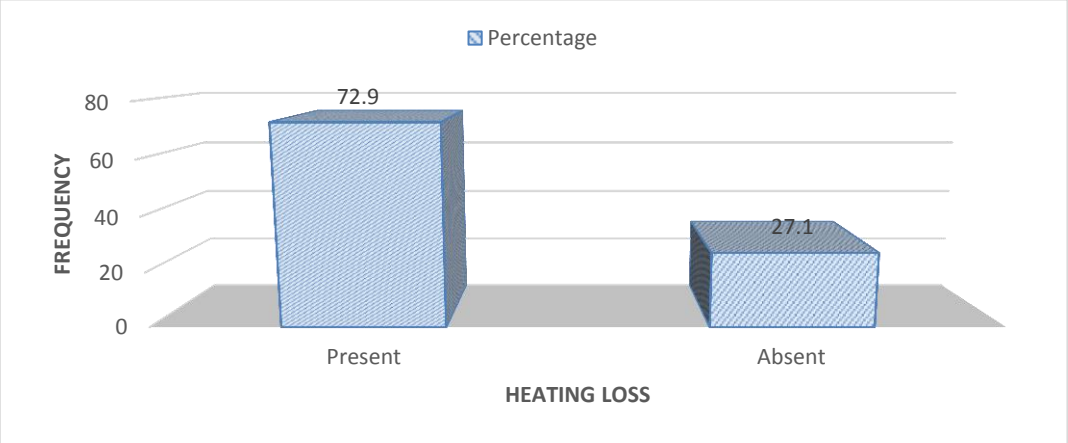


**Figure 2: Proportion of hearing loss in patients with renal failure.**

## DISCUSSION

Total 70 patients with renal failure were evaluated for the study. End-stage renal disease is commonly complicated with sensorineural hearing loss and adding to disability to life of diseased pearsons. In the present study, the proportions of hearing loss amongst patients with renal failure were documented to be 72.9%, with a male preponderance of 3.6:1. (78.6% patients were male and 21.4% patients were females).

In the present study, sensorineural hearing loss was present in 72.9% patients. The previous studies done on chronic renal failure patients showed high prevalence of sensorineural hearing loss (70%-75%).[9,10] Meena et al found 14 (28%) out of 50 cases of CRF had sensorineural hearing loss of moderate to a severe degree which was bilateral and symmetrical.[11] Stavroulaki et al found hearing loss in 55.5% of the children with CRF.[12]

The relation between the ototoxic drug and hearing loss were significantly present with Ibuprofen and furosemide (Lasix) ($p<0.05$), while no significant association of hearing loss with other drugs could be found.

Acoustic reflex was done and it was absent in 14.3% cases. As per Davis et al patients with severe to profound hearing loss have absent acoustic reflex while present in normal and mild to moderate sensorineural hearing loss.[13] The speech discrimination score was poor in 71.5% cases. In these patients the neural component was also found to be affected.

In this study 48.6% patients received dialysis. Significant observation was seen in these patients, it was observed that as the number of dialysis increased the severity of sensorineural hearing loss was also increased. Thus, signifying that sensorineural hearing loss was more prevalent in advanced renal failure patients. Many studies are done to find the correlation between haemodialysis and auditory function. Gierek et al, Pandey et al, Gore et al and Kligerman et al found no effect of haemodialysis on auditory function.[14-16] While in some studies positive correlation of hearing loss with haemodialysis were found.[17-19]

Venturini et al evaluated hearing loss in patients on RDT (Regular dialysis treatment). However, there was no negative effect of dialysis as such on hearing loss.[2] The relationship between dialysis and hearing loss is yet to be established by more research.

Association between hearing loss and comorbidities was evaluated and the correlation between hypertension and diabetes mellitus preexisting in a renal failure patient were present. Correlation of hearing loss with hypertension and diabetes mellitus were significant ($p<0.05$), however, other comorbidities had not that much association.

Kang et al revealed that the incidence of developing SNHL was higher in patients having CKD with comorbidities.[20]

### *Limitation*

In this study the patients were followed for 1.5 years, while this type of study requires a long duration to follow-up right from the diagnosis of renal failure to further onwards.

## CONCLUSION

Sensorineural hearing loss is more prevalent in renal failure patients. There is a significant association between raised serum creatinine and sensorineural hearing loss and comorbidities like hypertension and diabetes increase the risk of sensorineural hearing loss. Co-existing history of ototoxic drugs also is a independent risk factors but not statistically significant. In this study, number of dialysis showed increased severity of hearing loss but it was statistically not significant. The auditory health of patients with renal failure is more carefully evaluated by healthcare professionals. Furthermore, it is mandatory for necessary follow-ups to be done regularly.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388(10053):1459-544.
2. Bazzi C, Venturini CT, Pagani C, Arrigo G, D'Amico G. Hearing loss in short- and long-term haemodialysed patients. Nephrol Dial Transplant. 1995;10(10):1865-8.
3. Ozturan O, Lam S. The effect of hemodialysis on hearing using pure-tone audiometry and distortion-product otoacoustic emissions. ORL J Otorhinolaryngol Relat Spec. 1998;60(6):306-13.
4. Bergstrom L, Jenkins P, Sando I, English GM. Hearing loss in renal disease: clinical and pathological studies. Ann Otol Rhinol Laryngol. 1973;82(4):555-76.
5. Arnold W. Inner ear and renal diseases. Ann Otol Rhinol Laryngol Suppl. 1984;112:119-24.
6. Irwin J. Basic anatomy and physiology of the ear. In: Newton VE, Vallely PJ, eds. Infection and Hearing Impairment. Chichester, UK: John Wiley and Sons; 2006: 8-13.
7. Cosgrove D, Samuelson G, Meehan DT, Miller C, McGee J, Walsh EJ, et al. Ultrastructural, physiological, and molecular defects in the inner ear of a gene-knockout mouse model for autosomal Alport syndrome. Hear Res. 1998;121(1):84-98.
8. Pirodda A, Cicero AF, Borghi C. Kidney disease and inner ear impairment: a simpler and closer pathogenic analogy?. Intern Emerg Med. 2012;7(2):93-5.
9. Henrich WL, Thompson P, Bergstrom LV, Lum GM. Effect of dialysis on hearing acuity. Nephron. 1977;18(6):348-51.
10. Charachon R, Ribes V, Cordonnier D. Deafness due to renal failure. Clinicopathological study (author's transl). Ann Otolaryngol Chir Cervicofac. 1978;95(3):179-203.
11. Meena RS, Aseri Y, Singh BK, Verma PC. Hearing loss in patients of chronic renal failure: a study of 100 cases. Indian J Otolaryngol Head Neck Surg. 2012;64(4):356-9.
12. Stavroulaki P, Nikolopoulos TP, Psarommatis I, Apostolopoulos N. Hearing evaluation with distortion-product otoacoustic emissions in young patients undergoing haemodialysis. Clin Otolaryngol Allied Sci. 2001;26(3):235-42.
13. Davies RA. Handbook of Clinical Neurology. Netherland: Elsevier; 2016.

14. Gierek T, Markowski J, Kokot F, Paluch J, Wiecek A, Klimek D. Electrophysiological examinations (ABR and DPOAE) of hearing organ in hemodialysed patients suffering from chronic renal failure. Otolaryngol Pol. 2002;56(2):189-94.
15. Pandey S, Gore G, Valame D, Mehta K. Audiometric profile in patients with chronic renal failure. J Otolaryngol Head Neck Surg. 2011;40(2):131-6.
16. Kligerman AB, Solangi KB, Ventry IM, Goodman AI, Weseley SA. Hearing impairment associated with chronic renal failure. Laryngoscope. 1981;91(4):583-92.
17. Mirahmadi MK, Vaziri ND. Hearing loss in end-stage renal disease - effect of dialysis. J Dial. 1980;4(4):159-65.
18. Renda R, Renda L, Selçuk ÖT, Eyigör H, Yılmaz MD, Osma Ü. Cochlear sensitivity in children with chronic kidney disease and end-stage renal disease undergoing hemodialysis. Int J Pediatr Otorhinolaryngol. 2015;79(12):2378-83.
19. Bawa AG, Singh G, Uzair G, Garg S, Kaur J. Pattern of hearing loss among chronic kidney disease patients on haemodialysis. Int J Med Res Prof. 2017;3:193-6.
20. Wu KL, Shih CP, Chan JS, Chung CH, Lin HC, Tsao CH, et al. Investigation of the relationship between sensorineural hearing loss and associated comorbidities in patients with chronic kidney disease: A nationwide, population-based cohort study. PLoS One. 2020;15(9):238913.

**Cite this article as:** Thakur J, Sachdeva K. Hearing impairment in patients of renal failure. Int J Otorhinolaryngol Head Neck Surg 2021;7:1744-9.