



## Research Article

### Sensorineural Hearing Loss in Patients with Chronic Renal Failure in the Patients of Southern India

Hanumanthu Kishore Dora<sup>1</sup>, Swapna Lenka<sup>2</sup>, Shoba Seetharama Raju<sup>3</sup> & Srinivasa Rao Lenka<sup>\*4</sup>

<sup>1</sup> Assistant Professor, Department of ENT, Government Medical College, Srikakulam.

<sup>2</sup> Assistant Professor, Department of ENT, Andhra Medical College, Vishakapatnam.

<sup>3</sup> Assistant Professor, Department of ENT, Government Medical College, Rajahmundry.

<sup>4</sup> Associate Professor, Department of General Medicine, Maharaja Institute of Medical Sciences, Vijayanagaram.

#### ARTICLE INFO

##### Article History:

Received: 07-05-2024

Accepted: 04-06-2024

##### Keywords:

Ear infections

hemodialysis

audiometry

incidence and prognosis

prevalence

impairment

renal failure

incidence

dialysis

and hearing loss.

##### Corresponding author:

**Dr. Srinivasa Rao Lenka\***

Associate Professor

Department of General Medicine

Maharaja Institute of Medical

Sciences Vijayanagaram

#### ABSTRACT

**Introduction:** Chronic renal failure (CRF) patients often undergo hemodialysis as a critical life-sustaining treatment. This process, while essential, may have unintended side effects, including possible impacts on auditory function. Recent studies suggest that hemodialysis can influence the hearing threshold in CRF patients, potentially exacerbating or precipitating hearing loss. The mechanisms speculated to underlie these changes include the rapid alteration of electrolyte levels, especially potassium, which is crucial for normal cochlear function in the inner ear. Additionally, the hemodialysis procedure may lead to fluctuating blood pressure and microemboli formation, which could compromise the vascular supply to the auditory system, further affecting hearing capabilities. **Aim:** The study aims to evaluate the effect of hemodialysis on the hearing threshold in chronic renal failure patients (CRF). **Materials and Methods:** This study was conducted at Government Medical College, Srikakulam from March 2022 to March 2023. Patients with CRF on chronic regular hemodialysis regardless of the duration of renal failure or dialysis were included in the study. All sociodemographic characteristics and history of the patients were collected. Hearing loss was detected by ontological examination and tympanometry. **Results:** The study includes 76 patients with a mean age of  $39.2 \pm 7.1$  years. Among the total population, 55 experienced hearing loss initially and was extended to 68 after 12 months of follow-up. At the end of follow-up, deterioration of hearing acuity occurred in 90% of patients and 6% of patients showed improvement. The study results also found a positive correlation between the period of hemodialysis and hearing loss. ( $r=0.712$ ,  $P=0.0002$ ) **Conclusion:** Patients having chronic renal failure experience the most common condition called Sensorineural hearing loss.

#### INTRODUCTION

Chronic renal failure (CRF) affects the normal functioning of every organ system in the body. Uremic toxic accumulation and hemodialysis for longer duration affect most of the tissues and in particular the auditory system[1]. Numerous mechanisms for hearing loss were proposed which are caused due to CRF. The inner ear exhibits a complex process on the homeostasis of water and electrolytes. Any defect noted in the cationic rise of endolymphatic fluid will modify hearing effects[2,3]. Another vital proposed mechanism for hearing loss noted in CRF patients is Endolymphatic hydrops. Sensory-neural hearing loss (SNHL) which is upgraded by hemodialysis occurs due to this phenomenon.

Sensory neural hearing loss is considered the most prevalent condition in patients with chronic renal failure condition than in normal people with an incidence of 28% to 77%[4]. Though many disease conditions could be affected by CRF, the most common is hearing impairment[5].

The cochlea and kidney share similar antigens and mechanisms namely, the active transport of fluid and electrolytes achieved by striae vascularis in the cochlea and glomeruli in the kidney. Several other studies reported that the cochlea is affected by hydro electrolytic, hormonal changes, and systemic metabolic which are connected with CRF.

The etiopathogenetic mechanism of hearing loss in CRF might also

contributed by other factors like age, comorbid conditions (diabetes mellitus and hypertension), electrolyte disturbances, hemodialysis and electrolyte disturbances, ototoxic drugs[6]. In spite of studies on impact of hemodialysis in hearing loss, the results are still debated. Few studies confirm that there is less association between hemodialysis treatment and auditory function while other few studies demonstrate association of hearing loss and hemodialysis[7,8,9].

By considering the above facts, the study is designed to find the role of hemodialysis on SNHL in patients attending our hospital.

#### MATERIALS AND METHODS

This study was conducted in the Department of ENT at Government Medical College, Srikakulam from March 2022 to March 2023. Ethical clearance was obtained from the Institutional Ethical Committee with approval number (3A/IEC/GEMS&H/2022). Patients with CRF on chronic regular hemodialysis regardless of the duration of renal failure or dialysis were included in the study. Patients with a history of chronic use of ototoxic drugs, childhood onset, chronic noise exposure, and hearing loss before the onset of chronic kidney disease were excluded from the study.

A total of 76 patients including 40 males and 36 females were included in the study. Detailed written Informed consent was obtained from all the patients included in the study. History, Baseline characteristics, and all sociodemographic charac-

teristics of the patients were collected. Hearing loss was detected by otological examination and tympanometry. Pure-tone audiometric examinations were performed during admittance, followed by 6 and 12 months by BA 20 Kamplex audiometer. Hearing thresholds were measured in decibels at the frequencies of 500-8000 Hz. Four frequencies i.e., 500, 1000, 2000, and 4000 Hz average were recorded and hearing loss was defined as an average hearing threshold > 20 dB. All the patients were followed up for 1 year.

#### STATISTICAL ANALYSIS

All the data obtained was entered and analyzed by SPSS software version 23. Student's t-test was used to find the significant difference in mean hearing activity. A chi-square test was performed to find the difference in absolute parameters. The Pearson correlation coefficient was handed down to find the association between hearing loss and the duration of hemodialysis. Regression analysis was carried out to find independent predictors of hearing loss.

#### RESULT

In the present study of 76 patients, the mean age was  $39.2 \pm 7.1$  years. Patients displayed a substantially longer duration of CRF and hemodialysis in hearing loss than those without loss. No significant variation was noted between patients with and without hearing loss for the parameters assessed as represented in Table 1.

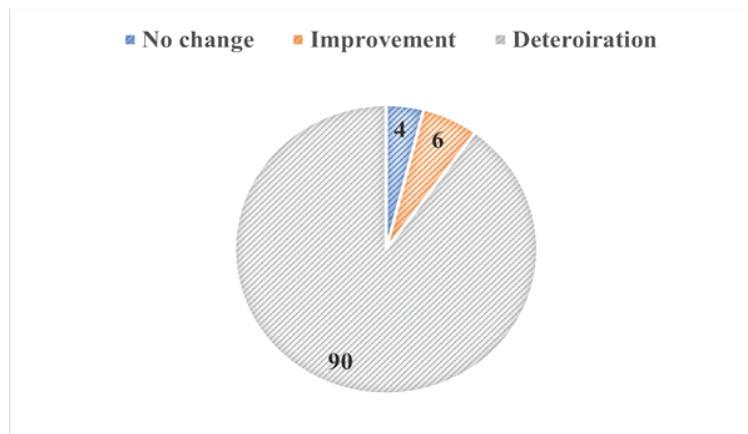
Table-1

Baseline characters	Total number of participants (n=76)	Patients with Haemodialysis (n=40)	Patients without Haemodialysis (n=36)	P value
Age	42.8±8.1	43.0±8.9	38.8±9.0	0.112
Male: female ratio	1.11	1.15	1.09	0.812
Duration of hemodialysis	3.3±2.8	4.0±1.2	1.8±1.3	0.005
Serum potassium (mmol/L)	4.3±0.3	4.2±0.2	4.5±0.8	0.129
Serum calcium (mg/dL)	4.1±0.2	4.1±0.1	4.0±0.5	0.552
Serum blood urea (mg/dL)	196.7±38.8	196.6±41.0	196.2±38.4	0.976
Serum creatinine (mg/dL)	9.5±1.2	9.7±1.3	9.2±1.2	0.613
Sessions of dialysis (/week)	42	34	10	0.342
Chronic renal failure in years (<2)	30	19	11	0.003

Hearing loss was detected in 55 (72.36%) patients at the start of the study and after 6 months, 8 patients developed hearing loss with a common rate of 82%. Later after 12 months of follow-up, 68 patients were detected with hearing loss with a prevalence rate of 89%. (Table 2)

**Table-2**

Audiometric examination	Patients with Hearing lossn (%)	Hearing loss in decibels (mean±SD)	P value
Baseline	55 (72.3%)	28.4±22.2	Reference
6 months	63 (82%)	36.3±13.8	0.0003*
12 months	68 (89%)	37.8± 18.3	0.0004*



At the end of follow-up, deterioration of hearing acuity occurred in 90% of patients and 6% of patients showed improvement. (Figure 1)

The study results also found a significant positive correlation between the duration of hemodialysis and hearing loss. (r=0.712, P=0.0002)

The variables of hearing loss were assessed by multivariate linear logistic regression analysis and the results were tabulated below in Table 3.

**Table-3**

Variable	B	R <sup>2</sup>	P value
value after a follow-up of 6 months Dialysis duration Age	0.543	0.345	0.0001
After a follow-up of 12 months Duration of dialysis	0.731	0.412	0.0002

**DISCUSSION**

The variables of hearing loss were assessed by multivariate linear logistic regression analysis and the results were tabulated below in Table 3.

Damage to the auditory nerve or the inner ear structures leads to Sensorineural hearing loss which leads to problems converting sound vibrations to neural signals which can be interpreted by brain. Hearing loss occurs when sound can't pass through outer or middle ear. The common reasons for hearing loss include benign tumours, deformations in outer or middle ear, ear wax and infections and hole in ear drum[10].

Some of the proposed mechanisms for hearing loss in CRF

patients are elevated serum urea levels, electrolyte imbalance, vitamin D deficiency[11].

SNHL is more common in chronic renal failure patients as noted in many studies globally. It differs in various countries. In India, hearing loss in CRF patients was noted to be 64%, in Nigeria it was found to be 67%, in Iran 46% and in Croatia 64%[12-15].

In this study, SNHL is noted in 55 patients at the start of the study which is comparable to the study results of Reddy et al. As the study ended, eight more patients started experiencing hearing loss followed by a total of 68 patients representing 89% of the total population. Similar results were noted in Aloubaide[16]. Bangladesh and Iraq where CRF patients on

regular hemodialysis patients experienced hearing loss. The role of hemodialysis in hearing loss patients may be due to changes in the electrolyte composition of endolymph and fluid accumulation as reported in a study by Lasisi et al[13].

chronic dialysis leads to hearing loss. However, the impact of haemodialysis on hearing impairment still remains controversial.

There are few studies, who stated that haemodialysis does not affect the auditory functions in short duration dialysis or a 5-year period follow up[5,7].

Various other studies demonstrate the controversial results where hearing is improved by haemodialysis[17, 18]. This is because haemodialysis promotes stabilization and normalization of metabolic and hydroelectric changes in the endolymph.

In our study, majority of the patients showed deterioration representing 90%; 6% displayed improved hearing and 4 % remained neutral without any improvement. This observation was in ordinance with many other studies where hearing 17. Stavroulaki P, Nikolopoulos TP, Psarommatis I, et al.: Hearing evaluation with distortion-product otoacoustic emissions in young patients undergoing haemodialysis. *Clin Otolaryngol Allied Sci.* 2001, 26:235-42.oss was dominant in most of the studied population.

Elevated blood urea and sodium electrolyte imbalance was suggested as possible factor for the contribution of hearing loss in CRF[19]. In contrast to that, our study results could not find any association between these levels and hearing loss which is in agreement with the results reported by Agarwal and Reddy et al[8,12].

Multivariate analysis proved that the duration of dialysis was the important predictor of hearing loss in the study which is similar to the results of Renda et al[20].

Though the results are found significant and comparable with previous results, there are certain limitations like sample size and lack of control group

### **CONCLUSION**

Sensorineural hearing loss occurs due to damage to the inner ear or auditory nerve. It is noticed as the primary cause of hearing loss in 90% of adults. genetic factors, loud noises, and the aging process are some of the factors of sensorineural hearing loss.

To conclude, as per the literature, the incidence of hearing loss is well documented in CRF patients than in the general population. in the present study, as per the observation, SNHL is more commonly seen in patients with CFR on hemodialysis. It was also concluded that the duration of hemodialysis had a significant effect on hearing patterns.

### **REFERENCE**

1. Bains KS, Chopra H, Sandhu JS, et al.: Cochlear function in chronic kidney disease and renal transplantation: a longitudinal study. *Transpl Proc.* 2007, 39:1465-1468. 10.1016/j.transproceed.2007.02.085
2. Balasubramanian C, Santhanakrishnakumar B, Anandan H: A

- the stria vascularis. *Dev Cell.* 200713, 325-337. 10.1016/j.devcel.2007.07.011.
4. Meena RS, Aseri Y, Singh BK, et al.: Hearing loss in patients of chronic renal failure: A study of 100 cases. *Indian J Otolaryngol Head Neck Surg.* 2012, 64:356-9. 10.1007/s12070-011-0405-5
5. 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, 60:306-13.
6. Cosgrove D, Samuelson G, Meehan DT, et al.: Ultrastructural, physiological, and molecular defects in the inner ear of a gene-knockout mouse model for autosomal alport syndrome. *Hear Res.* 1998, 121:84-98. 10.1016/s0378-5955(98)00069-0
8. Agarwal MK: A study of otorhinolaryngological manifestations in patients of chronic renal failure. *Indian J Otolaryngol Head Neck Surg.* 1997, 49:316-20.
9. Thodi C, Thodis E, Danielides V, et al.: Hearing in renal failure. *Nephrol Dial Transplant.* 2006, 21:3023-30. 10.1093/ndt/gfl472
10. Nikolopoulos TP, Kandiloros DC, Segas JV, et al.: Auditory function in young patients with chronic renal failure. *Clin Otolaryngol Allied Sci.* 1997, 22:222-5.
11. Gatland D, Tucker B, Chalstrey S, et al.: Hearing loss in chronic renal failure-hearing threshold changes following haemodialysis. *J R Soc Med.* 1991, 84:587-9. 10.1177/014107689108401006
12. Reddy EK, Surya Prakash DR, Rama Krishna MG: Proportion of hearing loss in chronic renal failure: Our experience. *Indian J Otol.* 2016, 22:4-9.
13. Lasisi AO, Salako BL, Kodiya MA, et al.: Hearing threshold in patients with chronic renal failure. *Saudi Med J.* 2007, 28:744-6.
14. Peyvandi A, Roozbahany NA: Hearing loss in chronic renal failure patient undergoing hemodialysis. *Indian J Otolaryngol Head Neck Surg.* 2013, 65:537-40.
15. Jakić M, Mihaljević D, Zibar L, et al.: Sensorineural hearing loss in hemodialysis patients. *Coll Antropol.* 2010, 34:165-71. 10.25259/IJMS\_135\_2021
16. Aloubaide RA, Alsaedi AJ, Saker R, et al.: Sensorineural deafness among patients with chronic renal failure in Al-Kindi Teaching Hospital. *Al Kindy Coll Med J.* 2011, 7:137-41.
17. Aspris AK, Thodi CD, Balatsouras DG, et al.: Auditory brainstem responses in patients under treatment of hemodialysis. *Ren Fail.* 2008, 30:383-90. 10.1080/08860220801947405
18. Gafter U, Shvili Y, Levi J, et al.: Brainstem auditory evoked responses in chronic renal failure and the effect of hemodialysis. *Nephron.* 1989, 53:2-5.

***Dora et al., 2024***

19. Govender SM, Govender CD, Matthews G: Cochlear function inpatients with chronic kidney disease. *S Afr J Commun Disord.* 2013, 60:44-9.
20. Renda R, Renda L, Selçuk ÖT, et al.: Cochlear sensitivity in children with chronic kidney disease and end-stage renal disease undergoing hemodialysis. *Int J Pediatr Otorhinolaryngol.* 2015, 79:2378-83