



Correlation Of Sensorineural Hearing Loss In Patients Undergoing Dialysis

¹Dr. Gabriela C Hawkes, ²Dr. Haritosh K Velankar,

¹Senior Resident, ²Professor,

Department of Otorhinolaryngology

Dr. D.Y Patil Medical College, Navi Mumbai

***Corresponding Author:**

Dr. Haritosh K Velankar

Professor, Department of Otorhinolaryngology, Dr. D.Y Patil Medical College, Navi Mumbai

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Abstract

Many similarities, anatomical, physiological, pharmacological and pathological, exist between the nephron and the stria vascularis of the cochlea, and hearing loss has been reported in patients with renal failure. The fact that the cochlea is susceptible to a wide variety of metabolic, hydroelectrolytic and hormonal imbalances is already widely known and these imbalances are systemic alterations usually found in patients who have compromised renal function. Therefore, it is expected that subjects with CRF develop cochlear dysfunction, clinically manifested by sensorineural hearing loss.

Keywords: NIL

Introduction

Chronic kidney disease is characterized by a decrease in glomerular filtration rate (less than 60 ml /min for three months or longer) and histological evidence of reduction in nephron population. The clinical course is typically one of a progressive and unrelenting loss of nephron function ultimately leading to end stage renal disease. There are multiple causes of kidney injury that lead to the final common pathway of End stage renal disease (ESRD), and this syndrome is characterized by hypertension, anemia, renal bone disease, nutritional impairment, neuropathy, impaired quality of life, and reduced life expectancy [1].

Chronic Kidney diseases is a worldwide public health problem. In a recent study, Modi and Jha et al. [2] suggested a crude incidence of CKD of 151 per million and age adjusted incidence of 232 per million in India. What is also interesting to note is that the average age of the ESRD population in India is 47 years, much younger than the data from the United State Renal Data System (USRDS), and that diabetes is present in 44% of the ESRD patients in India,

which is similar to the rate in the developed world. There is also evidence that, because of lack of medical facilities, poor control of risk factors, and delayed referral to the nephrologists, there is much more rapid progression of CKD in the Indian population than in developed countries [2].

The association between chronic kidney disease (CKD) and hearing impairment was first reported more than 80 years ago by Alport, who described a case of familial kidney disease related to hearing impairment [3].

The etiopathogenetic mechanisms of Sensorineural hearing loss in CKD is due to osmotic alteration resulting in loss of hair cells, collapse of the endolymphatic space, edema and atrophy of specialized auditory cells and in some, complications of hemodialysis itself. Because of certain anatomic, physiological and ultrastructural similarities between the stria vascularis of the inner ear and basement membranes of glomeruli and evidence for similar antigenicity of the cochlea and kidney, may explain

this association of CKD and SN loss can be explained to some extent [4].

In patients with established CKD, multiple risk factors have been hypothesized to cause hearing loss such as use of hypertension ototoxic drugs, hypertension, nephrotoxic drugs, electrolyte disturbances, diabetes, particularly in association with hypertension and hemodialysis itself and age of patient have been implicated in various studies [4].

Despite the multitude of studies regarding hearing loss in CKD, some dark domains still persists regarding the role of haemodialysis and duration of disease. There is high rise in the prevalence of CKD in India due to rise in conditions such as diabetes and hypertension. Comparatively, hearing loss has been found to be more prevalent among CKD patients than the general population in different parts of the world ranging from 28% to 67% has been recorded in similar studies [4].

In view of this, present study was conducted to determine the incidence of sensorineural hearing loss in a patient undergoing dialysis and to describe the possible contributing factors for the same.

Study

A prospective observational study was conducted in the Department of Otorhinolaryngology, Dr. D. Y. Patil Hospital, Navi Mumbai over a period of 2 years.

It aimed:

1. To determine the incidence of sensorineural hearing loss in a patient requiring dialysis.
2. To describe the effect of dialysis on hearing and the possible contributing factors for sensorineural hearing loss in a patient undergoing dialysis.

A total of 50 eligible cases were taken with the following inclusion criteria

1. 25-75 years
2. Patients of Chronic Renal Failure who have not yet undergone dialysis.

Results

3. No history of diabetes mellitus.
4. No history of previous ear surgery.
5. No history of renal transplantation.

Patients with previous otological trauma or surgery, family history of hearing loss, definite exposure to ototoxic drugs by careful drug history and habitual exposure to hazardous noise such as exposure to explosions, those who work in electric generation machines were excluded.

All patients were interviewed using a uniform proforma containing information on age, gender, and risk factors, including diabetes, hypertension, and history of ototoxic drug use. The time since diagnosis of chronic kidney disease was documented.

All the subjected then undergo complete haemogram, coagulogram, fasting and post prandial blood sugar, serum LFT and RFT, electrolytes, viral serology of HIV 1, HIV 2 and HBs Ag.

All CKD patients were then subjected otoscopic examination and hearing assessment using standard pure tone audiometry at 500, 1000, 2000 and 4000 Hz. The average of 4 frequencies, 500Hz, 1000Hz, 2000Hz, 4000Hz was recorded.

An average of the threshold levels of >26 db was considered as abnormal. A hearing loss of 26–40 db was classified as mild, 41–55 db as moderate, 56–70 as moderately severe, 71–90 as severe, and >90 db as profound hearing loss.

Pure Tone Audiometry examination was done again after 3 sessions of dialysis and the results were compared.

The quantitative data was represented as their mean \pm SD. Categorical and nominal data was expressed in percentage. The t-test was used for analysing quantitative data, or else non parametric data was analyzed by Mann Whitney test and categorical data was analyzed by using chi-square test. The significance threshold of p-value was set at <0.05. All analysis was carried out by using SPSS software version 21.

Table 1. Distribution of study cases as per prevalence of sensorineural hearing loss

SNHL	N	%
No	18	36.0%
Yes	32	64.0%
Total	50	100.0%

Prevalence of sensorineural hearing loss in cases of CKD was observed as 64% in present study

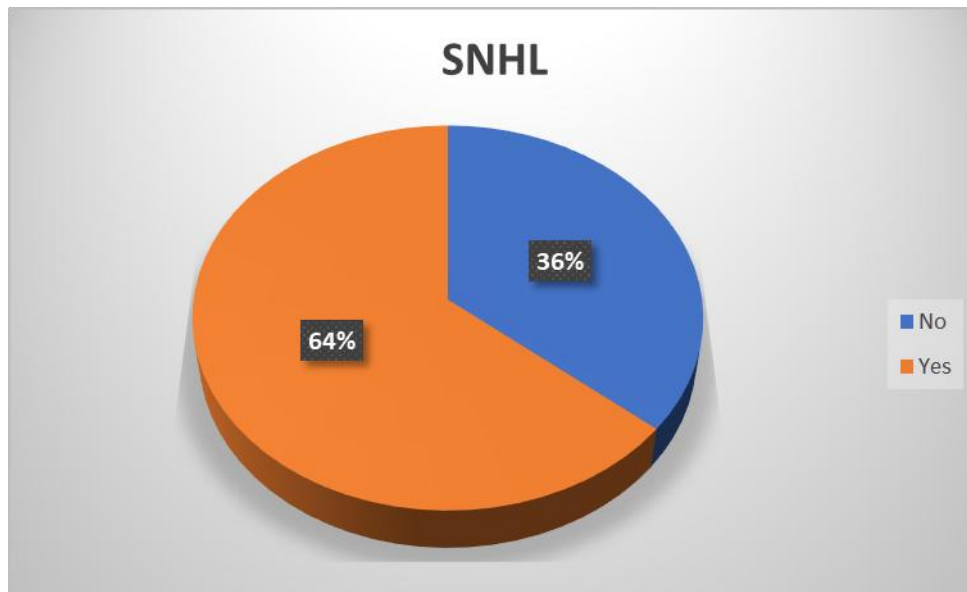


Table 2. Distribution of study cases as per degree of sensorineural hearing loss

Degree of SNHL	N	%
Mild	5	10.0%
Moderate	7	14.0%
Moderately Severe	8	16.0%
Severe	8	16.0%
Profound	4	8.0%
NA	18	36.0%
Total	50	100.0%

Mild to moderate hearing loss was seen in 40% cases while severe to profound hearing loss was seen in 16% and 8% cases respectively

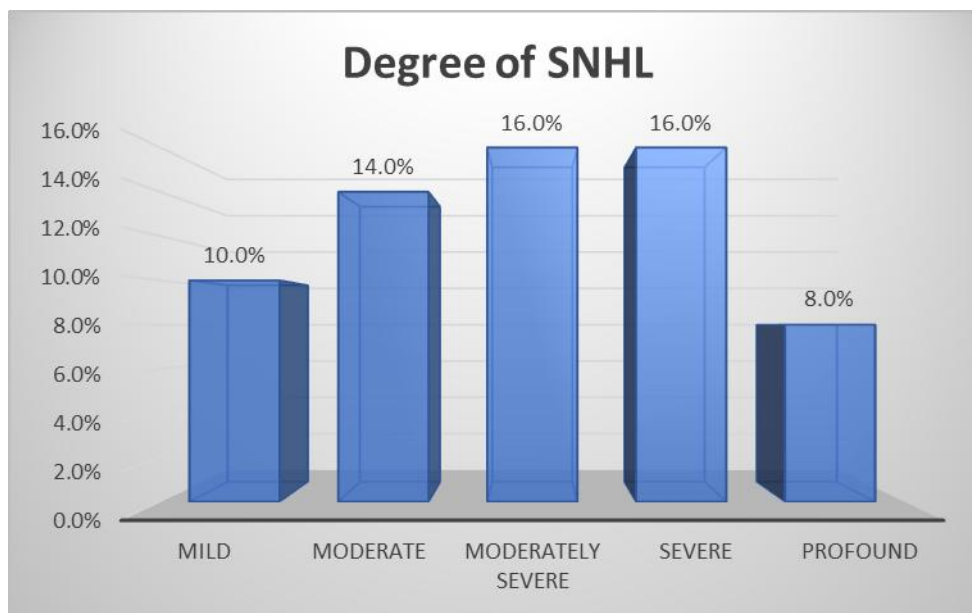


Table 3. Mean age comparison between cases with and without sensorineural loss

Variables	SNHL	N	Mean	SD	p-value
Age (years)	No	18	47.11	12.96	0.048
	Yes	32	54	10.92	

Mean age of cases with SNHL was significantly higher in cases with SNHL as compared to cases without SNHL (54 vs 47.1 years; $p < 0.05$).

Table 4. Association of gender with sensorineural hearing loss

Gender	SNHL		Total
	No	Yes	
Female	5	7	12
	41.7%	58.3%	100.0%
Male	13	25	38
	34.2%	65.8%	100.0%
Total	18	32	50
	36.0%	64.0%	100.0%
p- value - 0.73			

No difference was observed between males and females with respect to prevalence of SNHL (65.8% vs 58.3%; p=0.73).

Table 5. Mean comparison of duration of CKD in cases with and without sensorineural hearing loss

Variables	SNHL	N	Mean	SD	p- value
Duration of CKD (years)	No	18	3.71	1.06	<0.01
	Yes	32	5.91	1.53	

Mean duration of CKD was significantly longer in cases with SNHL as compared to cases without SNHL (5.91 vs 3.71 years; p<0.01)

Table 6. Mean comparison of hearing loss before and after dialysis

Variables		N	Mean	SD	p- value
Hearing Loss (db)	Baseline	18	45.46	28.49	<0.01
	After Dialysis	32	50.42	26.31	

A significant deterioration was observed in regards to hearing loss after dialysis (hearing loss: 45.46 db vs 50.42db; p<0.01).

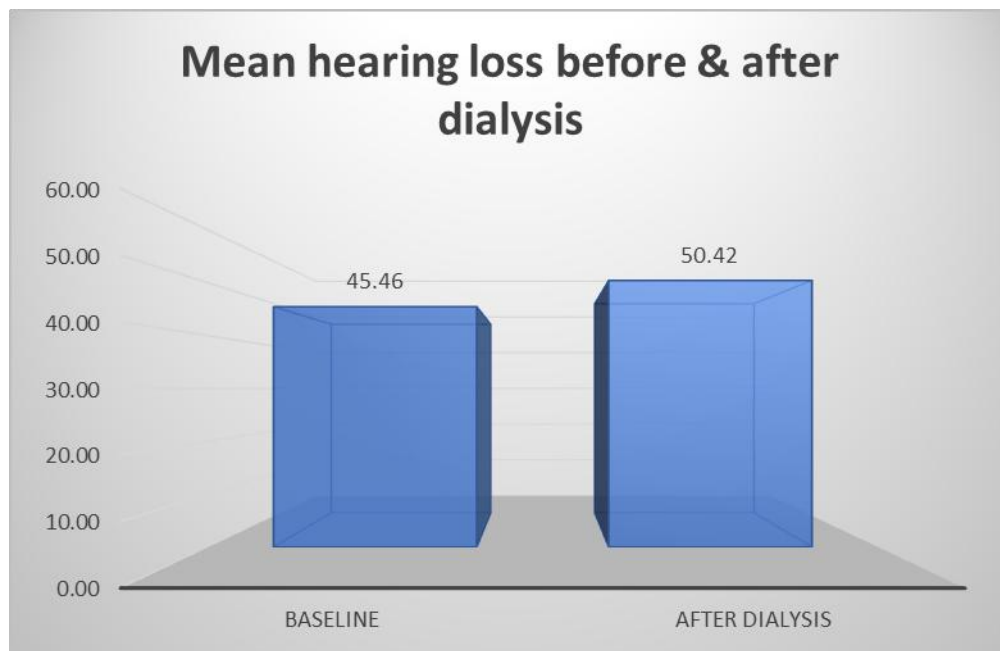


Table 7. Prevalence of sensorineural hearing loss after dialysis

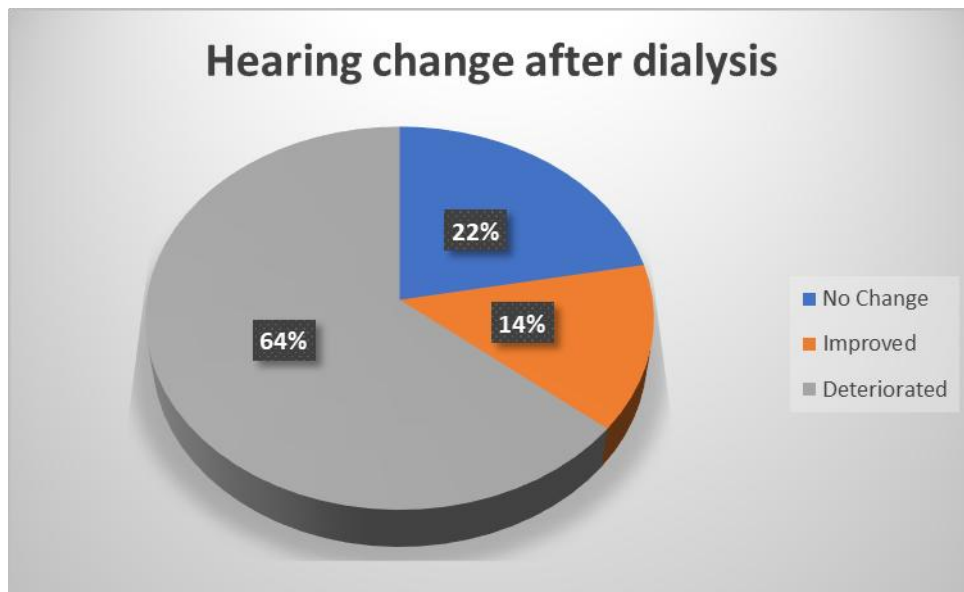
SNHL after Dialysis	N	%
No	14	28.0%
Yes	36	72.0%
Total	50	100.0%

Prevalence of sensorineural hearing loss in cases of CKD after dialysis increased to 72% from 64%.

Table 8. Degree of sensorineural hearing loss after dialysis

Degree of SNHL (after Dialysis)	N	%
Mild	7	14.0%
Moderate	8	16.0%
Moderately Severe	8	16.0%
Severe	9	18.0%
Profound	4	8.0%
NA	14	28.0%
Total	50	100.0%

After dialysis, mild to moderate hearing loss was seen in 46% cases while severe to profound loss was seen in 18% and 8% cases.



Discussion

Keeping the relative lacunae of literature on this topic in mind, present hospital based prospective, observational study aimed at finding the incidence of

sensorineural hearing loss in a patient requiring dialysis. We also aimed to describe the effect of dialysis and other possible contributing factors for sensorineural hearing loss. Study included 50 patients of chronic renal failure requiring haemodialysis.

Prevalence of sensorineural hearing loss

Electrolyte disturbances, particularly sodium, water imbalance, hypertension, Vitamin D deficiency, and elevated serum urea levels, are proposed mechanisms for hearing impairment in patients with CRF. Defects in the cationic gradient of endolymphatic fluid can change hearing properties. Furthermore, alterations in the peripheral and central nervous system, “uremic neuropathy,” may be involved in hearing impairment associated with CRF [60].

In present study, prevalence of sensorineural hearing loss in cases of CKD requiring dialysis was observed as 64%. Mild to moderate hearing loss was seen in 40% cases while severe to profound hearing loss was seen in 16% and 8% cases respectively. Hearing loss

in most of the cases was observed at higher frequencies.

Lasisi AO et al. [55] presented a report of investigation of the effect of hemodialysis on the hearing function. Hearing loss was found in 22/34 (67%) at recruitment before start of hemodialysis. Saeed HK et al. [60] (2018) aimed to determine the effect of hemodialysis on the hearing threshold in patients with chronic renal failure (CRF). At the beginning of the study, 39 patients (66.1%) had sensorineural hearing loss (SNHL). The hearing loss was more evident in the higher frequencies. Rahman R et al. [59] observed prevalence of hearing loss in CKD patients as 42% while Boateng JO et al. [61] observed the prevalence as 32%. Saha P et al. [4] observed the prevalence as 96.5% in CKD patients. Among the Stage 5 CKD group, 11.9% had mild SN hearing loss, 14.2% had moderate SNHL (sensorineural hearing loss), 14.8% (71 patients) had moderately severe SNHL, 25.7% had severe SNHL, and 33.2% had profound SNHL.

Authors	Prevalence of SNHL
Lasisi AO et al. [55]	67%
Saeed HK et al. [60]	66.1%
Rahman R et al. [59]	42%
Saha P et al. [4]	96.5%
Present Study	64%

Associated Factors For SNHL In CKD Patients

In present study, we observed that mean age of CKD was significantly associated with development of SNHL. Mean age of cases with SNHL was significantly higher in cases with SNHL as compared to cases without SNHL (54 vs 47.1 years; p<0.05). Similarly, mean duration of CKD was significantly longer in cases with SNHL as compared to cases without SNHL (5.91 vs 3.71 years; p<0.01).

However, no association was observed between SNHL and gender, BMI. SES, etiology of CKD, renal function tests and other laboratory parameters.

Antonelli et al. [37] compared pure tone thresholds, ABR wave latencies and interpeak latency differences of patients with CRF undergoing haemodialysis with a control group of gender and age-matched subjects. They reported that pure tone hearing loss as well as wave I latency of the CRF

group was correlated with age. Wu KL et al. [62] in their study also observed that age is significantly associated with SNHL in CKD cases. Lasisi AO et al. [55] in their study observed a significant association between duration of illness and prevalence of SNHL among CKD patients ($p=0.0034$). Saeed HK et al. [60] in their study observed that patients with hearing loss showed a significantly longer duration of CRF that without hearing loss. Similarly, Somashekara et al. [66] observed that duration of CRF was significantly longer in patients with hearing loss. However, Saeed HK et al. [60] and Boateng JO et al. [61] observed no significant association of hearing loss with age and duration of chronic kidney disease.

Effect Of Dialysis On Hearing Loss

A significant deterioration was observed in regards to hearing loss after dialysis (hearing loss: 45.46 db vs 50.42db; $p<0.01$). Prevalence of sensorineural hearing loss in cases of CKD after dialysis increased to 72% from 64%. In present study, we observed an overall deterioration of hearing in 64% cases after start of dialysis while in 22% cases no change was observed.

Early and more recent reports present conflicting findings concerning possible contributions of haemodialysis treatment to hearing loss in renal failure. Lasisi AO et al. [55] in their study observed that hearing loss was found in 67% cases at recruitment which increases to 79% after 3 sessions of hemodialysis. There was a significant difference between the mean pre- and post- hemodialysis PTA values ($p<0.01$). Saeed HK et al. [60] observed that 66.1% cases had SNHL at baseline and during the 12-month follow-up, 6 more patients developed SNHL giving a point prevalence rate of 76.3% at the end of the study. Of the studied patients, 64.4% showed deterioration of the hearing threshold. The mean hearing threshold at the beginning of the study was 29.2 ± 21.1 dB versus 36.9 ± 17.3 dB at the end of the study ($P < 0.001$). Multivariate analysis showed that the duration of hemodialysis was the only significant independent predictor of SNHL. They concluded that SNHL is common in patients with CRF on hemodialysis. Most of the patients showed further deterioration in the hearing threshold with the duration of dialysis. The role of hemodialysis in the occurrence of hearing loss among patients with CRF could be due either to changes in

the fluid and electrolyte composition of endolymph [67] or accumulation of amyloid materials in inner ear tissues. Aluminum toxicity associated with chronic dialysis may play a role in hearing loss [68]. High blood urea and electrolyte disturbances, particularly sodium, have been also suggested as possible factors that contribute to hearing acuity deterioration in CRF [69]. However, the effect of hemodialysis on hearing function remains controversial. S many authors like Nikolopoulos et al. [68], Ozturan and Lam [70], Stavroulaki et al. [71], and Pandey et al. [72] showed that auditory functions were not affected by hemodialysis, particularly short-term dialysis, or at least in the first 5 years of treatment.

Thus to summarize, SNHL is common in patients with CRF. It was mild to moderate in the majority of patients and seen on higher frequencies. Contributing factors for the same was duration of the disease and advancing age. Most of the patients showed further deterioration in the hearing threshold with dialysis. However further large scale studies with longer follow up duration are required to validate these findings.

Conclusion

Study concluded that SNHL is common in patients with CRF. It was mild to moderate in the majority of patients and seen on higher frequencies. Contributing factors for the same was duration of the disease and advancing age. Most of the patients showed further deterioration in the hearing threshold with dialysis.

Thus to conclude, dialysis have a deteriorative effect on hearing loss in CKD, an association that needs to be tested further. So, we recommend closely monitoring of hearing levels in dialysis patients. Although our results are interesting and in line with previously published results, they should be interpreted with caution because of the relatively small sample size and absence of a control group, such as patients on conservative treatment or healthy controls.

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Dr. Yogesh G Dabholkar- Professor & Head, Department of ENT, Dr D Y Patil Medical College, Navi Mumbai.

Dr. Surekha S Patil- Dean, Dr. D Y Patil Medical College, Navi Mumbai

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