

Sensorineural hearing loss in chronic renal failure patients in a tertiary care centre

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Abstract

Sensorineural hearing loss is considerably more prevalent in patients with Chronic Renal Failure than in the general population. This study is aimed to find the proportion of Sensorineural Hearing Loss (SNHL) in End Stage Chronic Renal Failure (Stage 4 and 5 CRF), to describe the hearing impairment and determine the possible factors responsible for hearing loss. The sample of the study consisted of 115 patients, with in the age group of 15 to 60 years. **Methods:** All patients underwent clinical evaluation including ENT examination and Pure Tone Audiometry. **Results:** 40% (46/115 patients) of patients had SNHL. Majority had bilateral and symmetrical hearing loss, mostly affecting high frequencies. Among the factors studied, age, duration of CRF, usage of ototoxic drugs, number of hemodialysis and serum creatinine were found to have statistically significant association with SNHL. **Conclusion:** 40% of CRF patients had SNHL and hearing loss was associated with the age of the patient, duration of CRF, number of hemodialysis and the high value of serum creatinine.

Keywords: Sensorineural hearing loss (SNHL), Chronic Renal Failure (CRF), Chronic Kidney Disease (CKD), Pure Tone Audiogram (PTA)

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Introduction

The incidence of sensorineural hearing loss among Chronic Renal Failure patients is considered to be higher than general population. It varies from mild hearing loss to moderately severe sensorineural hearing loss. The presence of hearing loss and estimation of the type and degree of hearing loss constitute one of the most common method used to investigate the effect of renal disease on auditory system[1].

The purpose of this study was to evaluate the hearing loss in patients with CRF End Stage (stage 4 and 5) and to find the contributory factors causing auditory dysfunction in CRF patients like changes in serum electrolytes, elevated serum urea, creatinine, duration of CRF, usage of ototoxic drugs, number of hemodialysis and blood pressure. Patients with Chronic Kidney Disease can develop sensorineural hearing loss which needs to be evaluated to halt its progress. Knowing the contributing factors will help to give timely intervention and thus prevent its further progression. Since this has not been studied in Kerala so far, the study will enable to know the proportion of sensorineural hearing loss among patients with CRF Stage 4 and 5 and the possible factors contributing to SNHL in the study subjects.

Materials and methods

This study was conducted over a period of 18 months during March 2016–August 2017 in Nephrology and Otorhinolaryngology department of Government Medical College Hospital, Thiruvananthapuram a tertiary care centre in Kerala, India.

The sample size was estimated to be 112 taking the proportion of moderately severe SNHL in CRF patients as 47 % and a relative precision of 20 % of 47 % at 5 % significance level.

Patients with CRF End Stage (Stage 4 and 5) and those in the age group of 15-60 years were included for the study. Patients with hearing loss before the onset of renal failure, diabetes mellitus, history of noise exposure, congenital kidney diseases and those not willing to give consent were excluded from the study. Consecutive cases satisfying the eligibility criteria were recruited and finally comprised of 115 patients in 15 to 60 years of age and of either sex diagnosed as having CRF of Stages 4 and 5. The data collection tools used for the study were semi-structured questionnaire with history, clinical findings and Otoscopy, Pure Tone Audiogram and blood reports of biochemical variables

Methods

After getting informed consent, each patient was included in the study according to inclusion criteria. Cases were evaluated in the Department of Otorhinolaryngology, interviewing using a semi-structured questionnaire containing information on age, sex, gender, detailed history about duration of CRF, number of hemodialysis, duration of onset of hearing loss, associated symptoms like vertigo, tinnitus, hypertension and use of ototoxic drugs. Detailed history of

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diseases of ear, its medical/surgical treatment, family history of sensorineural deafness, noise exposure was elicited. Age group of the patient was 15- 60 years (patients above 60 years were excluded in view of presbycusis). CRF patients of only stage 4 & 5 were selected as Stage 1, 2 & 3 are frequently asymptomatic with respect to metabolic and electrolyte parameters [2]. Also, being a tertiary care center, majority of the patients attending the Nephrology Department are those with end stage CRF. The diagnosis of CRF was based on the history, physical examination and laboratory tests. Staging of CRF patients were done according to the Kidney Disease Outcomes Quality Initiative (KDOQI) of the National Kidney Foundation

(NKF)[3]. Patients were subjected to full clinical examination including otorhinolaryngological examination.

Blood pressure recordings, blood parameters including Hb, mean blood sugar levels, blood urea, serum creatinine and electrolytes were documented for all patients. All patients underwent audiological assessment by Pure Tone Audiometry by qualified audiologist in audiometric test room. Pure Tone Audiogram was done for air conduction for 250Hz to 8000Hz and bone conduction for 250 Hz to 4000 Hz. The type and degree of hearing loss and the frequencies affected were assessed by Goodman’s classification which was modified in 1981 by J.G Clark[4].

Table 1: Clark’s modification of Goodman’s Classification of Hearing Loss

Degree of Hearing Loss	Hearing Loss Range(dB)
Normal	<15
Slight	16 to 25
Mild	26 to 40
Moderate	41 to 55
Moderately severe	56 to 70
Severe	71 to 90
Profound	>90

Audio frequencies were classified as low (250 and 500Hz), middle (1000 and 2000Hz) and high (4000 and 8000Hz) frequencies. According to the audiological findings, patients were grouped into two groups - with hearing loss and without hearing loss. Gathered data was entered in Microsoft Excel and analyzed using SPSS. Data was analyzed using descriptive and inferential statistical methods. Results of categorical measurements were presented in number and percentage. Chi square test was used to find the significance of study parameters between two variables.

Results

Out of 115 cases included in the study, 107 cases (93%) were of CRF End Stage 5 and 8 cases (7%) were of Stage 4.

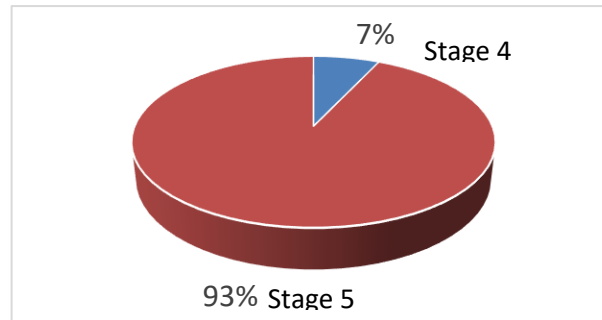


Fig 1: Stage of CRF

Degree of SNHL: The proportion of SNHL was found to be 40% (46/115). Out of this, 13% had slight, 13% mild, 8.7% moderate, 3.5% moderately severe, 0.9% severe and 0.9% profound degree of hearing loss, which is shown in figure 2. In majority of the cases, hearing loss was bilateral and symmetrical. Two cases had unilateral hearing loss - out of this, one had moderately severe SNHL which developed one week after hemodialysis and the other had only unilateral slight SNHL.

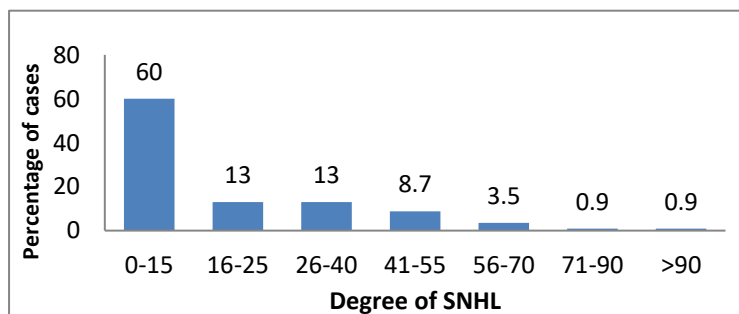


Fig 2: Degree of SNHL

Frequency distribution: For low frequencies, 64.3% (74) of patients had normal hearing and 35.7% (41) had SNHL. Out of this, 26.9% had slight to mild degree of SNHL, 5.2% had moderate and 1.7% had moderately severe and severe SNHL. At mid frequencies, 52.2% had normal hearing and 47.8% had SNHL. Out of this, 31.3% had slight to mild SNHL, 13.9% had moderate to moderately severe, 1.7% had severe and 0.9% had profound SNHL. At high frequencies, only 33.1% had normal hearing and 66.9% had SNHL. Out of this, 35.6% had slight to mild SNHL, 25.3% had moderate to moderately severe, 4.3% had severe and 1.7% had profound SNHL.

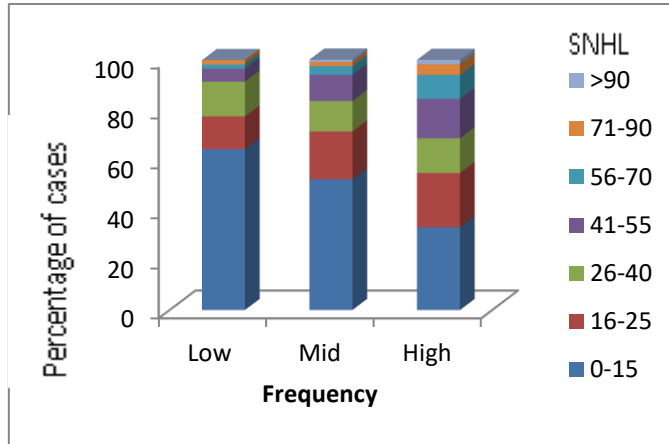


Fig 3: Degree of Hearing Loss according to Frequency

Age distribution: Majority of the patients were in the age group of 51-60 years (42.6%), followed by 41-50 years (28.7%). The youngest patient was 18 years and eldest was 60 years. As the age increases, possibility of developing SNHL increases but at an early age. The study was statistically significant.

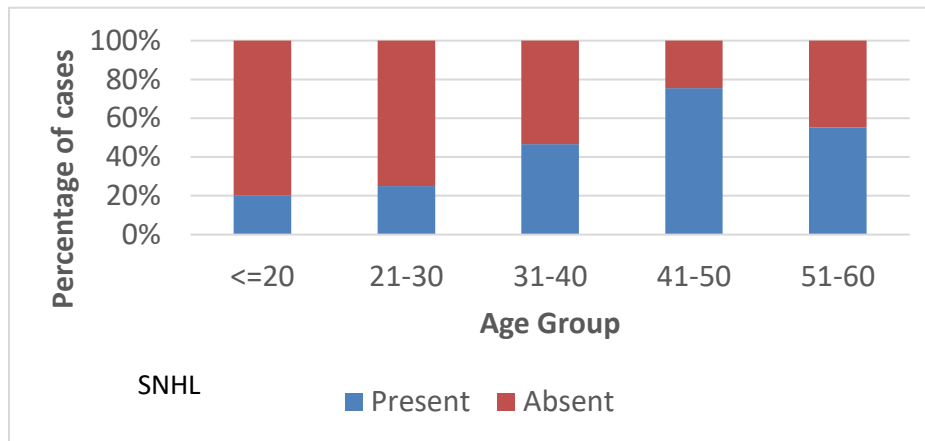


Fig 4: Age and Hearing loss

Gender distribution: Out of 115 cases, there were 78 males and 37 females; male to female ratio was 2.1:1. Among these, 37 males and 15 females had SNHL of various degrees. The relationship between age and hearing loss in CRF was not found to be significant.

Duration of CRF: Out of 13 cases with duration of CRF for more than 8 years, 9 cases (69.3%) had SNHL. Out of the 16 cases with duration 1 to 4 years, only 12 (75%) had SNHL. Out of the 28 cases with duration less than 1 year, only 3 (10.7%) had SNHL. Hence it was found that the proportion of cases with SNHL increases with increasing duration of CRF.

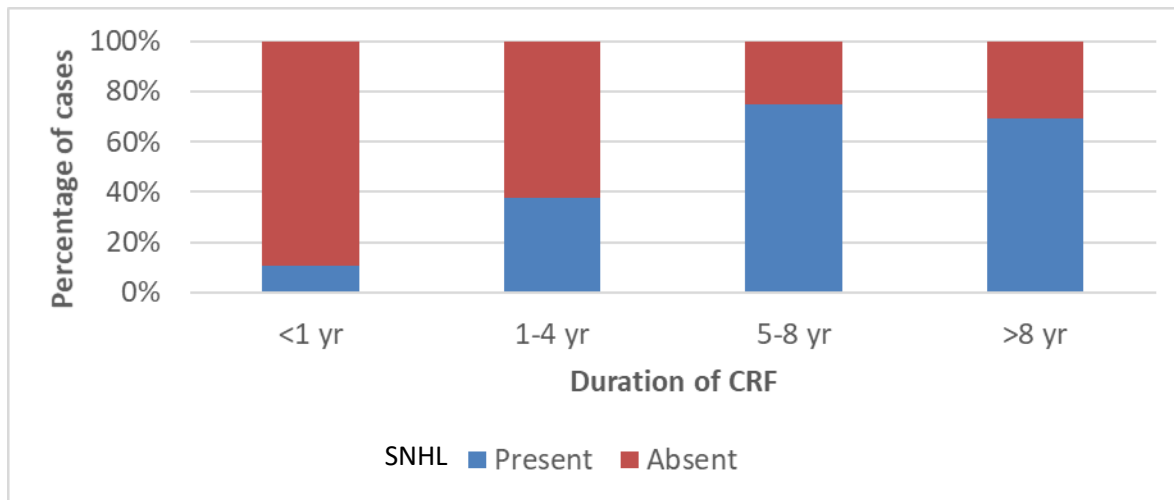


Fig 5: Duration of CRF and SNHL

All the patients in the study were found to be using ototoxic drugs at some point of time; commonly used drugs were Furosemide and Torsemide. **Number of haemodialysis:** Out of 115 cases, 30 patients (26.1%) were on medical management and did not undergo haemodialysis. The following table 2 shows the frequency and number of haemodialysis.

Table 2: Number of haemodialysis

Number of haemodialysis	Frequency	Percentage
No haemodialysis	30	26.1
1-25	36	31.3
26-50	13	11.3
51-75	12	10.4
76-100	4	3.5
101-125	5	4.3
126-150	6	5.2
>150	9	7.8
Total	115	100

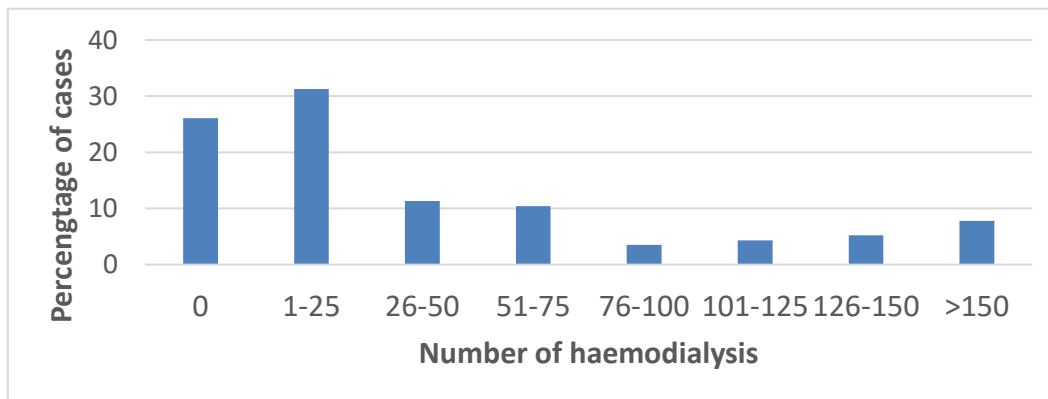


Fig 6: Number of haemodialysis

Number of haemodialysis and hearing loss

Table 3: Haemodialysis and SNHL

Number of haemodialysis	Hearing loss				Total	
	Present		Absent			
	N	%	N	%	N	%
No haemodialysis	6	20.0	24	80.0	30	100.0
1-25	8	22.2	28	77.8	36	100.0
26-50	9	69.2	4	30.8	13	100.0

51-75	5	41.7	7	58.3	12	100.0
76-100	2	50.0	2	50.0	4	100.0
101-125	4	80.0	1	20.0	5	100.0
126-150	6	100.0	0	0.0	6	100.0
>150	6	66.7	3	33.3	9	100.0
Total	46	40.0	69	60.0	115	100.0

$\chi^2 = 29.550, df = 7, P = < 0.001$

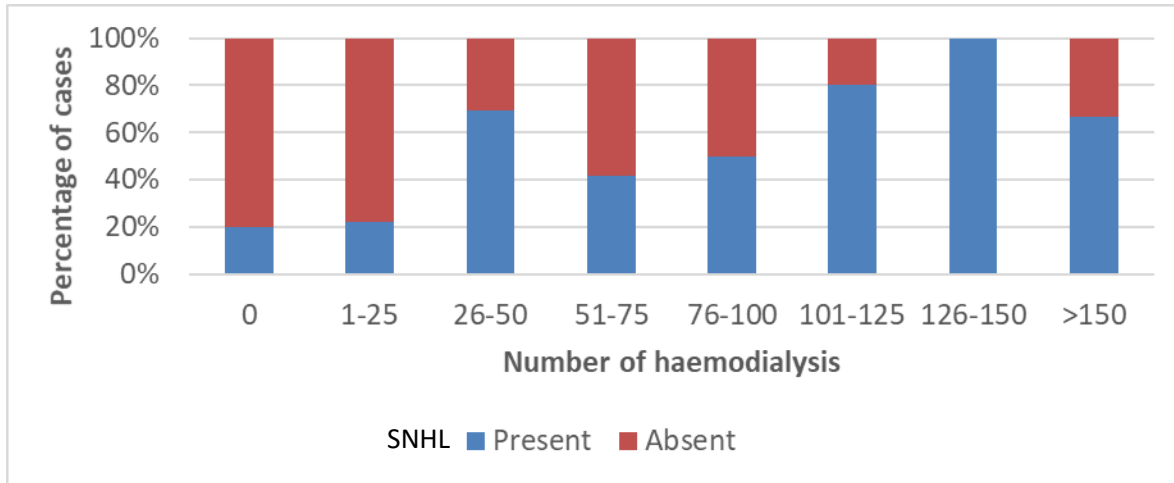


Fig 7: Haemodialysis and SNHL

From the table 3 and figure 7, it is evident that the percentage of patients with SNHL increases with increasing number of haemodialysis that the patients had received.

Serum creatinine and hearing loss: From the table 4 and figure 8, out of 67 patients whose serum creatinine was below 10 mg, 21 (31.3%) had hearing loss. But the proportion of SNHL, was high in patients whose serum creatinine level was above 10 mg (52.1%). This shows that as the creatinine level increases, there is more chance for SNHL in CRF patients. This observation was found to be significant.

$\chi^2 = 5.012, df = 1, P = 0.025$

Table 4: Serum Creatinine and SNHL

Creatinine	Hearing loss				Total	
	Absent		Present			
	N	%	N	%	N	%
≤10	46	68.7	21	31.3	67	100.0
> 10	23	47.9	25	52.1	48	100.0
Total	69	60	46	40	115	100.0

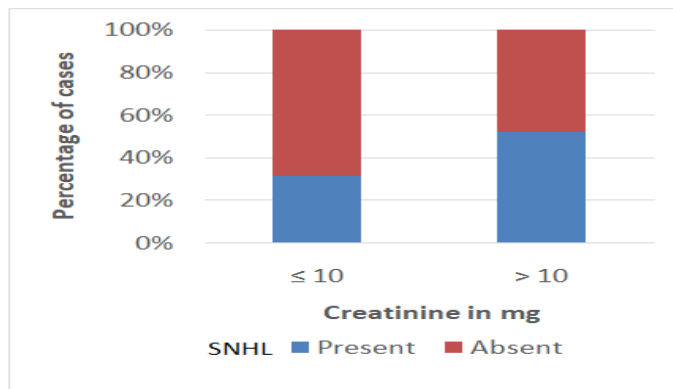


Fig 8: Serum creatinine and SNHL

Among the possible factors studied, only age, duration of CRF, ototoxic drugs, number of hemodialysis, and serum creatinine were having significant association with sensorineural hearing loss in

CRF. Primary hypertension, alteration in hemoglobin level, raised blood levels of urea, sodium and potassium were not found to have significant association with SNHL.

Discussion

This study sample consisted of 115 patients with CRF of Stage 4 & 5 (7 patients in Stage 4 and 108 patients in stage 5). The cases included in the study ranges from 15 to 60 years with a mean age of 37.5 years.

The proportion of SNHL in CRF patients was found to be 40% (46 out of 115 patients). Out of this, 13% had slight, 13% mild, 8.7% moderate, 3.5% moderately severe, 0.9% severe and 0.9% profound degree of hearing loss.

For low frequencies, 64.3% (74) of patients had normal hearing and 35.7% (41) had SNHL. At mid frequencies, 52.2% had normal hearing and 47.8% had SNHL. At high frequencies, only 33.1% had normal hearing and 66.9% had SNHL. This study shows that most of the patients had high frequency hearing loss.

In a study conducted by Bazzi C and colleagues [5], the incidence of SNHL among patients with CRF was considerably higher than general population. It varied from mild hearing loss found in 77% cases to moderately severe hearing loss in 46% and most of the hearing loss was in high frequencies. Nikolopoulos et al [6] found 41.3% hearing loss in children with CRF and it affected mostly high frequencies.

In our study, SNHL was bilateral and symmetrical in majority of the cases (44 out of 46 patients). Meena et al [7] reported 28% cases of CRF had moderate to severe degree of SNHL. SNHL was bilateral and symmetrical.

Gender was also considered as a criterium in this study. Male to female ratio was 2.1:1. Among males, 39.7% had hearing loss and in females 40.5%. There is no significant difference found in the occurrence of SNHL in both genders.

In the study by Bains K S et al [8] involving 40 patients with CRF stage 3, 4 and 5, bilateral SNHL at higher frequencies was seen in 70% (stage 3 and 4) and 60% (stage 5). No correlation of auditory findings with gender, degree of renal failure and serum sodium. On reevaluation after one year of renal transplant, there was maximum improvement at higher frequencies.

The relation between Primary Hypertension and SNHL was studied; but there was no significant association. In the study conducted by Meena et al [7], all patients had raised blood pressure. All the patients who had SNHL had systolic BP > 160 mmHg. In our study, there is no clear relationship between SNHL and high BP.

In our study, probability of SNHL increases with the number of haemodialysis. The association was found to be statistically significant. It was similar to a study conducted by Erkoç et al [9] who concluded that the mean duration of haemodialysis in the patient group with hearing loss was longer than that in the patients without hearing loss. But Mancini et al [10] found no correlation between hearing loss, duration of nephropathy and haemodialysis, suggesting that SNHL was causatively linked to the disease and not the treatment.

In the study of EK Reddy et al [11] of 200 patients of CKD5 who had undergone haemodialysis, 63.5% had SNHL and no correlation between other co-variables was reported. Saeed H K et al [12] in his study on 59 patients with CRF stage 5 on regular haemodialysis reported mild to moderate SNHL and was most obvious at the high frequencies. Bazzi et al [5] also reported high prevalence (77%) of slight to moderate SNHL in 91 patients on haemodialysis. In the study of Costa K V et al [13] on 80 patients on haemodialysis for more than 2 years, 86 ears (53.75%) had SNHL and was found to be statistically significant.

It was found that as the duration of CRF increases, the occurrence of SNHL also increases. All the patients in this study were found to be using ototoxic drugs-furosemide and Torsemide at some point of time. Ototoxic medication including furosemide can affect ionic gradients between the endolymph and perilymph resulting in edema of the epithelium of the stria vascularis and also by altering the endocochlear potential.

Out of 29 cases with duration of CRF for more than 5 years, 21 cases (72.4%) had hearing loss. But out of the 58 cases with duration of 1 to 4 years, only 22 cases (37.9%) had hearing loss and out of the 28 cases with duration less than 1 year, only 3 cases (10.7%) had hearing loss. It was similar to the study conducted by Rakesh Singh Meena et al [7] who concluded that duration of CRF was related to the degree of SNHL. In his study, it was found that out of the 8 patients with SNHL of more than 70 dB, 7 had CRF for more than 4 years and only one had duration less than 4 years.

According to the study by Mancini [10] on 68 CRF in children, 29% with conservative treatment, 28% with haemodialysis, 47% after renal transplant showed a significant correlation with the administration of ototoxic drugs- aminoglycoside and furosemide.

In our study, there was no association between blood urea and SNHL in CRF patients. But when serum creatinine level was taken into account, it was found that a statistically significant association was found between raised serum creatinine and SNHL. It was similar to the study conducted in guinea pigs by Adler et al [14] who found out an inverse relation between creatinine level and Na/K ATPase in the stria vascularis which leads to SNHL.

In this study, hyponatremia was found in 41.7% of the total cases, out of which 50% had SNHL. But no significant association was found between hyponatremia and SNHL (p=0.064). Serum potassium level was normal for all patients except one case who had hypokalemia. Samir et al [15] found no correlation between SNHL and serum electrolytes, urea and creatinine levels.

Hemoglobin was below 10 g% in 101 cases, out of this 38.6% had SNHL. Out of the 14 cases with Hb > 10 g%, 50% had hearing loss and no association could be found between the hemoglobin level and SNHL.

Patients with CRF often have multiple co-morbidities which make their life miserable. More over hearing loss in CRF patients is often overlooked.

It should encourage clinical nephrologist to include questions about hearing function in their preventive care protocol to refer all patients reporting hearing loss to the hearing health professional for evaluation and appropriate rehabilitation. Use of ototoxic drugs should be monitored to preserve the hearing. Early audiological assessment and appropriate fitting of hearing aids could preserve hearing function in CRF. Our study highlights the prevalence of SNHL in people suffering from CRF. Untreated hearing loss can have very significant consequences on a person's quality of life. SNHL have been found affected by anxiety, impaired memory and can be benefitted with hearing aids. Treatment options like renal transplant can be considered to improve the patient's quality of life.

Conclusion

From this study, it is inferred that the proportion of SNHL in patients with End Stage CRF was found to be 40% (46/115 patients). SNHL was mainly bilateral and symmetrical affecting high frequency. A statistically significant association was found between SNHL and increasing

- age
- duration of CRF with usage of ototoxic drugs
- number of haemodialysis
- serum creatinine level

In this study, no significant association of SNHL was seen between primary hypertension, alternation in haemoglobin level, raised blood urea and serum electrolyte levels. Our study recommends the importance of audiological assessment in CRF patients. Early identification of hearing loss and intervention with hearing aids can improve the quality of life in patients suffering from CRF.

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