

ORIGINAL RESEARCH ARTICLE

HEARING ASSESSMENT IN CHRONIC RENAL FAILURE PATIENTS

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ABSTRACT:

Background: The occurrence of hearing loss in the course of chronic renal failure (CRF) was investigated in numerous research studies, attempting to explain both the etiological factors and treatment possibilities. According to various authors, the percentage of occurrence of hearing loss in patients suffering from CRF differs between 20% and 80%.

Objectives: Our study was conducted in this context as an attempt to find the prevalence of sensorineural hearing loss in chronic renal failure patients, to assess the frequency and type of hearing loss in patients with CRF, to find any correlation between duration of illness and SNHL and also to assess the etiological factors related to sensorineural hearing loss among chronic renal failure patients.

Methodology: This is a hospital based cross-sectional study conducted at Dr S.M.C.S.I. Medical college, Karakonam, during the period November 2013 – June 2015. A sample of 89 chronic renal failure patients were assessed by pure-tone audiogram.

Results: Out of the 89 chronic renal failure patients, 57 patients (64%) were detected to have sensorineural hearing loss in the order of frequency high > mid > low frequency. In this study, there is a statistically significant correlation between age of the patients and stage of the disease with SNHL. However there is no significant correlation between duration of chronic renal failure and blood parameters with SNHL.

Conclusion: SNHL is common among patients with chronic renal failure. Hence a pure tone audiometry should be done routinely in all chronic renal failure patients even if they don't report hearing loss. Moreover periodic audiological assessment should be incorporated in their management to start rehabilitation as early as possible.

Keywords: Pure tone audiometry, sensorineural hearing loss, chronic renal failure.

INTRODUCTION:

Hearing loss and chronic renal failure are frequently associated and this association is known since 1927 when Alport first described a case of familial kidney disease with concomitant sensorineural hearing loss and termed it as Alport syndrome¹. Over the years a series of observations concerning infrequent affections or syndromes with a close relationship between hearing impairment and CRF was reported.

There are several potential mechanisms for hearing loss in chronic renal failure that have been postulated in literature including deranged haemoglobin levels, electrolytes, blood urea and serum creatinine, calcium and phosphorous levels, hypertension, diabetes, ototoxic medications, effects of haemodialysis^{2,3}. This study is thus undertaken with the aims

of assessing the frequency and type of hearing loss in patients with CRF and to evaluate the relationship between suggested etiological factors in causation of hearing loss in these patients. In patients with chronic renal failure, if sensorineural hearing loss is detected at an earlier stage, we can prevent the further progression of hearing loss in these patients by giving

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neurotropic drugs and auditory rehabilitation by providing hearing aids.

OBJECTIVES OF THE STUDY:

- To study the prevalence of sensorineural hearing loss in patients with chronic renal failure.
- To assess hearing loss at different frequencies (250, 500, 1000, 2000, 4000, 8000 Hz) in patients with chronic renal failure.
- To study the correlation between hearing loss and duration of chronic renal failure.
- To assess the factors affecting hearing loss in patients with chronic renal failure.

MATERIALS AND METHODS:

This is a prospective cross sectional study conducted in a period of 2 years, aimed at finding out the prevalence and factors related to hearing impairment among chronic renal failure patients attending the Nephrology OPD and Dialysis unit in Dr. S.M.C.S.I. Medical College and Hospital, Karakonam. Patients were brought to the ENT OPD and an informed consent was obtained from them. Data including age, sex, stage of the disease and duration of illness were noted. Investigations such as level of hemoglobin, blood urea, serum creatinine, serum potassium, serum sodium, serum phosphorous, serum calcium, serum chloride done as routine investigations in the Nephrology OPD and the results were noted from the IP/OP chart of the corresponding patient. All patients were then subjected to a routine otological workup which include otoscopic examination of the ear, tuning fork tests and pure tone audiometry.

Audiometric assessment was done in a sound proof room using GRASON STADLER (GSI 61) Audiometer. Pure tone average was calculated as the average value of hearing thresholds at 500 Hz, 1000 Hz and 2000 Hz. Pure tone average greater than 25 Hz was taken as hearing loss.

The data collected was entered in Microsoft Excel and was analyzed using SPSS software (version 21.0). Bivariable analysis using Chi square test and Odds ratio with 95% confidence interval was used to find out association between hearing impairment and various factors related to it. p value less than 0.05 was considered to be statistically significant. Binary logistic regression was used for finding out the independent predictors of hearing impairment.

RESULTS:

1. PREVALENCE OF SENSORINEURAL HEARING LOSS AMONG CRF PATIENTS

Out of 89 patients 57 (64%) patients with CRF had sensorineural hearing loss and it was absent in 32 (36%) patients. Prevalence of SNHL is shown in Figure 1.

2. SENSORINEURAL HEARING LOSS AT DIFFERENT FREQUENCIES:

In the right ear 81 (91.0%) patients showed a dip at 8000 Hz, 71 (79.8%) patients showed a dip at 4000 Hz, 59 (66.3%) patients showed a dip at 2000 kHz, 51 (57.3%) patients showed a dip at 1000 Hz, 43 (48.3%) showed a dip at 500 kHz and 35 (39.3%) showed hearing loss at 250 Hz. Similarly in the left ear, 82 (92.1%) of patients showed SNHL at 8000 Hz, 66 (74.2%) patients showed SNHL at 4000 kHz, 57 (64%) showed a dip at 2000 kHz, 44 (49.4%) patients showed a dip at 1000 kHz, 41 (46.1%) patients showed SNHL at 500 Hz and 38 (42.7%) showed SNHL at 250 Hz. Results are depicted in Figure 2. The inference from these results are that maximum number of patients with chronic renal failure had SNHL at high frequencies and only few patients have SNHL at lower frequencies ie 8000 kHz > 4000 kHz > 2000 kHz > 1000 kHz > 500 kHz > 250 kHz.

3. SENSORINEURAL HEARING LOSS AND DURATION OF ILLNESS:

Sensorineural hearing loss was present in 21 (55.3%) and absent in 17 (44.7%) patients who had the disease for less than 2 years duration. Between 2 and 4 years duration 23 (69.7%) patients had SNHL and 10 (30.3%) were normal. More than 4 years duration 13 (72.2%) patients had SNHL and 5 (27.8%) were normal. These results show that maximum number of CRF patients have the disease for more than 4 years duration. Relation between duration of illness and sensorineural hearing loss is shown in Table 1. There is statistically no significant association detected between duration of illness and sensorineural hearing loss (p value = 0.324)

4. FACTORS AFFECTING HEARING LOSS IN PATIENTS WITH CHRONIC RENAL FAILURE:

1. AGE: Age was classified into 2 groups, ≤ 50 and > 50 . Patients ≤ 50 consisted of a total of 25 patients of which 10 (40%) patients had SNHL and 15 (60%) did not have SNHL. Patients > 50 years consisted of a total of 64 patients of which 47 (73.4%) had SNHL and it was absent in 17 (26.6%) patients. Relation between age and sensorineural hearing loss is shown in Table 2. There is statistically significant association between age and sensorineural hearing loss (p value = 0.003)

2. STAGE OF THE DISEASE: 17 patients were under stage 2 disease of which 6 (35.3%) of them had SNHL and 11 (64.7%) of them did not have hearing loss. In stage 3, there were total of 18 patients of which 11 (61.1%) of them have SNHL and 7 (38.9%) of them did not have SNHL. In stages 4 and 5 there were a total of 16 and 38 patients of which 14 (87.5%) in stage 4 and 26 (68.4%) in stage 5 have SNHL and 2 (12.5%) in stage 4 and 12 (31.6%) in stage 5 are not diagnosed

to have SNHL. Relation between stage of the disease and sensorineural hearing loss is shown in Table 3. There is statistically significant association between stage of the disease and sensorineural hearing loss (p value=0.016)

3. BLOOD PARAMETERS: There is statistically no significant association between the levels of Hemoglobin (p=0.729), Blood urea (p=0.482), Serum creatinine (p=0.945), Serum potassium (p=0.970), Serum sodium (p=0.556), Serum chloride (p=0.967), Serum calcium (p=0.069), Serum phosphorous (p=0.852) with sensorineural hearing loss. Relation between laboratory values and sensorineural hearing loss is shown in Table 4.

DISCUSSION:

Sensorineural hearing loss among patients with CRF has been a common finding in studies investigating the effects of renal failure on auditory function. Despite differences in methodologies and indices of auditory function, existence of hearing loss has been a common threat⁴. The higher incidence of hearing loss among patient with CRF has long been established and is constantly being verified by new studies. Although the gross anatomy of the kidney and cochlea differ, many similarities exist between the nephron and the striavascularis at the anatomical, physiological, pharmacological, pathological and ultra-structural levels¹.



Fig-1: Prevalence of sensorineural hearing loss among chronic renal failure patients.

All this may make the nephron and the striavascularis susceptible to the same type of hemodynamic or pharmacological insults. Many studies have documented the association between the hearing loss and chronic renal failure. Accelerated presbycusis, duration of renal failure, hemodialysis, ototoxic drugs, hypotension, circulating uremic

Table-1. Sensorineural hearing loss and duration of illness: $\chi^2 = 2.253$ df = 2 p = 0.324

Duration of illness	Hearing loss				Total	
	Absent		Present			
	N	%	N	%	N	%
<2	17	44.7	21	55.3	38	100
2.1-4.0	10	30.3	23	69.7	33	100
>4	5	27.8	13	72.2	18	100
Total	32	36	57	64	89	100

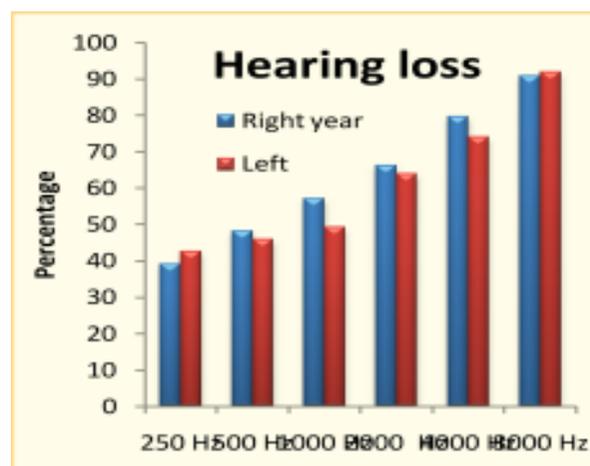


Fig-2: Sensorineural hearing loss frequencies.

Table-2. Age and sensorineural hearing loss $\chi^2 = 8.729$ df = 1 p=0.003.

Age	Hearing loss				Total	
	Absent		Present			
	N	%	N	%	N	%
≤50	15	60	10	40	25	100
>50	17	26.6	47	73.4	64	100
Total	32	36	57	64	89	100

toxins, anemia, electrolytic imbalances and metabolic disturbances are some of the causes listed in literature as possible causes for hearing loss in patients with chronic renal failure⁵. Out of 89 patients in our study with chronic renal

Table -3:Hearing loss and stage of the disease.

Stage of the disease	Hearing loss				Total	
	Absent		Present			
	N	%	N	%	N	%
2	11	64.7	6	35.3	17	100
3	7	38.9	11	61.1	18	100
4	2	12.5	14	87.5	16	100
5	12	31.6	26	68.4	38	100
Total	32	36	57	64	89	100

failure the prevalence of sensorineural hearing loss was noted in 57 (64%) patients. These results were supported by studies done by Aliasghar Peyvandi et al⁶, in which 70 end stage renal disease patients were taken of which 23 (46%) patients had sensorineural hearing loss and by Sanjay Gaur et al⁷ who showed among 52 CRF patients, an overall prevalence of sensorineural hearing loss was 73.07%. In our study sensorineural hearing loss was noted maximum at high frequencies (91%) followed by mid frequencies (64%) and least in low frequencies (42.7%). Same pattern of hearing loss was observed in a prospective study conducted by Suja Sreedharan et al⁸ in 25 patients receiving treatment for CRF, 18% of patients had SNHL at low frequencies, 32% of patients had SNHL at mid frequencies and 72% of them had at high frequencies. Similarly Lam and Ozturan⁹ studied 15 subjects with CRF and 10 controls using pure tone audiometry and otoacoustic emissions. Their results supported our study by mentioning that all 15 subjects with CRF were found to have

Table -4: Blood parameters and their effects on sensorineural hearing loss.

BLOOD PARAMETERS	Hearing loss				t	p
	Absent (N=32)		Present (N=57)			
	mean	sd	mean	sd		
Haemoglobin	8.903	2.3472	9.060	1.8512	-.347	.729
Blood urea	95.50	39.563	101.32	35.920	-.707	.482
Serum creatinine	7.175	3.7294	7.123	3.2669	.069	.945
Serum potasium	5.184	.9027	5.177	.8571	.037	.970
Serum sodium	133.59	6.829	134.56	7.723	-.591	.556
Serum chloride	103.63	6.399	103.68	6.636	-.041	.967
Serum calcium	8.466	1.1494	8.921	1.1045	-1.840	.069
Serum phosphorous	5.081	1.6415	5.023	1.2788	.186	.852

sensorineural hearing loss in high frequencies, compared to that of controls. In our study sensorineural hearing loss was present in 21 (55.3%) and absent in 17 (44.7%) patients who had the disease for less than 2 years duration. In patients with duration of disease between 2 and 4 years, 23 (69.7%) patients had SNHL and 10 (30.3%) were normal. In case of duration of disease more than 4 years, 13 (72.2%) patients had SNHL and 5 (27.8%) were normal. These results show that maximum percentage of sensorineural hearing loss occurred in CRF patients who had the disease for more than 4 years duration. However, no statistically significant association was detected between duration of illness and sensorineural hearing loss (p value=0.324) in our study. But this inference was disputed by Raaed About Aloubadeet al¹⁰ in his study in which out of total of 100 patients with CRF of which all were males and 92 of them were on regular hemodialysis and 8 were on conservative management. They found that 36% showed SNHL and the incidence of SNHL was found to increase with duration of chronic kidney disease. In a case control study done by Akeem.O.Laisi¹¹ et al to determine the pattern of hearing loss among patients with chronic renal failure, 33 CRF patients and 28 healthy controls of which 34 were males and 27 were females, they also found a positive correlation between duration of illness and chronic renal failure. In our study, age was classified into 2 groups, <=50 and >50. Patients <=50 consisted of a total of 25 patients of which 10 (40%) patients had SNHL and 15 (60%) did not have SNHL. Patients >50 years consisted of a total of 64 patients of which 47 (73.4%) had SNHL and it was absent in 17 (26.6%) patients. There is statistically significant association between age and sensorineural hearing loss (p value=0.003). Our study was supported by Raaed About Aloubade et al¹⁰ who conducted

a study to find out the incidence of sensorineural hearing loss in a total of 100 patients with CRF, which showed a positive correlation between incidence of SNHL and advanced age. In our study 17 patients comes under stage 2 of which 6 (35.3%) of them have SNHL and 11(64.7%) of them don't have. In stage 3, there were total of 18 patients of which 11 (61.1%) of them have SNHL and 7 (38.9%) of them had normal hearing. In stages 4 and 5 there were total of 16 and 38 patients of which 14 (87.5%) in stage 4 and 26 (68.4%) in stage 5 have SNHL and 2 (12.5%) in stage 4 and 12 (31.6%) in

stage 5 are not diagnosed to have SNHL. There is statistically significant association between stage of the disease and sensorineural hearing loss (p value=0.016). Our inferences were supported by a retrospective study done by Pandey S et al¹² to know the relationship between the different stages of CRF and corresponding audiological findings in them. Twenty-three subjects (46 ears) in the age range of 25 to 60 years were included in the study and subjected to pure tone audiogram. Significant differences in the degree of sensorineural hearing loss were observed among patients with different stages of CRF. In our study, no statistically significant association was found between the levels of hemoglobin (p=0.729), blood urea (p=0.482), serum creatinine (p=0.945), serum potassium (p=.970), serum sodium (p=0.556), serum chloride (p=0.967), serum calcium (p=0.069), serum phosphorous (p=0.852) with sensorineural hearing loss. Our results were supported by studies done by Johnson et al¹³ who found no relationship between fluctuations of hearing and serum urea nitrogen, creatinine, potassium, sodium, calcium and glucose.

CONCLUSION

In our study, we have made certain conclusions regarding the effect of various etiological factors on the hearing thresholds in patients with chronic renal failure based on a single audiological evaluation. Patients with CRF are subject to wide fluctuations in hemodynamic and metabolic parameters over time. Though we have arrived at certain broad conclusions based on our results, we cannot presume to identify the exact etiological factors responsible for hearing loss. High frequency sensorineural hearing loss was detected in majority of chronic renal failure patients and there was a positive correlation of sensorineural hearing loss with stage of the disease and age of the patients. However, lack of correlation between hearing function and blood parameters precludes a detailed description of the mechanisms causing hearing loss in CRF. A routine screening for hearing loss in chronic renal failure patients may be helpful to diminish comorbidities and improve their quality of life. Prevention of development of chronic renal failure is another important factor. Based on this study we recommend the following points

1. Pure tone audiometry should be done routinely in all chronic renal failure patients even if they don't report hearing loss.
2. Periodic audiological assessment should be incorporated in the management of all chronic renal failure patients to start rehabilitation as early as possible.

DISCLOSURES:

- (a) Competing interests/ Interests of Conflict-None
- (b) Sponsorships - None
- (c) Funding - None (d) No financial disclosures
- (e) Presentation at a meeting: None
- (f) Acknowledgement: None

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