

HEARING LOSS IN PATIENTS WITH CHRONIC KIDNEY: OUR EXPERIENCE IN A TERTIARY CARE HOSPITAL IN NEPAL

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ABSTRACT

Introduction

Patients with chronic kidney disease suffer from sensorineural hearing loss as a complication. The prevalence, type and degree of hearing loss along with the associated factors like age, electrolyte imbalance, hypertension, diabetes, duration and stage of Chronic Kidney Disease (CKD) were studied.

Methodology

This was a prospective cross-sectional study conducted in the department of Otorhinolaryngology and Nephrology at Nobel Medical College & Teaching Hospital, Kanchanbari, Biratnagar, Nepal from 1st August 2018 to 30th September 2019. After thorough history taking, clinical & biochemical examinations, all patients underwent Tuning fork test and Pure tone audiometry. CKD was staged according to the Estimated Glomerular Filtration Rate. Data were stored in excel spreadsheet and analysis was done using the SPSS software (version 21)

Result

Out of 150 patients, the ratio of male to female was 1.2:1. The mean age of the patients was 44.04 ± 10.524 years. 68 (45%) patients had CKD stage V with a median duration of 24 (18 – 36) months. The prevalence of hearing loss was found to be 83 (55.3%), most of them in bilateral ear (58%). The staging of CKD had a significant association with the prevalence of hearing loss and its severity. The duration of the illness had a strong association with hearing loss.

Conclusion

This study shows that sensorineural hearing loss prevails in the patients suffering from CKD, which increases with age, duration of CKD, presence of comorbidities like hypertension, diabetes and level of serum urea and creatinine. However, it could not establish diabetes and electrolyte as a potential risk factor for developing hearing loss from CKD.

KEYWORDS

Chronic kidney disease, hearing loss, ototoxic, sensorineural



INTRODUCTION

God created human beings with nine holes on their body surface popularly referred in some old religious literature as "Naba-daar" (nine doors) which are essential for survival. Out of these nine holes the two ears are meant for hearing and its subsequent response with proper speech formation and communication. Any disharmony of this cycle like hearing loss leads human beings to a life of untold misery. With the advancement of science and technology, one of the most intriguing discovery of human being has been that the cochlea, a part of the internal ear can emit sounds which prompted Dr. Kempt to experiment on human subjects by sealing a small microphone and speaker into the internal ear and finally he discovered cochlea echoes.¹ Renal failure induced sensorineural hearing loss was 1st described by Grahe in 1924.²

Contrary to the common belief the incidence and prevalence of hearing loss, both subclinical and overt is high in patients with Chronic Kidney Disease (CKD). As a matter of fact, presence of hearing loss and estimation of type and degree constitute one of the most common method used to investigate the effects and severity of renal disease. The exact etiology of sensorineural is not well defined in spite of the fact that anatomical, physiological, pathological and pharmacological similarities exist between the nephron and stria vascularis of the cochlea. Also, there is ultrastructural and antigenic analogies between the kidneys and the cochlea that results in osmotic alteration resulting in loss of hair cells, collapse of the endolymphatic space, oedema, atrophy of specialized auditory cells and in some complication of haemodialysis. Moreover, there are multiple shared risk factors for CKD and hearing loss including age, diabetes, hypertension and medications that are both ototoxic and nephrotoxic, electrolyte disturbance, uremic toxin, metabolic disturbances and haemodialysis. All these established facts permit to infer that the link between inner ear damage and kidney failure is likely to be much more than a coincidental finding.³ So, patients with CKD suffer widespread complications and sensorineural hearing loss is one of them.

OBJECTIVES

The incidence of CKD is on the rise throughout the world particularly in those with co-morbidities like diabetes, hypertension and use of ototoxic drugs. Nephrologist usually don't evaluate the CKD patients for hearing loss. The sensorineural hearing loss is increasing found in CKD patients irrespective of its causes. So, early detection of hearing loss should be an essential component of CKD management which is very frequently overlooked leading to more morbidity and jeopardizing the quality of life. Moreover, early detection of sensorineural hearing loss in CKD patients will reduce risk factors and also to take appropriate measures to improve the hearing function and quality of life. There is dearth of research articles in Nepal about the various aspects of CKD which leads to hearing loss. So, this prospective study of 300 ears were taken up in

150 diagnosed CKD patients collected from the department of Nephrology to study the

1. Relationship, proportion, pattern and magnitude of Sensorineural Hearing Loss (SNHL) amongst the patients with CKD attending Nephrology and ENT.
2. To study the association between demographic characteristics and degree of hearing loss.
3. To identify the association between hearing loss and factors like age, electrolyte imbalance, hypertension, diabetes, use of ototoxic drugs and duration and stage of CKD.

METHODOLOGY

This prospective, cross-sectional study was carried out in 150 willing patients who gave their informed consent to participate in this study at the Department of Otorhinolaryngology and Head & Neck Surgery, Nobel Medical College and Teaching Hospital. This study was carried out from 1st August 2018 to 30th September 2019 after obtaining Ethical approval from the hospital Ethical committee.

The inclusion criteria are: Patients registered to this hospital within this study period, age between 20-60 years, diagnosed case of CKD with GFR > 60ml/min.1.73m², duration of illness more than 3 months. The patients excluded were: Unwilling patients and not giving consent, use of topical ototoxic drugs, Living or working in noisy environment, history of hearing loss prior to the diagnosis of CKD, history of hearing loss in the family, ear discharge, trauma or ear surgery.

The diagnosis of CKD for all the patients had already been done at the nephrology department based on history, physical examination, lab tests, ultrasonography and biopsy. At our department, detailed general, systemic and ENT examinations were done for all the 150 patients. e-GFR was calculated using the Cockcroft Gault estimating equation and accordingly the patients were grouped into 5 different stages of CKD following K/DOQI (Kidney disease outcome quality initiative) 2002 guidelines. Renal ultrasound was done again to measure the kidney size. All these were filled in the data sheet which already contained age, gender, weight and any risk factors like hypertension, diabetes and use of any ototoxic drugs. Otoscopic examination was performed to rule out any problem in external ear and tympanic membrane. The patients were divided into 4 groups for both age and duration of CKD. The patients were then evaluated for their hearing functions. Hearing-related questions included family history of hearing loss, past medical or surgical treatment of otologic conditions and diseases associated with hearing loss and all these were filled up in the data sheet. Degree of hearing loss based on hearing loss range (decible), as per WHO 1980 recommendation, was divided into mild, moderate, moderately severe, severe and profound. Tuning fork test was done in all the patients to find out the presence of any hearing loss and confirmed by audiological evaluation with



pure tone audiometry using Intracoustics AD629 Diagnostic Audiometer and standard TDH-39 earphones performed by a qualified audiologist in a sound treated booth. All the findings were recorded in the data sheet.

After collecting the data were verified and coded accordingly and entered in Microsoft excel 2007 and converted it into statistical package for social science (SPSS 21 version) for statistical analysis. p-Value of <0.05 was considered as significant level.

RESULTS

Demographic Distribution

1. Age Distribution

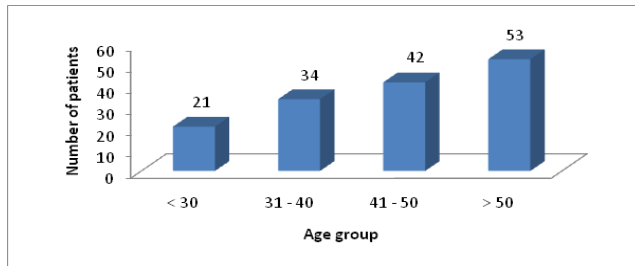


Figure 1: Distribution of age groups

The age ranged from 20 to 60 years which was divided into 4 group viz. < 30, 31 – 40, 41 – 50 and > 50. The maximum number of patients were in > 50 years (35.3%) The mean age of the patients was 44.04 ± 10.524 years.

2. Gender Distribution

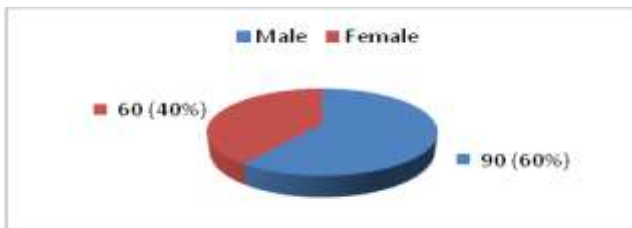


Figure 2: Distribution of gender in patients with CKD.

Out of 150 patients, 90 (60%) were male and 60 (40%) were female. The ratio of male to female was 1.2:1.

3. Risk Factors in CKD

Systemic hypertension and diabetes mellitus are the two most common conditions associated with chronic kidney disease. The distribution of hypertension, diabetes and use of ototoxic drug are shown in the table.

Risk Factors	No. of patients (%)
Hypertension	
No	64 (42.7)
Yes	86 (57.3)
Diabetes	
No	93 (62.0)
Yes	57 (38.0)
Ototoxic drugs	
No	85 (56.7)
Yes	65 (43.3)

Out of 150 patients, 86 (57.3%) patients had systemic hypertension and 57 (38.0%) had diabetes mellitus. 65 (43.3%) patients had a history of using ototoxic drugs as a part of their medical therapy for CKD.

4. Distribution of Stages of CKD

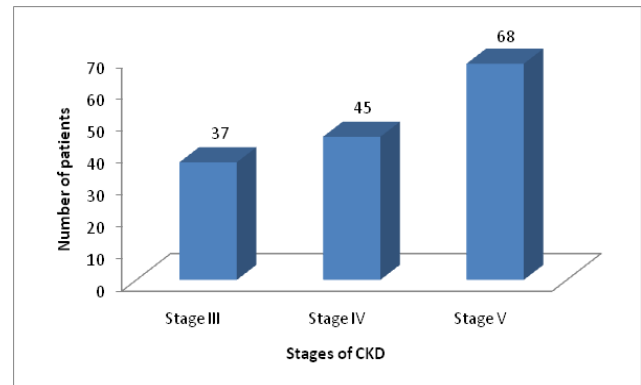


Figure 3: Distribution of stages of CKD.

In the clinical setting patients usually present late in their disease process. This is because of lack of screening program to find the patient in the early stages of kidney dysfunction. Hence, only stages III and above were included in the study. Out of 150 patients, 68 (45.3%) patients were stage V, 45 (30%) were stage IV and 37 (24.7%) were stage III.

5. Distribution of Patients by Duration of Illness

Duration of CKD (months)	Number of patients (%)
≤18	64 (42.7)
19 – 36	62 (41.3)
37 – 54	18 (12.0)
≥55	6 (4.0)
Total	150 (100.0)

The total number of CKD patient were grouped into 4 groups depending on the length of the ailment. Out of 150 patients, 64 (42.7%) had the disease for less than or equal to 18 months while 62 (41.3%) patients had kidney dysfunction for 19 to 36 months. Only 24 (16%) patients had the disease for more than 3 years. The median duration of CKD was 24 (18–36) months.

6. Prevalence of Hearing Loss in CKD

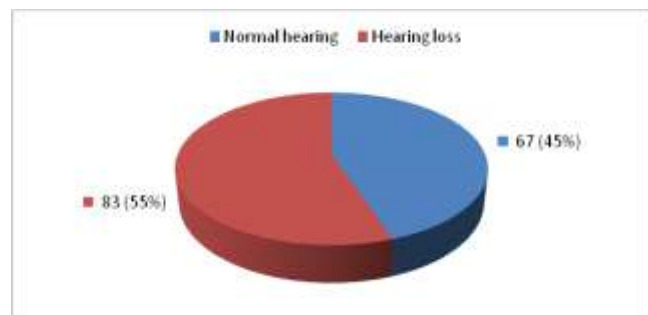


Figure 4 : Prevalence of hearing loss in CKD.

Based on the audiogram finding of more than 25 dB, 83 (55.3%) had sensorineural hearing loss of varying severity and 67(55%) had normal hearing.

7. Risk Factors for Hearing Loss in CKD

Table 3: Comparison of risk factors for hearing loss in CKD.

Variables	Hearing loss		p Value	Remarks
	No	Yes		
Age	42.07 ± 10.331	45.67 ± 10.464	0.037	Sig
Sodium	136.88 ± 3.979	136.18 ± 5.075	0.358	NS
Potassium	4.3487 ± 0.60433	4.4475 ± 0.71546	0.369	NS
Urea	77.51 ± 27.709	96.63 ± 28.743	< 0.05	Sig
Creatinine	4.5760 ± 2.25400	5.7595 ± 2.25703	0.002	Sig

The mean age of CKD patients without hearing loss was 42.07 ± 10.33 and with hearing loss was 45.67 ± 10.46 (p<0.05). Hence, hearing loss was more prevalent in older patients with CKD.

The mean sodium and potassium levels between CKD patients with and without hearing loss was statistically not significant (p>0.05). The mean serum urea in patients with and without hearing loss in CKD patients was 96.63 ± 28.74 and 77.51 ± 27.70 respectively (p<0.05) which was statistically significant. The mean serum creatinine was significantly higher (p value <0.05) in patients with hearing loss in CKD (4.5760 ± 2.25 vs 5.7595 ± 2.25). Therefore, increase in serum urea and creatinine is a significant risk factor for developing hearing loss in CKD.

Table 4: Comparison of comorbidities associated with hearing loss in CKD.

Comorbidities	Hearing loss		p value	Remarks
	No	Yes		
Hypertension				
No	39 (60.9%)	25 (39.1%)	0.001	Sig
Yes	28 (32.6%)	58 (67.4%)		
Diabetes				
No	43 (46.2%)	50 (53.8%)	0.621	NS
Yes	24 (42.1%)	33 (57.9%)		
Ototoxic drugs				
No	45 (52.9%)	40 (47.1%)	0.020	Sig
Yes	22 (33.8%)	43 (66.2%)		

As seen in table 4 statistically significant (p-value) number of patients with CKD had hearing loss with hypertension (76.4%) and those taking ototoxic drugs (66.2%).

Table 5: Comparison of stages of CKD with hearing loss.

Stages of CKD	Hearing loss n (%)		p value	Remarks
	No	Yes		
Stage III	25 (67.6%)	12 (32.4%)	<0.01	SIG
Stage IV	23 (51.1%)	22 (48.9%)		
Stage V	19 (27.9%)	49 (72.1%)		
Total	67 (44.7%)	83 (55.3%)		

Hearing loss was found to be present in 12 (32.4%) patients in stage III, 22 (48.9%) patients in stage IV and 49 (72.1%) patients in stage V (p value<0.05). Therefore, it can be implied that with increase in the staging of CKD, the prevalence of hearing loss also increases.

DISCUSSION

Hearing is one of the special senses in human being. Hearing loss is the impairment of the ability to hear sounds. Cochlear dysfunction in kidney disease gives rise to sensorineural hearing loss which was first established as "Hereditary Familial Congenital Hemorrhagic Nephritis". This syndrome is characterized by nephropathy, bilateral symmetrical sensorineural hearing loss, ocular abnormalities and hereditary origin. This association between chronic kidney disease and hearing loss was first described in patients with Alport syndrome.⁴

CKD is defined as renal injury (proteinuria) and/or a Glomerular Filtration Rate (GFR) <60ml/min/ 1.73m² for more than 3 months.⁵ National kidney foundation in 2002 classified CKD into 6 stages on the basis of GFR. End stage renal disease (ESRD) represent a stage of CKD where toxins, fluids and electrolytes normally excreted by kidneys accumulate in the body resulting in uremic syndrome where renal replacement therapy are needed.^{6,7} Virtually all organ systems are adversely affected by CKD. Auditory system is no exception to this and a high incidence of hearing loss has been reported in this set up.

The normal healthy ear can process sound frequency ranging from 20 Hz to 20 KHz. It can detect sound as soft as 0.002 dynes/cm²(120 decibel). Ear is also sensitive to signal between 500 to 4000 Hz, frequency most important to speech frequency.⁸ Hearing loss is generally classified as conductive hearing loss where air conduction is affected due to room pathology in the conductive division (outer ear and middle ear). Sensorineural hearing loss is due to permanent damaged of hair cells of cochlea. No known treatment of damage hair cell is available at present and generally treated with amplification devices like hearing aids and cochlear implantation.⁸ In mixed hearing loss both conductive and sensorineural components are present. Degree of hearing loss is generally classified on the basis of hearing loss range (decibel) into normal, slight, mild, moderate, moderately severe, severe, profound. Degree of hearing loss, based on hearing loss range was noted as per WHO 1980 recommendation.

According to various researchers, there is a wide variation in the prevalence of hearing loss ranging from 28% to 77%.⁹⁻¹¹ These wide variations might be due to various different inclusion criteria's like stages of CKD, duration of the disease and haemodialysis. In the present study prevalence of hearing loss in CKD patients was 55.3%. Similar was the observations in the studies by Shaheen et al, Vilayur et al

and Rahman et al.¹²⁻¹⁴ The etiopathogenesis of prevalence of hearing loss in CKD is still not clear. Various hypothesis has been reported by various researchers¹⁵ who blamed abnormal electrolyte, urea, diabetics and other ototoxic drugs for this. A pure tone audiometer (Intracoustics AD629 Diagnostic Audiometer and standard TDH-39 earphones) like other researchers^{9,16} was used to determine the hearing loss threshold. Accelerated presbycusis has been mentioned in the literatures as a possible cause of hearing loss in patients with renal failure.⁷ The present study also supports this view as 45.67 ± 10.46 number of subjects with CKD had sensorineural hearing loss compared to 42.05±10.33 subjects who didn't have hearing loss. Similar was the observation by Vilayur et al.¹³ But it should be noted that age itself is an independent risk factor for development of sensorineural hearing loss. A large-scale study with age matched control may point out a conclusive answer to this problem. Based on the audiogram finding of more than 25db with pure tone audiometry, the present study revealed that 83 (55%) patients had sensorineural hearing loss out of which 48(58%) had bilateral hearing loss and rest 35(42%) had unilateral hearing loss. Present study also revealed that 2/3rd of the patients had mild hearing loss and rest 1/3rd had moderate to severe degree hearing loss. On analyzing the profile of hearing loss in the present study, normal hearing was observed in 87(58%) cases in the right ear and 83(55.3%) cases in the left ear. Rest of the patients had mild to severe degree of sensorineural hearing loss. Almost similar type of profile was also reported by Jamalden et al, Vilayur et al and Nikolopoulos et al.^{7,10,13}

While analyzing the patients with hearing loss it was found that hearing threshold were abnormal at higher frequencies in 46% and at lower frequencies in 22%. This finding is comparable to a study done by Jamaldeen et al.¹⁰ Other studies also reported hearing loss dominant only in higher frequencies.^{7,9,11,17,18} This might be due to the fact that these researchers took most of their cases in the later stages of CKD.

Statistically significant number of patients in the present study who suffered from hearing loss had hypertension (67.4%) or were on ototoxic drugs (66.2%). Kligerman et al and Gatland et al^{19,20} also observed such correlation between hypertension and hearing loss. Like the present study, many researchers like Ransome et al and Kimura E.T et al^{11,22} reported a significant increase in hearing loss who were on ototoxic drugs. Significant increase in the levels of serum urea (96.63% +_28.743) and creatinine (5.7595+_0.002) were observed in the present study like the studies of R.R et al, Bazzi et al.²³ Slight changes in the level of serum potassium and sodium were observed in this study which was not significant.

The present study had similar observation reported by

Akeem et al, Pevyandi et al, Meena et al and many others^{11,17,24} reported that the prevalence of hearing loss increases with the duration of CKD. However, some others^{10,20} reported that hearing loss was not associated with duration of disease. This is probably because CKD in these patients improved with medical management and is an independent risk factors for development of sensorineural hearing loss. A large-scale study with age matched control may point out a certain answer to this problem.

LIMITATIONS OF THE STUDY

1. As this is a cross-sectional study so causation couldn't be established.
2. In the present study, a pure tone audiometry was used, more sensitive modalities like otoacoustic emission, brainstem induced response audiometry could have improved the sensitivity of the study.
3. All the patients in the present study had renal disease with comorbidities which may have affected the outcomes of the study.
4. The number of patients enrolled in this study is not large enough to represent the whole population of Nepal.

CONCLUSION

The present study substantiates the observation that sensorineural hearing loss prevails in the patients suffering from CKD, which intensifies with age, duration of CKD, presence of comorbidities like hypertension, diabetes and level of serum urea and creatinine. This study could not establish diabetes and electrolyte as a potential risk factor for developing hearing loss from CKD. The present study strongly recommends proper medical management with monitoring and periodical audiological check-up by otolaryngologists to prevent hearing loss and to provide a better quality of life.

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CONFLICT OF INTEREST

We declare no conflict of interest.

FINANCIAL DISCLOSURE

None



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