Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2018/4

Original Article

A Study of Hearing Loss in Chronic Renal Failure

C Balasubramanian[1], B Santhanakrishnakumar[2], Heber Anandan[2]

[1]Associate Professor, Department of Otorhinolaryngology, Thoothukudi Medical College, Thoothukudi, Tamil Nadu, India, [2]Assistant Professor, Department of Otorhinolaryngology, Thoothukudi Medical College, Thoothukudi, Tamil Nadu, India, [3]Senior Clinical Scientist, Department of Clinical Research, Dr. Agarwal's Healthcare Limited, Chennai, Tamil Nadu, India

Abstract

Introduction: It is well known that chronic renal failure (CRF) causes different systemic and otorhinolaryngologic manifestations due to the accumulation of nitrogenous waste products. Hearing loss in patients of CRF is relatively higher in comparison to the general population.

Objective: The objective of this study was to evaluate the severity of hearing loss at different frequencies in patients of CRF.

Materials and Methods: The study subjects were divided into two groups, 50 CRF patients and 50 healthy volunteers in age group 15–60 years, and histories of hearing impairment after the occurrence of renal failure were included in the study. All chronic kidney disease (CKD) patients and controls were subjected to hearing assessment using standard pure tone audiometry.

Results: Hearing loss was present in 80% of patients of CRF than in healthy controls. In the CKD group, 40% were diabetics and 60% were non-diabetics, and in the control group, 32% were diabetics and 68% were non-diabetics. In CKD group, 48% suffered from hypertension and in control group 36% suffered from hypertension.

Conclusion: Our study highlights the prevalence of hearing loss in people suffering from chronic renal failure. Early identification can prevent further deterioration of hearing and improve the quality of life in patients suffering from chronic renal failure.

Key words: Chronic kidney disease, Diabetes, Otorhinolaryngologic

INTRODUCTION

Sensorineural hearing impairment has been reported in chronic renal failure (CRF) patients with a prevalence of 20–40%. The etiopathogenetic mechanisms reported included 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.[1] Hearing impairment has been reported in patients with CRF. There are also certain anatomic similarities at an ultrastructural level and evidence for similar antigenicity of the cochlea and kidney.[2-4] Multiple shared risk factors for chronic kidney disease (CKD) and hearing loss include age, diabetes, hypertension, and medications that are both ototoxic and nephrotoxic.

Access this article online

www.ijss-sn.com

Month of Submission : 11-0000
Month of Peer Review : 12-0000
Month of Acceptance : 12-0000
Month of Publishing : 01-2018

Moreover, in patients with established CKD, multiple risk factors have been hypothesized to cause hearing loss including the use of ototoxic medications, hypertension, and diabetes, particularly in association with hypertension, electrolyte disturbances, and hemodialysis itself.[5-7] Older adults with moderate CKD have a higher prevalence of hearing loss than those of the same age without CKD according to recent studies.[3] Although several causes and prevalence of renal disease-related hearing loss have been proposed the etiology and proportion are still controversial. The exact pathophysiological mechanism underlying the presence of hearing loss among CKD patients is unknown although several potential mechanisms have been hypothesized. The kidney and the stria vascularis of the cochlea share physiological, ultrastructural, and antigenic similarities that could explain the association between CKD and hearing loss.

Aim

This study aims to evaluate the severity of hearing loss at different frequencies in patients of chronic renal failure.

Corresponding Author: B Santhanakrishnakumar,Department of Otorhinolaryngology, Thoothukudi Medical College, Thoothukudi, Tamil Nadu, India. Phone: +91-9894167045. E-mail: drbskkent@gmail.com

MATERIALS AND METHODS

A prospective study was conducted in the Department of Ear Nose and Throat (ENT), Thoothukudi Government Medical College. The study subjects were divided into two groups, 50 CRF patients and 50 healthy volunteers whose age, sex, and confounding factors were matched. Subjects with age group 15–60 years and history of hearing impairment after the occurrence of renal failure were included in the study. Subjects with a history of hearing loss, diabetes, hypertension, ototoxic drugs intake, and noise exposure were excluded from the study. Cases were evaluated in the department of ENT, interviewing using a uniform pro forma containing information on age, sex, gender, and risk factors including diabetes, hypertension, and history of ototoxic drug use. Blood parameters including Hb% blood urea, serum creatinine, and electrolytes were obtained. All CKD patients and controls were subjected to hearing assessment using standard pure tone audiometry at 250, 500, 1000, 2000, 3000, 6000, 7000, and 8000 Hz. 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.

RESULTS

The present study was on hearing loss in chronic renal failure patients. Cases are tabulated as regard to their incidence, age of presentation, sex distribution, and pattern of hearing loss. In chronic renal failure patients group, 21 were females and 29 were males. In control group, 24 females and 24 males were participated. Mean age in the group females 48.5 and males 55.9. In our study, 42% was female and 58% was male in CKD group and 48% was female and 52% was male in control group. Mean age in the group females 48.5 and males 55.9.

Stages in the CKD group are classified as one patient in CKD 2nd stage, 12 patients in stage 3, 14 patients in stage 4, and 13 patients in stage 5 CKD Table 1. In CKD group, 80% suffer from hearing loss and 20% have normal hearing. In control group, 12% suffer from hearing loss and 88% have no hearing loss Table 2. Prevalence of hearing loss in the 2nd stage was 2%, hearing loss in the 3rd stage is 24%, the 4th stage was 14%, and hearing loss in CKD 5th stage is 26%. Among the CKD group, 10% had mild hearing loss, 20% had moderate hearing loss Figure 1, 40% had severe hearing loss, and 36% had profound hearing loss. Within the hearing loss group, 60% had high-frequency hearing loss, 30% had mid-frequency hearing loss, and 10% had low-frequency hearing loss Figure 2. In the CKD group,

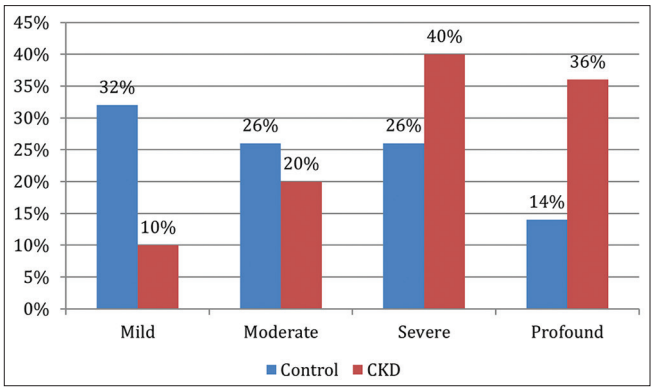

Figure 1: Degree of hearing loss based on pure tone audiometry

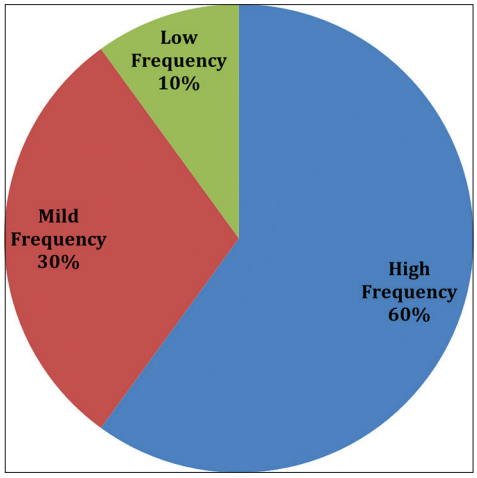

Figure 2: Pattern of hearing loss in chronic kidney disease patients

40% were diabetics and 60% were non-diabetics; in the control group, 32% were diabetics and 68% were non-diabetics. In CKD group, 48% suffered from hypertension and in control group 36% suffered from hypertension.

DISCUSSION

Many different studies conducted here and abroad have demonstrated that quite a few serious ailments can impact our hearing the higher incidence of hearing loss among children and adults with chronic renal failure is well documented in published reports. The pathophysiology between hearing impairment and CKD remains unclear. Over many years', reports were identified link between CRF and hearing loss in patients with rare diseases such as mitochondrial myopathy, lactic acidosis, stroke, Alport syndrome, and Fabry's disease. Untreated hearing loss can have very significant consequences on a person quality of life. People with moderate hearing loss untreated has been found to be affected by anxiety, impaired memory and can be benefitted with hearing aids. The cochlea and

Table 1: Distribution of study patients

Stages of CKD	Number of patients (%)
1	0 (0)
2	1 (2)
3	12 (24)
4	14 (28)
5	13 (26)

CKD: Chronic kidney disease

Table 2: Comparison of hearing loss in study group

Study group	Hearing loss (%)	Normal (%)
CKD	80	20
Control	12	88

CKD: Chronic kidney disease

kidney may have common antigenic similarity between basement membranes of glomeruli and stria vascularis of the inner ear.[8] Several etiological factors have been linked to hearing loss in renal failure.[9,10] Including the use of ototoxic medications, electrolyte imbalances, hypertension, and hemodialysis. A comparison of hearing loss patterns in people with recent and long-standing renal failure will establish the difference between renal failure causing hearing loss and common etiologies causing hearing loss and renal failure. Di Paolo *et al.* indicated a very high incidence of nerve conduction dysfunction in groups of CRF patients.[11] Kochhar *et al.* reported an association between hearing loss and CKD in 27.5% of patients.[12] Hearing loss in CRF patients is related the high sensitivity C-reactive protein, which suggests an inflammatory role in the pathogenesis of hearing loss. Several auditory brainstem response studies of CRF indicate dysfunction of the auditory nerve and pathways. Thus, the auditory nerve may be involved in uremic neuropathy such as peripheral nerves, inflammatory endothelial activation, and dysfunction are some of the underlying causes for the small vessel disease affecting the cochlea and auditory pathway.[13] Samir *et al.*[14] found no correlation between pure tone audiometry findings with serum electrolytes levels. Ototoxic medications 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.[15,16] Qin *et al.* and Gurbanor reported that the characteristic of hearing loss in CKD patients in high-frequency abnormality.[17,18] Prevalence of hearing loss in CKD patients vary from 28% to 77% according to different studies.[19,20] In our study, we observe hearing loss at higher frequencies 60%, mid frequencies 30%, and 10% low-frequency Hz. Gatland *et al.*[21] found 41% hearing impairment in low frequency and 53% in high-frequency range. The higher incidence of bilateral hearing impairment noted in chronic renal failure also indicates electrolytic, osmotic, biochemical, vascular, and immunological changes in the inner ear which leads to severe audiovestibular symptoms and pathology. Bains *et al.* who found that chronic kidney disease patients have a significant bilateral sensorineural hearing loss at all frequencies and more marked in higher frequencies.[22] High-frequency audiometry is a sensitive method for detecting hearing changes in patients with chronic renal failure and can be used to monitor these patients. Our results show a high-frequency hearing loss in patients with renal impairment compared to normal control subjects. Similar results were obtained by Zeigelboim *et al.*, who found a severe high-frequency hearing loss in CRF patients.[23]

CONCLUSION

Hearing loss in chronic renal failure patients does not follow any specific pattern and prevails at high and low frequencies. Patients with chronic renal failure often have multiple comorbidities which make their life miserable. Hearing loss in CKD patients is often not attended well. Our study highlights the prevalence of hearing loss in people suffering from chronic renal failure. Early identification can prevent further deterioration of hearing and improve the quality of life in patients suffering from chronic renal failure.

REFERENCES

1. Quick CA, Fish A, Brown C. The relationship between cochlea and kidney. Laryngoscope 1973;83:1469-82.
2. Irwin J. Basic anatomy and physiology of the ear. In: Newton VE, Vallely PJ, editors. Infection and Hearing Impairment. Ch. 1. Chichester, United Kingdom: John Wiley and Sons, Ltd.; 2006. p. 8-13.
3. Alport AC. Hereditary familial congenital haemorrhagic nephritis. Br Med J 1927;1:504-6.
4. Furness DN, Hackney CM. Form and ultrastructure of the cochlea and its central connections. Scott-Brown's Otorhinolaryngology, Head and Neck Surgery. 7th ed., Ch. 226. Great Britain: Michael Gleeson, Edward Arnold (Publishers) Ltd.; 2008. p. 3126-40.
5. Arnold W. Inner ear and renal diseases. Ann Otol Rhinol Laryngol Suppl 1984;112:119-24.
6. Davison AM, Cameron JS, Grünfeld JP, Kerr DN, Ritz E, Winearls CG. Oxford Textbook of Clinical Nephrology. 2nd ed. Oxford, UK: Oxford University Press; 1998.
7. Dhingra PL, editor. Anatomy of ear. In: Diseases of Ear, Nose and Throat. 4th ed. Ch. 1. New Delhi: Elsevier, Division of Reed Elsevier India Private Limited; 2007. p. 9.
8. Quic C, Fish A, Brain C. The relation Shio between cochlea and kidney. Laryngoscope 1973;83:1469-82.
9. Antonelli A, Benfiolli F, Garrubbaaa V. Audiological findings in elderly patients with chronic renal failure. Acta Otolaryngol 1991;476 Suppl:54-68.
10. Bergstrom L, Jenkins P, Sando I, English GM. Hearing loss in renal disease: Clinical and pathological studies. Ann Otol Rhinol Laryngol 1973;82:555-76.
11. Di Paolo B, Di Marco T, Capelli P. Electrophysiological aspects of nervous condition in uremia. Clin Nephrol 1988;29:253-60.
12. Kochhar A, Fischer SM, Kimberling WJ, Smith RJ. Branchio-Oto-renal

syndrome. Am J Med Genet A 2007;143A:1671-8.
13. Hassan A, Hunt BJ, O'Sullivan M. Markers of endothelial dysfunction in lacunar infarction and ischemic leukokariosis. Brain 2003;126:424-32.
14. Samir M, Riad H, Mahgaub M, Awad Z, Kamal N. Transient otoacoustic emissions in children with chronic renal failure. Clin Otolaryngol 2007;23:87-90.
15. Mudd PA, Edmonts Al, Glatz FR, Campbell KC, Rysak LP. Ototoxicity: Overview, Aminoglycosides, Other Antibiotics; 2016. Available from: https://www.emedicine.medscape.com/article/857679-overview. [Last cited on 2017 Nov 19].
16. Schmiedt RA, Lang H, Okamura HO, Schulte BA. Effects of furosemide applied chronically to the round window: A model of metabolic presbyacusis. J Neurosci 2002;22:9643-50.
17. Qin Y, Sun Y, Zhai L, Lü H, Xu J. Application of extended high frequency audiometry in the patients with chronic renal failure treated by hemodialysis. Lin Chuang Er Bi Yan Hou Ke Za Zhi 2005;19:17-8.
18. Gurbanov FA. Hearing status in patients with pronounced chronic kidney insufficiency. Vestn Otorinolaringol 1999;2:39-41.
19. Meena RS, Aseri Y, Singh BK, Verma PC. Hearing loss in patients of chronic renal failure: A study of 100 cases. Indian J Otolaryngol Head Neck Surg 2012;64:356-9.
20. Bazzi C, Venturini CT, Pagani C, Arrigo G, D'Amico G. Hearing loss in short- and long-term haemodialysed patients. Nephrol Dial Transplant 1995;10:1865-8.
21. Gatland D, Tucker B, Chalstrey S, Keene M, Baker L. Hearing loss in chronic renal failure-hearing threshold changes following haemodialysis. J R Soc Med 1991;84:587-9.
22. Bains KS, Chopra H, Sandhu JS, Aulakh BS. Cochlear function in chronic kidney disease and renal transplantation: A longitudinal study. Transplant Proc 2007;39:1465-8.
23. Zeigelboim BS, Mangabeira-Albernaz PL, Fukuda Y. High frequency audiometry and chronic renal failure. Acta Otolaryngol 2001;121:245-8.

How to cite this article: Balasubramanian C, Santhanakrishnakumar B, Anandan H. A Study of Hearing Loss in Chronic Renal Failure. Int J Sci Stud 2018;5(10):15-18.

Source of Support: Nil, **Conflict of Interest:** None declared.