

RESEARCH PAPER

# Tinnitus and vertigo in CKD patients in basra hemodialysis center

Haider Kadhem Saeed <sup>1</sup>, Ahmed M. Alabbasi <sup>2</sup>

<sup>1</sup> MBChB, F.I.B.M.S, Department of Otolaryngology, Saddam Teaching Hospital, Alzahra Medical College, Basra, Iraq.

<sup>2</sup> F.R.C.S.F.I.B.M.S, Department of Surgery, College of Medicine, University of Basra, Basra, Iraq.

Received: 05.11.2020

Accepted: 15.05.2021

## Abstract

as the relation between hearing impairment and CKD been discussed thoroughly in many literatures, the relationship if present between CKD, hemodialysis, tinnitus and vertigo is not clear in regard to their prevalence, incidence, relation to disease severity and other co-morbid conditions. **Objective:** inspect the relation between hemodialysis and the development of tinnitus and/or vertigo in patients with chronic kidney disease undergoing hemodialysis in addition to the effect of other factors associated with CKD as increase blood urea and creatinine levels, the effect of hypertension and Diabetes mellitus, and the effect of other electrolytes mainly Na level.

**Methods:** A prospective study conducted in Basra hemodialysis center and otolaryngology departments in Basra Teaching Hospital, Basra, Iraq. Fifty-nine patients with CKD on regular hemodialysis of variable duration enrolled in this study. The statistical analysis done using SPSS 22.

**Results:** patients mean age was  $41.8 \pm 9.2$  years (range: 17–50 years). Male to Female ratio was 1.27:1. 16.95% of patients had tinnitus only, 16.95% had vertigo only, 30.51% had combination of both tinnitus and vertigo and only 35.59% didn't develop symptoms. There was significant relation between the duration of hemodialysis and the development of tinnitus and vertigo (P value = 0.047). No significant relation was found between age, sex, serum electrolytes, blood urea and serum creatinine.

**Conclusion:** Tinnitus and/or vertigo are common in patients with CKD on hemodialysis as 64.41% were affected either with one symptom or with both and they were affected by the duration of the disease.

**Keywords:** CKD, Tinnitus, Vertigo

## Corresponding to:

Ahmed M. Alabbasi, F.R.C.S.F.I.B.M.S, Department of Surgery, College of Medicine, University of Basra, Basra, Iraq

✉ [ahmed.mhoder@uobasrah.edu.iq](mailto:ahmed.mhoder@uobasrah.edu.iq)

## Introduction

Chronic kidney disease (CKD) is characterized by progressive and irreversible loss of kidney function over the period of months and years. Diabetes and hypertension are the main causes in most countries and diabetes accounts for 30–50% of the patients with CKD <sup>1</sup>. As CKD progresses, the formation and accumulation of uremic toxin will lead to adverse biological effects. Uremic

toxin can contribute to inflammation, immune dysfunction, vascular disease and platelet dysfunction <sup>2</sup>.

The general increase in life span of patients with CKD wither they are on renal replacement therapy or not had led to development of late manifestation hearing system impairment <sup>3</sup>. Tinnitus is a perception of sound in the absence of external auditory stimulus and often has a negative effect upon the quality of life. Vertigo is a delusional perception of movement either of one's own body, such as swaying or rotation, or of the environment, or both <sup>4,5</sup>.

In addition to antigenic similarity, the cochlea and kidney have similar physiological mechanisms, namely, the active transport of fluid and electrolytes achieved by the stria vascularis in the cochlea and the glomeruli in the kidney [6] 7.

It was previously confirmed that the cochlea is affected by the systemic metabolic, hydroelectrolytic and hormonal alterations that are associated with CKD [8].

Several variables may contribute to the etiopathogenetic mechanisms of tinnitus and vertigo in CKD including factors related to the severity and duration of the disease, electrolyte disturbances,

ototoxic drugs, age, comorbid conditions such as diabetes mellitus and hypertension, and hemodialysis [9-11]. MRI and MRA of the brain of patients with CKD brought light on etiological aspect of vertigo in these patients. Results indicate vascular etiology of vertiginous syndrome in patients on chronic program of hemodialysis [12].

Although the relation between hearing impairment and CKD has been discussed, the relationship if present between CKD, hemodialysis, tinnitus and vertigo is not clear in regards to their prevalence, incidence, relation to disease severity and other co-morbid conditions. The aims of our study are to inspect the relation between tinnitus and vertigo in CKD patients submitted to hemodialysis treatment, and to inspect any changes of the symptoms (tinnitus and vertigo) in association with the duration of CKD and hemodialysis, medical treatment, levels of blood urea, creatinine and other electrolytes.

## Methods

### Study design and setting

This prospective cross-sectional study was done at the Otolaryngology and Haemodialysis units in Basra Teaching Hospital from December 2014 to December 2016. Written informed consent was obtained from each patient before enrollment in the study following a detailed explanation of the objectives and protocol of the study. This study was approved by the Ethical Committee of the College of Medicine, University of Basra and the ethical committee in Basra Teaching Hospital.

### Patients

Chronic kidney disease patients on regular hemodialysis for different durations were interviewed for this study. The inclusion criteria for the patients were a stage 5 CKD on hemodialysis regardless of the duration of the renal failure or the dialysis. The exclusion criteria included patients age >50 years, history of chronic use of ototoxic drugs, chronic suppurative otitis media, acoustic neuroma, childhood-onset hearing loss or hearing loss before the onset of chronic kidney disease, excessive or chronic noise exposure, otological trauma or surgery, renal transplantation, and conductive hearing loss. Eighty-one consecutive patients admitted to the hemodialysis unit were targeted. Fourteen patients were excluded according to the exclusion criteria. In addition, eight patients died during the follow-up period. The remaining 59 patients (33 males and 26 females) representing the final sample size enrolled in the study.

### Data collection

The patients interviewed about their sociodemographic characteristics and medical history. Otological examination, pure tone audiometry and tympanometry were done to exclude conductive hearing loss, external and middle ear pathologies. The pure-tone audiometric examinations performed by an audiologist. Symptoms of Tinnitus and/or Vertigo evaluated regarding their duration, medication taken and their corresponding effect on the patient’s life.

### Statistical analysis

The data analyzed using the SPSS (SPSS Inc., Chicago, IL, USA) version 22. Chi-square test used to find the significance of differences in categorical parameters.

### Results

Fifty-nine patients were enrolled in this study (33 [55.9%] men and 26 [44.1%] women). The mean age of the studied population was  $41.8 \pm 9.2$  years (range: 17–50 years). Other sociodemographic findings are illustrated in table [1].

Of the 59 patients enrolled in this study, 10 patients (16.95%) complain from tinnitus, 10 patients (16.95%) complain from vertigo, 18 patients (30.51%) had both tinnitus and vertigo, and the remaining 21 patients (35.59%) didn’t develop any tinnitus or vertigo symptoms during the time of the study, as shown in figure [1].

TABLE [1]: THE BASIC VARIABLES OF 59 PATIENTS		
	Variable	Total (59)
1	Mean age in years	41.8 +/- 9.2
2	Male / Female ratio	1.27:1
3	Duration of hemodialysis (years)	3.4±2.9
4	percentage of patients with HTN, DM, or both	94.9 %
5	Duration of CKD (years)	
	< 2 yrs.	27 (45.8%)
	2-5 yrs.	19 (32.2%)
	>5 yrs.	13 (22%)
6	Serum blood urea (mg/dL)	194.8±39.9
7	Serum creatinine (mg/dL)	9.5±1.5
8	Serum sodium (mmol/L)	141.7±8.8
9	Serum potassium (mmol/L)	4.7±0.7
10	Serum calcium (mg/dL)	4.1±0.6

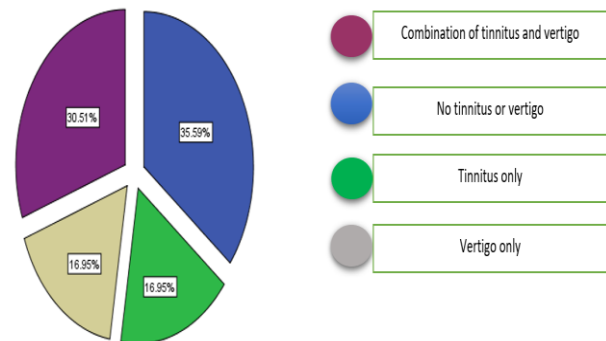


Figure [1]: distribution of symptoms among the patients

Onset of development of tinnitus and\or vertigo symptoms with regards to the start of hemodialysis was also reviewed as shown in table [2].

A significant correlation was found between the duration of hemodialysis and the onset of symptoms development in the involved patients (P-value = 0.047).

No other significant correlations found between the presence of tinnitus and/or vertigo with age, gender, blood urea level, serum creatinine level, serum sodium, serum potassium, serum calcium, comorbidity like HTN, DM and medications.

This is shown in table [3].

**TABLE [2]: TIME ONSET OF DEVELOPMENT OF TINNITUS AND/OR VERTIGO SYMPTOMS IN RELATION TO HEMODIALYSIS DURATION.**

	Onset of symptoms development	Frequency	Percentage	Cumulative percentage
1	No tinnitus \ vertigo from the start of hemodialysis	21	35.59%	35.59%
2	Tinnitus \ vertigo developed during the 1 <sup>st</sup> year of hemodialysis	19	32.21%	67.79%
3	Tinnitus \ vertigo developed during 1-5 years of hemodialysis	15	25.42%	93.22%
4	Tinnitus \ vertigo developed after 5 years of hemodialysis	4	6.78%	100%

**TABLE [3]: THE SIGNIFICANCE OF DIFFERENT VARIABLES TESTED IN THE STUDY**

	The tested variables	P-value
1	Patients age (mean)	0.883
2	Gender	0.647
3	Blood urea level	0.643
4	serum creatinine level	0.634
5	serum sodium	0.285
6	serum potassium	0.125
7	serum calcium	0.458
8	comorbidity like HTN, DM	0.448
9	medications	0.498

## Discussion

The effect of CKD and chronic hemodialysis on auditory system had been known since more than 80 years, as Alport had reported the presence of hereditary nephritis associated with sensorineural hearing loss and ocular abnormalities, which he describes as Alport's Syndrome in 1927<sup>13</sup>.

Since then, many studies had been conducted to explain the relationship between CKD, hemodialysis and auditory functions, those were concerned with the hearing and few studies explained their relation to the development of tinnitus and/or vertigo.

alterations in the peripheral and central nervous system, "uremic neuropathy," may be involved in auditory impairment associated with CKD said Albertazzi<sup>14</sup> and Bazzi<sup>15</sup>. Di Paolo *et al.*<sup>16</sup> reported a high incidence of nerve conduction dysfunction in patients with CKD. They found decreased conduction velocity in the sensory and motor units, with the sensory units being more compromised than the motor. Da Jung *et al.*<sup>25</sup> found CKD to be associated with vestibular dysfunction in the general population. Therefore, the participants with CKD may be closely monitored for vestibular dysfunction. Gaber *et al.*<sup>26</sup> found that both the auditory and vestibular pathways are affected in different stages of chronic kidney disease regardless of the disease stage.

This study found that 69.49% of the enrolled patients develop tinnitus, vertigo or both during their treatment with hemodialysis for their CKD. Only 30.51% didn't develop any history of tinnitus and/or vertigo during the study period. This finding was similar to the finding of Sun Kang *et al.*<sup>27</sup>, Gabr *et al.*<sup>26</sup> and which found 68.2% and 60% respectively had either tinnitus or vertigo. Neslihan *et al.*<sup>29</sup> found that 15.95% had develop tinnitus alone . While Maria Köping *et al.* [17,18] and Juliana *et al.*<sup>19</sup> found that 58.8%, 45.6% and 71.4% respectively did not develop any symptoms of tinnitus and/or vertigo (Juliana *et al.*<sup>19</sup> said only 20% had tinnitus, 8.6% had combination of tinnitus and light dizziness and no patient develop true vertigo. This might be attributed to the restricted number of patients taken by their study (35) and variable disease duration (from 1 month to 17 year).

In this study, significant positive relationship was found between the duration of hemodialysis and the occurrence of tinnitus and/or vertigo

symptoms among our patients (p value= 0.047). this was similar to the finding of Shih CP et al [20] (P value = 0.001), Peyvandi et al<sup>28</sup> and Da Jung et al<sup>25</sup> while Juliana et al<sup>19</sup>, Bazzi [15] and Neslihan et al<sup>29</sup> stated that the duration of dialysis treatment is not a risk factor for tinnitus and vertigo. Again, this might be attributed to the little number of patients enrolled in the study and more frequent home and hospital dialysis sessions.

In this study, we didn't find any significant correlations between the presence of tinnitus and/or vertigo with age, gender, blood urea level, serum creatinine level, serum sodium, serum potassium, serum calcium, comorbidity like HTN, DM and medications. This was similar to the finding of Agarwal *et al*<sup>10</sup>, Yassin et al<sup>21</sup> and Reddy *et al.*<sup>22</sup>. While, Bazzi<sup>15</sup> and Gatland<sup>23</sup> report that High blood urea and electrolyte disturbances, particularly sodium, have been suggested as possible factors that contribute to hearing system deterioration in CKD.

### Conclusion

Despite the limited number of patients enrolled, this study found that both tinnitus and/or vertigo is common in patients with CKD on hemodialysis (up to 69% in this study). The duration of hemodialysis has a significant adverse effect on both auditory and vestibular systems.

**Conflict of interest:** The authors declare no conflict of interest.

**Financial Support:** None declared.

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