

Hearing Loss in Chronic Kidney Disease: An Assessment of Multiple Aetiological Parameters

Mohammed Bello Fufore¹, Abdullahi Musa Kirfi², Abubakar Danjuma Salisu³, Thomas Musa Samdi⁴, Abdulhameed Bala Abubakar⁵, Jamila Lawal⁴

¹Department of ENT, Federal Medical Centre, Yola Nigeria

²Department of ENT, Abubakar Tafawa Balewa University Teaching Hospital, Bauchi Nigeria

³Department of ENT, Aminu Kano Teaching Hospital, Kano Nigeria

⁴Department of Clinical Services, National Ear Care Centre, Kaduna Nigeria

⁵Department of Internal Medicine, Barau Dikko Teaching Hospital, Kaduna Nigeria

*Corresponding author: Dr. Mohammed Bello Fufore, Department of ENT, Federal Medical Centre, Yola, PMB 2017, Adamawa State, Nigeria. E-mail: drbellofufore@yahoo.com

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Abstract

Background: Hearing loss in chronic kidney disease (CKD) is believed to be of multifactorial aetiology resulting from electrolytes imbalance, hypertension and diabetes.

Aim: This study aimed to correlate hearing thresholds of CKD patients with multiple parameters such as serum levels of creatinine, urea, sodium, chloride, potassium and bicarbonate, and packed cell volume, hypertension, diabetes and duration of CKD.

Methods: This was a prospective study of patients with chronic kidney disease (CKD). Ethical approval and informed consent were obtained before enrolment. Patients were recruited using convenience sampling technique. Using a health questionnaire, a brief ENT history was obtained and pure tone audiometry was carried out. Blood samples were collected prior to audiometric evaluation. Data collected was analysed using SPSS version 20.

Results: Sixty CKD patients were studied. The age range was 20-68 years with mean (SD) age of 43.2(13.4) years and 70.0% (42/60) were males. There was a positive correlation between hearing thresholds and systolic blood pressure ($r=0.2$, $p=0.04$) and diastolic blood pressure ($r=0.3$, $p<0.001$). Similarly, there was statistically significant correlation between hearing threshold and duration of CKD, packed cell volume, serum creatinine, sodium and bicarbonate. However, there was no statistically significant correlation between hearing threshold and serum urea, chloride and potassium.

Conclusion: This study found that longer duration of CKD, elevated systolic and diastolic blood pressure, elevated serum creatinine, low packed cell volume and low levels of serum sodium and bicarbonate are strong factors affecting hearing thresholds in patients with CKD.

Keywords: Chronic kidney disease; Electrolytes; Hearing loss; Hypertension

Introduction

There are numerous potential causes of chronic kidney disease in sub-Saharan Africa, making disease of the kidney particularly burdensome in the region. Chronic kidney disease can be caused by either communicable or non-communicable diseases; most common non-communicable disease causes of CKD include hypertension and diabetes while infectious glomerulonephritis, Human Immune-Deficiency Virus (HIV) infection, Leishmaniasis and Schistosomiasis are common communicable diseases that cause CKD [1,2]. These causes of CKD are very common in sub-Saharan Africa; for instance, HIV alone affects more than 22.0 million people in sub-Saharan Africa [2]. This makes the burden of CKD in the region overwhelmingly high [2].

Disease of the kidney simulates disease-associated loss of renal parenchyma making the kidney to develop a compensatory adaptation

by increasing blood flow and glomerular hyperfiltration that maintain function at increased levels per nephron, leading to hypertrophy of glomeruli and tubules [3]. As a consequence of these adaptations, kidneys structure and function deteriorate steadily, reaching an end-stage renal failure within months [3]. It has been found that hyperfiltration and hypertension of the glomeruli are the major contributing factors to the deterioration of CKD [4,5]. As peritubular vasculature underlies glomerular circulation, some mediators of glomerular inflammatory reaction frequently recorded in glomerular disease [4,5]. Any decrease in preglomerular or glomerular perfusion leads to decrease in peritubular blood flow, which, depending on the degree of

lesion is cochlear and to some extent, retro-cochlear [7]. However, lack of correlation between blood measures and hearing function hinders a detailed explanation of the mechanism causing hearing impairment in CKD [7]. Getland et al. [12] tried to explain that, on the basis that low tone SNHL is known to be a feature of endolymphatic hydrops and that hydrops is influenced by fluid balance (the glycerol dehydration test) and suggest that it is possible that endolymphatic hydrops may be part of the pathological process.

Some studies have shown that patients with long standing renal disease had higher chances of acquiring hearing impairment than the healthy controls even after excluding other risk factors such as hypertension, electrolyte abnormalities, diabetes and proteinuria [9,13]. However, there is paucity of literature on possible causes of hearing loss among adult patients with chronic kidney disease in our environment. This study aimed to correlate hearing thresholds of CKD patients with multiple parameters such as serum levels of creatinine, urea, sodium, chloride, potassium and bicarbonate, and packed cell volume, hypertension, diabetes and duration of CKD.

Participants and Methods

This was a prospective, hospital-based study of patients with chronic kidney disease in a tertiary hospital in Kaduna Nigeria. The study was carried out over a one year period (December, 2017 to November, 2018). Ethical approval was obtained from the hospital's Health Research Ethics Committee and Kaduna State Ministry of Health Ethics Committee (HREC Ref. No. 18-0004 and MOH/ADM/744/VOL.1/510). Informed consent was obtained from the patients.

Convenience sampling technique was used and sample size was calculated using Fisher's formula: $n = Z^2 pq / d^2$ where p=prevalence (3.6%) [14], q=p-1, Z=standard normal deviate, which is 1.96 at 95% confidence interval and d=degree of precision at 95% confidence interval. Thus: $n = (1.96)^2 \times 0.036 \times 0.964 / (0.05)^2 = 53$ plus 10% attrition ($53/100 \times 10 = 5.3$). The minimum sample size required for this study was 58; however, the figure was rounded to 60. Information on demography, history, examination and pure tone audiometry were carried out. This study recruited patients with chronic kidney disease (i.e. GFR=59 ml/min/1.73m² and below), regardless of whether they

pt- (h, s) 2, 7, 11, w, 8, (at) 6, (a) 1, 6, 5, 2, 1, 0, (s) 6, 1, 1, 0, 3, (t) 2, 6, 0, 8, 1, 2, 8, 1, 0, 6, 3, (e) 7, 5, 2, 7, 1, 3, 4, (e) 6, (h) 23, (y) 9, (e) 1, (r) 10, (t) 6, (e) 1, (n) 8, (s) 2, (i) 1, (o) 12, (n, di) 3, (ur) 5

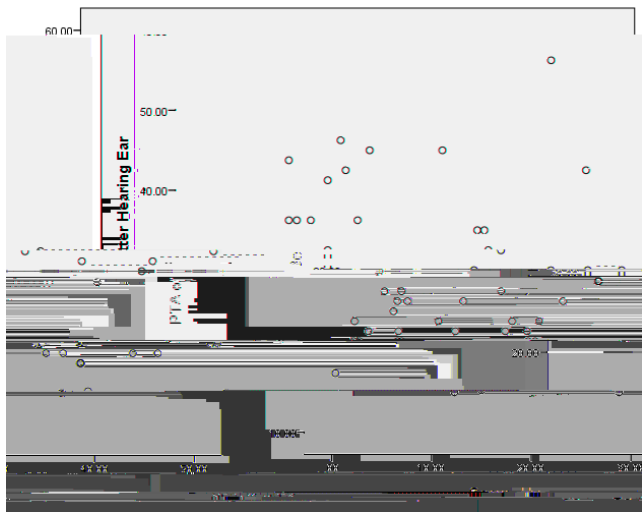
Figure one (68.3%, 41/60) of the patients were hypertensive.

Table 2 showed subjects with hypertension with or without hearing loss and those without hypertension with or without hearing loss.

Hearing Threshold

Normal (≤ 25dBHL)

AbHL)



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