

# Role of Arterial Hypertension and Diabetes Mellitus in Hemodialysis Patients with Sensorineural Hearing Loss

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## Abstract

Cases of chronic kidney disease (CKD) patients have increased significantly in the past few years. The main causes of chronic kidney disease are arterial hypertension and diabetes mellitus. **The aim** of this study is to identify arterial hypertension as one of the causes of neurosensorial hearing loss in patients under hemodialysis treatment. **Methodology:** This is a transversal study. The study population is 65 patients who are undergoing hemodialysis treatment at the American Hospital during the years 2015-2016. All collected data were calculated with SPSS program. Pearson R correlation,  $\chi^2$  test, and ANOVA test were used to analyze the sample. **Results:** In this study were included 65 patients where 27 are from 2015 and 38 from 2016. 32.3% of patients were female and 67.7% male. Age min 32 years and max 83 years, mean = 62.69 years, DEV Std  $\pm$  11.32 years. In our study 81.5% of patients had problems with sensorineural hearing loss of varying degrees, ranging from mild sensorineural hearing loss 15.4%, moderate sensorineural hearing loss 50.8%, severe sensorineural hearing loss 9.2% and profound sensorineural hearing loss 6.2%. **Conclusion:** Hemodialysis patients with arterial hypertension are more likely to have sensorineural hearing loss than hemodialysis patients without hypertension. The presence or absence of DM in patients undergoing dialysis does not affect hearing problems.

**Keywords:** hearing loss, hemodialysis, neurosensorial, arterial hypertension

## Introduction

Hearing impairment is very common in end stage renal disease patients. Sensorineural hearing loss is much more common in this group of patients than

conductive hearing loss.(1) Literature data report that 20–87% of these patients have sensorineural hearing loss.(2)

Possible mechanisms of sensorineural hearing loss (SNHL) associated with renal failure and hemodialysis are controversial. Possible mechanisms include a shared antigenicity between the kidney and the inner ear, osmotic alteration caused by hemodialysis, and the ototoxic effect of diuretics.(3)

Hearing loss is a common finding in patients with chronic renal failure, and deafness may occur during the course of hemodialysis. Uremia, ototoxins, axonal uremic neuropathy, anemia, and toxic degradation products from cellulose acetate dialyzer membranes are all possible etiologic factors. Anemia seems to be an important factor responsible for hearing disorders in patients with end-stage renal failure.(5) Arterial hypertension and Diabetes Mellitus are a probable cause of hearing impairment and treatment of anemia with erythropoietin administration seemed to be a possible preventing factor.(6)

In general, the frequency of hearing impairment in chronic kidney disease is connected with age and gender, and with associated disorders such as hypertension and diabetes mellitus. Hearing loss included hypertension and DM type-2, and hypercholesterolemia. Those factors affect the inner ear blood flow which directly causing impairment of oxygen and nutrient transport to the cochlear cells and indirectly on auditory nerve degeneration. Chronic arterial hypertension causes nephrosclerosis and the longer the hypertension the more severe glomerular injury and tubular atrophy that eventually leads to renal failure. Diabetes mellitus is a common systemic metabolic disease, associated with multiple macro- and microvascular complications, including thickening of the basal membrane of the stria vascularis capillaries on the lateral wall of the cochlea and other microvascular and neuropathic changes that could induce hearing loss. DM usually is associated with the development of bilateral hearing loss.(7)

With progression in the stage of chronic kidney disease, the hearing loss also increased indicating a possible link between the two. We also noted that the hearing loss increased with the increasing age.(8)

## **Methodology**

This is a transversal study. In this study were included 65 patients where 27 are from 2015 and 38 from 2016. 32.3% of patients were female and 67.7% male. Age min 32 years and max 83 years, mean = 62.69 years, DEV Std ± 11.32 years. The patients were in end stage of renal disease and were treated with hemodialysis, three times a week, for 4–4.5 hours, using capillary dialyzers made of cellulose diacetate or polysulphone, of the surface area of 1.5–2.2 m<sup>2</sup>, of predominantly low permeability, sterilized by g-irradiation or ethylene oxide, with common blood (250–300 mL/min) and dialysate flow (500 mL/min). Water for dialysis was prepared by reverse osmosis, and conductivity of below 10 µS/cm<sup>3</sup> was ensured. Exclusion criteria were history of

exposure to noise, Alport’s syndrome and those with conductive and/or mixed hearing loss confirmed by pure tone audiometry. The patients underwent examination by the otorhinolaryngologist which was familiar with the study. HT was measured for air and bone conductivity, for both ears, for frequencies of 125,250, 500, 1000, 2000,3000, 4000, 6000 and 8000 Hz.

We were based on World Health Organization Grades of Hearing impairment (WHO 2008) for the classification of hearing loss in hemodialysis patients.

Grade of impairment*	Corresponding audiometric ISO value**	Performance	Recommendations
0 - No impairment	25 dB or better (better ear)	No or very slight hearing problems. Able to hear whispers.	
1 - Slight impairment	26-40 dB (better ear)	Able to hear and repeat words spoken in normal voice at 1 metre.	Counselling. Hearing aids may be needed.
2 - Moderate impairment	41-60 dB (better ear)	Able to hear and repeat words spoken in raised voice at 1 metre.	Hearing aids usually recommended.
3 - Severe impairment	61-80 dB (better ear)	Able to hear some words when shouted into better ear.	Hearing aids needed. If no hearing aids available, lip-reading and signing should be taught.
4 - Profound impairment including deafness	81 dB or greater (better ear)	Unable to hear and understand even a shouted voice.	Hearing aids may help understanding words. Additional rehabilitation needed. Lip-reading and sometimes signing essential.

Table 1. World Health Organization Grades of Hearing impairment (WHO 2008)

## Result and Discussion

In this study

65 patients

31% of patients were female and 69% male.

31% were 56-65 years old, 24% were 66-75 years old, 21% were 45-55 years old and 17% were over 75 years old, STDEV  $\pm 16.0$ , min 32 years old, max 83 years old, mean = 62.3 years old.

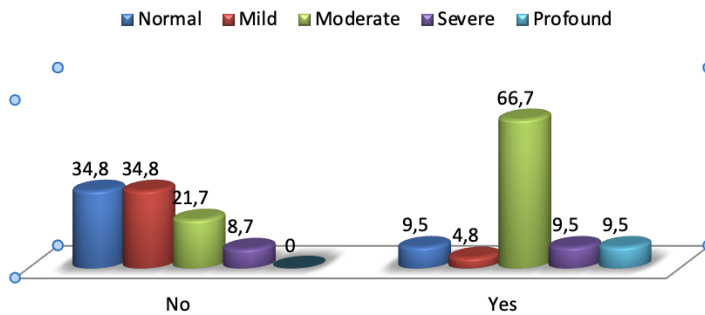
Arterial Hypertension	Number of patients	(%)
No	23	35.4
Yes	42	64.6
Total	65	100.0

Table 2. The distribution of patients based on arterial hypertension

From the applied tests there is statistically important connection between presence of arterial hypertension and hearing loss in hemodialysis patients. There is a positive connection between these two variables. Fig 1,  $\chi^2 = 21.952$ ,  $p < 0.001$ ; Pearson's  $R = 0.45$ ,  $p < 0.001$ . We can say patients in hemodialysis with arterial hypertension have higher possibility in having sensorineural hearing loss of different degrees.

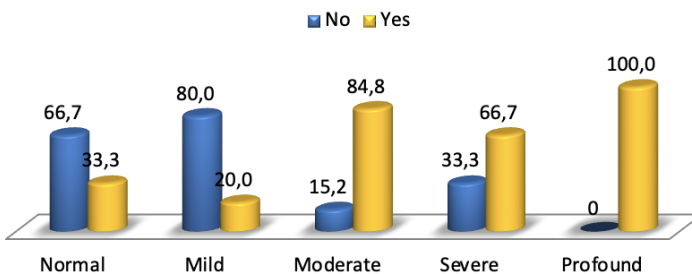
66.7% hypertensive patients in hemodialysis have moderate sensorineural hearing loss. From the patients with sensorineural hearing loss 84.8 patients have arterial hypertension (Graf 1). From the patients with severe sensorineural hearing loss 66.7% have arterial hypertension and all patients (100%) with profound sensorineural hearing loss have arterial hypertension (Graf 2).

### Distribution of hearing loss among patients with arterial hypertension (%)



Graphic 1: Distribution of hearing loss among hypertensive patients and normotensive patients

### Distribution of hearing loss among patients with arterial hypertension and Normotension (%)

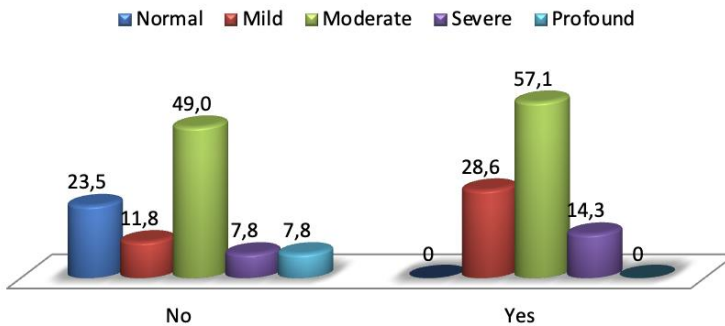


Graphic 2: Distribution of sensorineural hearing loss among patients with arterial hypertension and among patients with normal arterial tension

In our study 23.5 of patients without diabetes mellitus have normal hearing. 11.8% have mild sensorineural hearing loss, 49.0% have moderate sensorineural hearing loss, 7.8% have severe sensorineural hearing loss and 7.8 have profound sensorineural hearing loss.

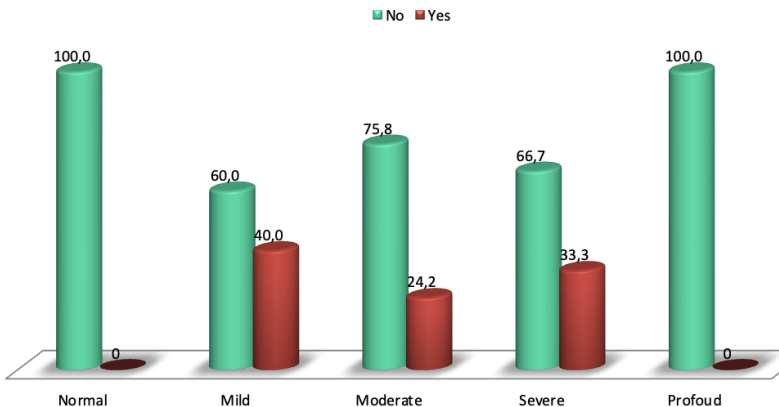
In the group of patients with diabetes mellitus there are no patients with normal hearing, 28.8% of patients have mild sensorineural hearing loss, 57.1% of patients have moderate sensorineural hearing loss, 14.3% of patients have severe sensorineural hearing loss and none has profound hearing loss.

### Distribution of sensorineural hearing loss among patients with diabete mellitus (%)



Graphic 3. Distribution of sensorineural hearing loss among patients with diabetes mellitus

### Distribution of sensorineural hearing loss in patients with and without Diabetes Mellitus(%)



#### Graphic 4. Distribution of sensorineural hearing in patients with and without diabetes mellitus

Based on the presence of diabetes mellitus in connection with problems with hearing there is none with diabetes mellitus and normal hearing, 40% of patients with diabetes have mild sensorineural hearing loss, 24.2% of patients have moderate sensorineural hearing loss, 33.3% have severe sensorineural hearing loss and none have profound sensorineural hearing loss. Based on these results the presence or not of diabetes mellitus in patients that are under hemodialysis treatment does not affect in the hearing of these patients. On the other side there is a positive connection statistically not significant between these two variables.

On the study of Lin et al. 2016 the results suggested an important connection between chronic kidney disease and the increased risk for sudden sensorineural hearing loss. Comorbidity of diabetes in the patients with kidney failure may be connected with increased risk for sudden sensorineural hearing loss especially in patients over 35 years old.(9)

In the study of Kohansall et al., 2020, arterial hypertension and diabetes mellites are risk factors connected in general in the hemodialysis patients with hearing loss without connection between comorbidity. And sensorineural hearing loss in the patients in hemodialysis.(10) This results about the role of diabetes mellites in hearing loss is in accordance with the results of our study. Meanwhile about the role of arterial hypertension in hearing loss of hemodialysis patients the results are not in accordance where in our study there is a positive connection statistically very significant between arterial hypertension and sensorineural hearing loss in hemodialysis patients.

In the study of Meena et al. 2012 also is supported the idea that arterial hypertension, damage of electrolyte balance and proteinuria are factors that have an important role in the worsening of sensorineural hearing loss in the patients in hemodialysis. Hearing loss is becoming more evident because the patients are living longer because of improvements of lifestyle in the patients with chronic kidney failure.

Also, in the study of Meena et al. 2012 results are in accordance with our study where arterial hypertension has a significant role in sensorineural hearing loss of hemodialysis patients. In this study all the patients with sensorineural hearing loss had systolic arterial hypertension over 160 mmHg.(11)

Based on the study of Purnami et al., hearing loss happened in the patients with arterial hypertension accompanied with diabetes mellitus type 2 (45%). Arterial hypertension causes changes in the structure of arterioles in the body, meanwhile diabetes mellitus causes microangiopathy in cochlea causing atrophy and reduction of hairy cells.(7)

## Conclusions

Sensorineural hearing loss is very common in hemodialysis patients. Hemodialysis patients with arterial hypertension are more likely to have sensorineural hearing loss than hemodialysis patients without hypertension. The presence or absence of DM in patients undergoing dialysis does not affect hearing problems.

## Acknowledgments

We would like to thank the patients for their collaboration.

## Conflict of Interest

The authors declare that they have no conflicts of interest.

## Author Contributions

Emirjona Vajushi followed these patients, drafted and revised this manuscript.

## Ethics Approval

An Ethics Approval Statement was not required for this report.

## Animal Rights

This article does not contain any studies with human or animal subjects performed by the any of the authors.

## Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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