

# HEARING LOSS IN HEMODIALYSIS PATIENTS

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## ABSTRACT

Inner ear cells are sensitive to some metabolic and hormonal disorders, but the relation between chronic renal failure (CRF), regular dialysis treatment (RDT) and sensorineural hearing loss (SNHL) is still a debatable field. The object of this paper was to verify the presence of SNHL in patients submitted to hemodialysis with different duration due to CRF and in those submitted to conservative treatments compared to normal controls. Sixteen chronic renal failure patients, thirty CRF patients with different duration of hemodialysis (14 cases less than 5 years, 9 cases between 5 to 10 years and 7 cases more than 10 years) and sixteen controls were studied according to clinical exam, pure tone audiometry and immittance audiometry. The hearing acuity in the CRF groups compared to the normal group showed impairment, mainly in 4 and 8 kHz. There was no statistically significant difference in hearing acuity between CRF patients on RDT and those with conservative management.

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**Keywords:** Sensorineural hearing loss, Chronic renal failure, Hemodialysis, Audiometry.

## INTRODUCTION

Cranial nerve involvement is common in renal failure patients.<sup>1</sup> The fact that the cochlea is susceptible to a wide variety of metabolic, hydroelectrolytic and hormonal imbalances is already widely known and these imbalances are systemic alterations usually found in patients who have compromised renal function. Therefore, it is expected that subjects with CRF develop cochlear dysfunction, clinically manifested by sensorineural hearing loss. Audiometric evidence of hearing loss is present in 15-75% of patients with chronic renal failure.<sup>2,3,4,5</sup> Regular dialysis treatment (RDT) does not seem to affect hearing loss for at least the first 5 years of treatment,<sup>2</sup> but few studies on hearing in RDT for longer than 10 years

have been published.

The objectives of the present study were: 1) to check the difference between minimal audible thresholds of normal subjects and patients with chronic renal failure; 2) observe the influence of hemodialysis on minimal audible thresholds; and 3) investigate if CRF and RDT may be considered the direct cause of sensorineural hearing loss.

## MATERIAL AND METHODS

The population we studied included subjects aged 15 to 60 years who had renal failure in the stages of failure (more than 40% to 50% of the renal function compromised). 16 patients with CRF who were on conservative treatment formed group A; 30 patients with CRF that have been hemodialysed with various duration (14 cases less than 5 years, 9 cases between 5 to 10 years and 7 cases more than 10 years) were group B. They had been on RDT for  $62.7 \pm 57$  months (range 4-240 months) and most of the patients had been treated by short dialysis

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## Hearing Loss in Hemodialysed Patients

schedule (4-5 h, three times weekly) with cuprophane membrane. 16 cases of the same age range and sex match who did not have any renal pathology or hearing complaints were the control group (group C).

The candidates for the study were referred by the nephrology department and the diagnosis of CRF was confirmed by the records in the medical files according to creatinine clearance values lower than 60 mL/min/1.73m<sup>2</sup> for more than 3 months. We excluded subjects who had a history of hearing loss previous to CRF, risk of occupational otological disease (exposure to noise or solvent), diabetes mellitus or other metabolic diseases, Alport's syndrome or family history of primary low hearing disability, external or middle ear pathologies at physical exam, air - bone gap in audiometry, tympanometric curves types B or C. We also excluded patients who had taken aminoglycosides or furosemide.

Audiologic exam was performed with a Madsen OB822 clinical audiometry apparatus and "AT22 Impedance audiometry" in a sound-proof chamber, and data were recorded in standardized protocols that comprised the analyzed material.

Acoustic immittance audiometry included static and dynamic complacency and acoustic stapedial reflex, and it was performed in all subjects. The exam was conducted in order to exclude middle ear pathologies of subclinical stages. Statistical analysis included the study of the differences in mean threshold values for each group using Student's t-test. The study was conducted with a confidence interval of 95%.

### RESULTS

The mean age of patients in group A was 41.64±10.45 years; in group B it was 43.21±14.1 years; and in control group C it was 44.94±11.72 years. These results did not present a statistically significant difference. Means for creatinine clearance were: 31.32±13.64, 14.2±11.58 and 117.94±13.23 respectively. 30 patients with CRF were under dialysis management with different duration (range 4-240 months): group I (14 cases) less than 5 years of RDT (22.6±13 months); group II (9 cases) 5-10 years of

RDT (81±20 months); group III (7 cases) more than 10 years of RDT (149 ±26 months). These intergroup patients were adjusted by age and sex and their means of auditory thresholds for all frequencies did not show statistically significant differences ( $p<0.05$ ) (Table I).

Means of auditory thresholds for 0.5, 1 and 2 kHz for group A, B and C were 5.32, 6.1 and 5.54 (in the right ear) and 6.25, 5.32 and 3.51 (in the left ear) respectively. These results did not show a statistically significant difference.

Mean of auditory threshold for 4 kHz was 19.37; 17.26 and 5.31 (in the right ear) and 17.19; 21.14 and 3.75 (in the left ear) for group A, B and C, respectively. We observed a statistically significant difference when comparing the control group (C) and the studied groups (A, B), but not between the studied groups.

The mean auditory thresholds in 8 kHz were 25.41; 30.62 and 8.12 (in the right ear) and 27.21; 31.28 and 9.35 (in the left ear) for group A, B and C, respectively. There was a statistically significant difference between control (C) and studied groups (A & B), but not between studied groups themselves (Figs. 1-6).

### DISCUSSION

Analyzing only low frequencies (0.5, 1 and 2 kHz), there was no SNHL in patients with CRF, regardless of being on hemodialysis or not, compared to the control group. However, in 4 and 8 kHz frequencies, the hearing level of renal patients was statistically different ( $p<0.05$ ) from the control group, showing mild sensorineural hearing loss. In these frequencies, the result was similar to that reported by Kligerman et al,<sup>6</sup> who found a large incidence of hearing loss in high frequencies. Gatland<sup>5</sup> and Nikolopoulos<sup>7</sup> obtained results that showed SNHL with significant clinical impact. Other authors<sup>8,9</sup> found 18 to 75% hearing loss in patients with CRF treated by RDT or renal transplantation. Wigand et al.<sup>10</sup> reported an average hearing loss of 20 dB in a group of uremic patients, particularly in high frequencies, suggesting cochlear involvement. Bazzi and Veturini<sup>3</sup> did not find evidence of any worsen-

**Table I.** Mean of auditory thresholds in hemodialysed patients with different duration.

Duration (Year)	0.5,1,2 kHz		4 kHz		8 kHz	
	Right	Left	Right	Left	Right	Left
< 5	4.79	4.41	16.79	17.86	27.86	26.92
> 5, < 10	4.71	4	16.67	18.33	29	28
> 10	5.78	5.14	18.33	21.13	31.42	34.3

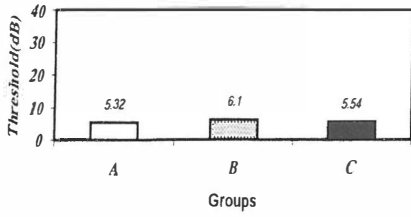


Fig. 1. Mean of auditory thresholds of 0.5, 1 and 2 kHz in the right ear.

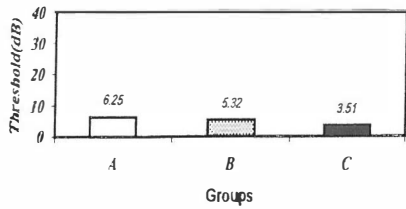


Fig. 2. Mean of auditory thresholds of 0.5, 1 and 2 kHz in the left ear.

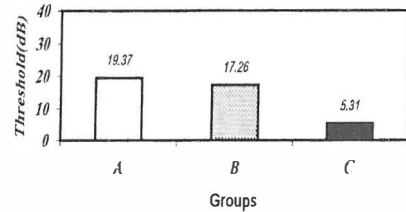


Fig. 3. Mean of auditory thresholds of 4 kHz in the right ear.

A: CRF patients with conservative management  
 B: CRF patients under haemodialysis  
 C: Controls

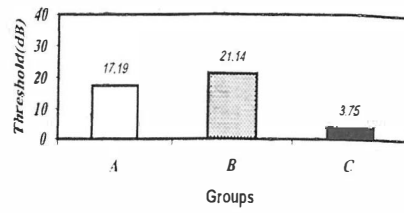


Fig. 4. Mean of auditory thresholds of 4 kHz in the left ear.

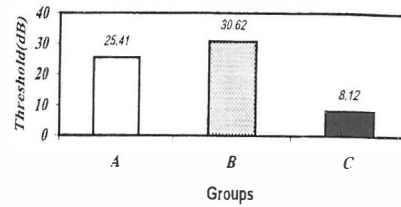


Fig. 5. Mean of auditory thresholds of 8 kHz in the right ear.

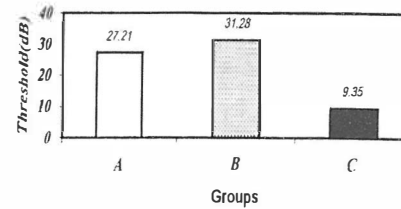


Fig. 6. Mean of auditory thresholds of 8 kHz in the left ear.

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ing of hearing after RDT protracted for 1-5 years. We didn't find any significant differences of SNHL frequency in the three groups with different duration of dialysis, and the percentage of various types of hypoacusia were also similar to that found by Bazzi et al.<sup>3</sup> (77%) and higher than that reported by Quick (about 18%)<sup>3,8</sup>; perhaps due to differences in mean age and duration of CRF & RDT. Moreover, the majority of the patients studied by Odu et al.<sup>11</sup> and Quick<sup>8</sup> had undergone renal transplantation that is well known to improve some aspects of nervous system involvement such as peripheral neuropathy. Therefore our study confirms that there is a high incidence of hypoacusia in RDT patients, even at the beginning of dialysis treatment.

The literature reports that about 80% of the cases of SNHL in patients with CRF would be due to cases that lead to this kind of loss, such as use of aminoglycosides, or occupational exposure to noise.<sup>12</sup> The remaining 20% would be directly caused by CRF. However, because of

its complex clinical condition, demanding the use of various drugs, with multiple etiologies and affecting especially the elderly, it is difficult to investigate its correlation with hearing acuity. This explains the controversy in the area. Harada et al. reported three cases of acute sensorineural hearing loss in hemodialysis patients.<sup>13</sup>

Based on the results, it is suggested that there is a direct relationship between CRF as the cause of SNHL, especially in high frequencies. Considering the absence of statistically significant differences between the group with CRF and hemodialysis and the group submitted to conservative treatment, we may state that hemodialysis is not directly related with hearing loss, a fact supported by other studies.

In fact, since hemodialysis corrects a large part of hydroelectric and metabolic disorders, it tends to reduce the risks of hearing loss, because it promotes stabilization and correction of metabolic alterations caused by chronic renal failure. Therefore, the correct treatment for CRF should be initiated as early as possible, preventing

## Hearing Loss in Hemodialysed Patients

body damage, including damage to the cochlea and auditory pathways.

### CONCLUSION

Minimal auditory thresholds were lower for patients with chronic renal failure, especially in high frequencies. Hemodialysis is not a causative factor for sensorineural hearing loss in CRF patients, but there is a relationship between CRF and SNHL in high frequencies.

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