

# SENSORINEURAL HEARING LOSS IN CHILDREN WITH END-STAGE RENAL DISEASE

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**Abstract-** One of the complications of end-stage renal disease (ESRD) is sensorineural hearing loss (SNHL). Despite large number of studies on adults ESRD patients, there are only a few reported surveys regarding SNHL in children. To determine the prevalence of SNHL in children with ESRD and its relationship with sex of patients, presence of hypertension, history of ototoxic drugs administration and duration of dialysis, we evaluated 30 children and adolescents suffering from ESRD who were under hemodialysis therapy with standard pure-tone audiometry. The ages of children were 5-17.5 years (mean 12 years). Patients with Alport's syndrome and other hereditary or congenital syndromes involving the ears were excluded from the study. SNHL was detected in 9 patients (30%); 3 children had unilateral and 6 had bilateral SNHL (15 ears). In all of these 15 ears SNHL was in high frequencies (4000-8000 Hz). In 10 ears (66%) also there was SNHL in middle frequencies and in 7 ears (46.6%) there was hearing loss in all frequencies (250-8000 Hz). The severity of SNHL was mild in 7, moderate in 9, severe in 13 and profound in 3 ears in at least one frequency. There was no significant relationship between SNHL and sex of patients, presence of hypertension, history of ototoxic drugs administration and duration of dialysis (*P* values were 0.8107, 0.3217, 0.69, 0.087, respectively). SNHL is common in children and adolescents with ESRD and must be considered in rehabilitation of these children; the etiology of this impairment is not clear.

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**Key words:** Sensorineural hearing loss, end-stage renal disease, chronic renal failure, children, ototoxic drugs

## INTRODUCTION

Children with end-stage renal disease (ESRD) suffer from many complications of ESRD such as growth failure, anemia, renal osteodystrophy, acidosis and neuropathy. One of the complications of ESRD is sensorineural hearing loss (SNHL).

In adult patients with ESRD, reported incidence of SNHL is about 20-87% which is much higher than the general population. In spite of the large number

of studies (over 200) on adults ESRD patients, there are only a few reported surveys regarding SNHL in children with ESRD (1-3).

We conducted the present study to determine the prevalence of SNHL in children with ESRD and its relationship with sex of patients, presence of hypertension, history of ototoxic drug administration and duration of dialysis .

## MATERIALS AND METHODS

All children with ESRD who were on regular hemodialysis in our department were selected for the study. Children who could not cooperate for audiometric examination because of low age or

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mental retardation or children with conductive or mixed hearing loss were excluded from the study. Also patients with Alport's syndrome or other hereditary syndromes involving the ears were excluded from the study.

All children were examined by an otorhinolaryngologist and the problems which could affect audiometric evaluation such as cerumen in auditory canal or otitis media were treated before audiometric evaluation; then a standard pure-tone audiometry was done by an expert audiometrist. For each child bone and air conduction for both ears were measured individually from 250 Hz up to 8000 Hz. Normal hearing was defined as hearing of intensities lower than 21 decibels (dB). Hearing loss was divided into four grades according to the classification of the Bureau International de Audio Phonology (4):

- 1) Mild hearing loss: hearing threshold between 21-40 dB.
- 2) Moderate hearing loss: hearing threshold between 41-70 dB.
- 3) Severe hearing loss: hearing threshold between 71-90 dB.
- 4) Profound hearing loss: hearing threshold above 90 dB.

Sound frequencies between 250-500 Hz were regarded as low frequencies, 1000-2000 Hz as middle frequencies and 4000-8000 Hz as high frequencies. Ototoxic drug usage was considered positive when the patient had history of more than one week use of ototoxic drugs such as aminoglycoside antibiotics, vancomycin or furosemide. Statistical analysis was performed using Chi square and Students' *t* test. Significance was defined as  $P < 0.05$ .

## RESULTS

Of 40 children with ESRD, 10 children were excluded by exclusion criteria from the study, so we described the result of study on 30 children. Mean age of these 30 patients (16 girls, 14 boys) was 12 years (range 5-17.5 years).

Of 30 children who entered the study, 9 (30%) had SNHL; 3 had unilateral SNHL and 6 had bilateral

SNHL. Considering number of ears, 15 out of 60 ears (25%) had SNHL.

Severity of hearing loss in different frequencies was not the same. In all the 9 patients (15 ears) SNHL was in high frequencies which was mild in 1, moderate in 5, severe in 6 and profound in 3 ears. In 5 patients (10 ears) there was also SNHL in middle frequencies, which was mild in 3, moderate in 3 and severe in 4 ears. In 4 patients (7 ears) in addition of SNHL in high and middle frequencies, there was also SNHL in low frequencies, which was mild in 3, moderate in 1 and severe in 3 ears. In 3 patients there was hearing loss in both ears and in all frequencies. In summary, in all the involved ears hearing loss was in high frequencies; also, 66% had hearing loss in middle frequencies in addition of high frequencies and 46% had hearing loss in all frequencies (High, middle and low) (Fig. 1).

Regarding severity of hearing loss in different frequencies, there were 7 instances of mild, 9 instances of moderate, 13 instances of severe and 3 instances of profound hearing loss (Fig. 2).

Of 16 girls, 4 had SNHL and of 14 boys, 5 had SNHL. There was no significant difference between two groups ( $P = 0.8107$ ).

Five out of 15 patients with history of ototoxic drug usage and 4 out of 15 patients without history of ototoxic drug usage had SNHL. There was no significant correlation between ototoxic drug usage and SNHL ( $P=0.69$ ).

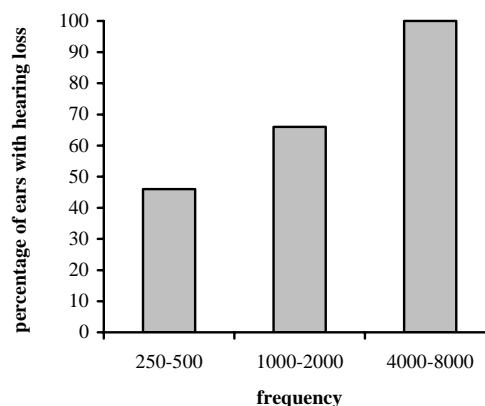
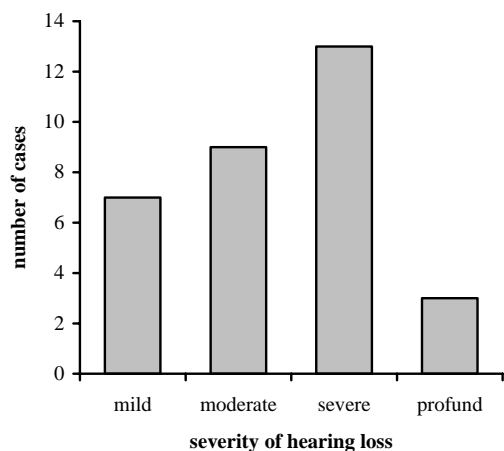


Fig. 1. Incidence of sensorineural hearing loss in different frequencies.



**Fig. 2.** Severity of hearing loss in at least one frequency in involved ears

Of 22 patients with hypertension, 5 had SNHL and of 8 patients with normal blood pressure, 4 had SNHL so there was no significant relationship between high blood pressure and SNHL ( $P = 0.3217$ ).

Patients were divided into two groups. In group 1 who had been on hemodialysis therapy for fewer than 24 months, 3 of 17 patients had SNHL and in group 2 who had been on hemodialysis for more than 24 months, 6 of 13 children had SNHL; so there was a weak relation between SNHL and duration of dialysis ( $P = 0.081$ ).

## DISCUSSION

Although estimates vary because of differences in criteria for defining hearing impairment and the testing methods used, approximately 1-2 newborns/1000 live births have moderate, severe or profound bilateral SNHL. An additional 1-2/1000 may have mild or unilateral impairments. By the age of 19, the prevalence doubles (5).

Hearing loss is common in patients with chronic renal failure. In adult patients reported incidence is about 20- 87% (3) which is much higher than the general population. There are only a few reports regarding incidence of hearing loss in children with chronic renal failure. Mancini *et al.* reported an incidence of 28% (3) and Nikolopoulos *et al.* found an

incidence of 30.4% (1). In our study it was 30%, so hearing loss is common in children with ESRD and since it may affect development of speech and language, social and emotional development, behavior, attention and academic achievement (6), it must be considered in rehabilitation of these children. Even unilateral hearing loss may impair school performance and lead to educational failure and behavior problems (7).

Hearing loss did not significantly correlate with gender of patients. In most studies hearing loss has been reported mainly in high frequencies and around 30% of the ears have been affected in the middle and low frequencies. In our study, all of affected ears had hearing loss in high frequencies, 66% had also hearing loss in middle frequencies and 46% had hearing loss in low frequencies.

In Nikolopoulos' study, 50% of patients had unilateral and 50% of patients had bilateral hearing loss. In our study bilateral involvement was more frequent than unilateral involvement.

Some of the children with ESRD and SNHL have used ototoxic drugs during their illness, but the role of ototoxic drugs in hearing loss of these patients is controversial. In Mancini work there was significant relationship between ototoxic drug usage and hearing loss, but in Nikolopoulos' study as ours there was no significant relationship between ototoxic drug usage and SNHL. It must be considered that retrospective studies are not suitable for finding a possible correlation between exposure to ototoxic drugs and SNHL.

There was no significant relationship between hypertension and SNHL in Nikolopoulos' study as ours. The effect of hemodialysis and its duration on SNHL is not clear; in most reported series no adverse effect on hearing have been reported (8-11). In our study also long term dialysis had not significant effect on hearing.

The cause of SNHL in ESRD is not clear. Some hypothesis such as similarity between antigens of kidney and cochlea or disturbances of water and electrolytes in uremia have been proposed to explain the SNHL, but it is possible that SNHL is a component of or of similar etiology as uremic neuropathy because there has been significant improvements after renal transplantation (12,13).

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