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Original Article

Value of Otoacoustic Emission in Monitoring Hearing Acuity in Chronic Renal Failure Patients

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ABSTRACT. To evaluate hearing acuity in chronic renal failure (CRF), we studied 48 patients of age less than 40 year as well as 15 years age and sex matched healthy subjects as controls by using the conventional pure-tone audiometry and evoked otoacoustic emission (TEOAE). Twenty-two of the study patients were treated conservatively and 26 patients by regular hemodialysis (HD). The dialyzed patients were further classified according to the duration of HD into 14 patients dialyzed for <1 year and 12 patients dialyzed for >1-year. TEOAE was applied only for patients proved to have normal pure tone thresholds. Sensorineural hearing loss was more in CRF patients treated conservatively than in those treated by dialysis (22.7%) and 15.3%, respectively), but the difference was not statistically significant. TEOAE was more sensitive than pure-tone audiometry in detecting sensorineural hearing loss in these patients (27.2% Vs 19.2%, respectively) and in the whole reproducibility of the test. However there were no significant statistical differences in the CRF subgroups and the controls. Furthermore, there was no correlation between TEOAE parameters and serum urea and creatinine. In conclusion, hearing acuity was found to be impaired in chronic renal failure patients whether treated conservatively or hemodialyzed. The transient evoked otoacoustic emission is more sensitive than the conventional pure-tone audiometry for evaluation of hearing acuity in this setting. Although the parameters of TEOAE seem to be better in hemodialyzed than in conservatively treated patients, but it did not reach statistical significance.

Key words: Hearing loss, Otoacoustic emission, Renal Failure.

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Introduction

Since Alport[1] reported the classic genetic syndrome linking hearing deficit and renal failure, there has been a steadily growing

Table 1. Demographic and laboratory data (mean ± SD) of different groups.

Parameters	Group I (n=15)	Group II (n=22)	Group III (n=26)
Age (years)	26.8 ± 6.3	29.6± 8.8	29.0± 7.7
Sex (m/y)	10/5	11/11	18/8
Serum urea (µmol/L)	4.4 ± 0.95	18.1± 4.75*	39.8 ± 7.8*
Serum creatinine (µmol/L)	104 ± 5	547 ± 20*	1100 ± 128*

Significant versus control group ($p<0.001$). Results are pre-dialysis figure.
Group I = control group. Group II = chronic renal failure on conservative treatment.
Group III = chronic renal failure on hemodialysis.

interest in the erring function of patients with kidney disease. Unfortunately, debate on such relationship continues either because of the possible effect of advanced age on the results in the studied patient[2] or treatment with hemodialysis on hearing threshold.[3] Some studies have reported either deterioration or improvement in hearing acuity in patients with renal failure irrespective of modality of therapy.[3]

We evaluate in this study the hearing acuity in chronic renal failure (CRF) patient sand the sensitivity of detecting methods of sensorineural hearing loss (SNHL) as well as the effect.

Subjects and Methods

Sixty-three subjects wee enrolled in this study in the renal dialysis unit of Assiut University Hospital, Egypt, during the period from March to December 1997. They were classified into 3 groups. Group I included 15 healthy subjects as a control group. Group II included 22 patients with CRF on conservative treatment. Group III included 26 patients with CRF on regular hemodialysis (HD) who were further classified according to the duration of HD into tow subgroups; IIIb included 12 for >1 year, Table 1.

Patients with history of otological diseases, ear trauma, noise exposure, diabetes mellitus or receiving ototoxic drugs were excluded. Only subjects with normal middle ear function as confirmed by tympanometric measurement were selected. We evaluated hearing loss by using the conventional pure-tone audiometry and evoked otoacoustic emission (TEOAE). TEOAE was applied only for patients proved to have normal pure tone threshold. TEOAEs were measured using computerized ILO88 analyzer (oto-dynamic Ltd.).[4] The schedule for patients on HD was 4-6 hours three times weekly using cuprophane dialyzers. In these patients evaluation of hearing acuity was performed before starting dialysis sessions.

Statistical Analysis

The laboratory values are reported as mean ± standard deviation. Student's (t) test, Spearman's rank correlation coefficient and Fisher's exact test are applied in comparing groups. P value is set at <0.05.

Results

Table 2 shows the patients with SNHL as detected by pure-tone audiometry and TEOAE. There were 22.7% and 15.3% of patients with hearing loss in group (II) and (III), respectively, detected by pure-tone audiometry. TEOAE detected more patients with hearing loss than pure-tone audiometry in these patients; 27.2% and 19.2% for both the response and the whole reproducibility

Table 2. Patients with sensorineural hearing loss (SNHL) utilizing pure-tone audiometry and transient evoked otoacoustic emission in the study groups.

	Pure-tone audiometry		Treatment evoked otoacoustic emission			
			Response		Whole reproducibility*	
Groups	**Right ear**	**Left ear**	**Right ear**	**Left ear**	**Right ear**	**Left ear**
Group I (n=15)	0	0	0	0	0	0
Group II (n=22)	5 (22.7%)	5 (22.5%)	6 (27.2%)	7 (31.8%)	6 (27.2%)	7 (31.8%)
Group III (n=26)	4 (15.3%)	4 (15.3%)	5 (19.2%)	6 (23.1%)	5 (19.2%)	6 (23.1%)
Group III a (n=14)	2 (14.2%)	2 (14.2%)	2 (14.2%)	2 (14.2%)	2 (14.2%)	2 (14.2%)
Group III b (n=12)	2 (16.6%)	2 (16.6%)	3 (25%)	4 (33.3%)	3 (25%)	4 (33.3%)

The number and percentage of patients included also those who had SNHL on pure-tone audiometry.
No significant differences on comparing between group II and III.

of the right ear versus 31.8% and 23.1% for the left ear, respectively. There is no statistically significant difference in the percentages of patients with SNHL on comparing between the two groups. There was no correlation between the levels of serum urea and creatinine and TEOAE parameter.

Discussion

Patients with CRF exhibit varying degrees of sensorineural hearing loss (SNHK).[5-10] The percentages of SNHL in our patients were 22.7% and 15.3% in the CRF and the hemodialyzed groups, respectively, as detected by pure-tone audiometry test. TEOAE raised the percentages of detection of SNHL indicating that it is a better technique than the conventional pure-tone audiometry for evaluation of hearing acuity.

The frequency of sensorineural hearing loss in our patients was comparable to that reported y some authors, [2,9,11-14] though higher percentage of SNHL was reported by others. [7,8,15-17] This discrepancy may be due to age of patients, duration of CRF and HD, or magnitude of hearing impairment. In our stud, we selected patients who were relatively young (aged less than 40 years) to avoid the possibility of effect of early presbycusis on the results. Also, we excluded any factor that could contribute to the genesis of hearing impairment other than CRF and/or HD. The difference between our results and those of others may also be related to the method of assessment of hearing acuity. We used TEOAE, which is a more sensitive technique than the conventional pure-tone audiometry used in other studies. [7,8,15-17] There was a marginal increment in response and whole reproducibility of group III compared with group II; however, this did not reach statistical significance.

Electrolyte disturbances, in particular sodium, water imbalance an elevated serum urea level, have all been implicated as potential factors that could participate in deteriorating hearing acuity in chronic renal failure. [7,14,17-19] Hemodialysis has a beneficial effect on these risk factors. However, some authors have negated the deleterious effects of some or all of these factors. [2,3,14]

The results of our study demonstrate marginally worse, though statistically not significant, effect of increased duration of dialysis on hearing acuity. Episodes of hypotension, hypoxia, prolonged alkalosis and accumulation of contaminants from dialysate water have been incriminated as having a direct deleterious effect on the organ of Corti in long-term HD patients.[20] The debate on the effect of regular HD on hearing acuity continues. Some have reported

that regular HD treatment does not seem to affect hearing acuity for at least the first five years of treatment. [21-24]However, others have reported an adverse effect of HD on hearing acuity. [2,9,12]

In conclusion, hearing acuity was found to be impaired in CRF patients whether conservatively treated or hemodialyzed. The transient evoked otoacoustic emission is more sensitive than the conventional pure-tone audiometry for evaluation of hearing acuity in this setting. Hemodialysis may not have a deleterious effect on hearing impairment in CRF patients.

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