ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN — POLONIA
VOL. LIV, 59 SECTIO D 1999

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Otoacoustic emission in dialysed children

Otoemisja akustyczna u dzieci dializowanych

Uraemia resulting from terminal renal insufficiency negatively influences body adaptive mechanisms leading to homeostasis disturbances. The cochlea is a very sensitive organ and the anatomical, physiological, pharmacological and pathological relationships make it similar to kidney (4). These relations are clearly confirmed when the disorders concern both the kidney and the inner ear (in the genetically determined Alport syndrome or in acquired disorders due to application of otonephrotoxic aminoglycoside antibiotics). It is known that the similarities in microanatomical structure of cochlea and renal glomerules are the basis for ear–renal dysfunction development (3).

Hearing disorders resulting from chronic renal insufficiency is frequently met, however their etiology is still controversial.

Grahe first described nephrogenic sensorineural hearing loss in 1924. He observed this kind of hearing loss in 82% of patients with chronic renal insufficiency. The following factors may cause the disease: not clearly determined uraemia toxins, disorders of water–electrolyte homeostasis, anaemia, blood pressure oscillations, embolus, ototoxicity drugs, immunity disorders (3).

Otoacoustic emission (OAE) is the objective and non–invasive test that allows for evaluations of outer hair cells function in the inner ear. Both the references and our studies confirmed sensorineural disturbances in dialysed children subjected to ABR tests.

The aim of the study was to evaluate the influence of chronic renal failure on the otoacoustic emission registration in children before and after haemodialysis (1, 2).

MATERIAL AND METHODS

Our investigations included 9 children (3 girls and 6 boys) aged 9–18, undergoing 4–5 hour haemodialyses, 3–4 times a week due to renal failure. The children were exposed to haemodialysis for 5–41 months.

Clinical tests included otoscopy, pure–tone and impedance audiometry. Otoacoustic emission consisting of SOAE, TOAE, DPOAE was performed before and after haemodialyses. These tests were carried out in a quiet room with application of ILO 88 DP of "Otodynamic" connected with computer. The tests were performed using 1–channel sound for SOAE registration and 2–channel sound for TOAE and DPOAE registration. In TOAE tests, non–linear click stimulus lasting for 80 μs and intensity 84 dB SPL in outer ear canal was used. The intensity was measured from 500–5000 Hz, for 20 ms after stimulus. The stimulus was considered to exist when its intensity was at least 3 dB higher than the noise threshold. In DPOAE test there were used 2 pure tones of stimulating intensity 70 dB SPL with the proportion f2/f1=1.22.

The following parameters were analysed: urea, uric acid, creatinine, Na, K, Ca, P04, HCO_3, blood cell count, fluid overload of body weight and blood pressure measurements.

RESULTS

The otoscopic tests in all of the children indicated the normal tympanic membrane. In 4 children sensorineural hearing loss on high frequencies in pure tone audiometry was confirmed.

Tympanogram type "A" with stapedial reflex connected with hearing level was present in all of the children's ears. In 5 children audiograms were correct and the tympanometric tests were correct as well.

The analysis of OAE parameters proved the presence of SOAE in 5 ears (in frequency range 1400–4500 Hz) both before and after haemodialysis. TOAE was not present in all of the children with hearing loss, but it was present in children with normal hearing (with frequency range 500–4500 Hz), but it had low amplitude. DPOAE responses were performed on the whole frequency band from 800––6000 Hz, so it allowed for evaluations of high frequencies. In the studied group there was observed the depression of DPOAE curve for 4000 or 6000 Hz.

No differences in otoacoustic emission before and after haemodialysis were observed. The influence of evaluated biochemical parameters on the OAE was not noticed, either. However, the relationship between hearing loss and blood pressure oscillations was confirmed (Table 1).

DISCUSSION

Our results are complying with Samir's studies, which did not confirm any correlation between OAE and biochemical parameters of blood, frequency of dialyses and the disease duration. (4). Ozturan states that haemodialysis has not any negative influence on the cochlea in spite of frequent changes of blood osmolarity (3). Marton and Gethand noticed lower values of OAE in frequencies above 2000 Hz. Bergstrom confirmed the same results in 40–50% of the dialysed children (3, 4).

Tab. 1. Biochemical parameters before and after dialysis

	Before dialysis		After dialysis	
	Range	Median	Range	Median
Urea (mg%)	106.7 – 247.6	148.4	20.2 – 86.2	42.6
Creatinine (mg%)	7.6 – 14.6	10.0	2.1 – 6.1	4.15
Uric acid (mg%)	4.1 – 7.6	5.78	0.4 – 3.0	1.5
Na^+ (mmol/l)	135.1 – 147.0	139.3	131.0 – 140.0	136.3
K^+ (mmol/l)	4.54 – 5.81	5.81	2.3 – 2.97	3.27
Ca^{++} (mmol/l)	1.55 – 2.55	2.44	2.21 – 2.97	2.41
PO_4^- (mmol/l)	1.55 – 2.55	2.16	0.97 – 1.33	1.12
HCO_3 (mmol/l)	14.5 – 21.0	19.56	17.5 – 27.3	24.24
Blood pressure (mm Hg)	83–140/46–89	110/70	58–152/33–91	101/61
Fluid overload (%)	2.0 – 11.0	6.88	0.0 – 3.0	0.88

In our study we always noticed the presence of depression on the higher frequencies. In the available references there is a compatibility of blood pressure oscillation with cochlea failure.

Due to small number of children, our study results allow us for cautious conclusions:

1. The differences of TOAE and DPOAE responses before and after haemodialysis were not observed.

2. In children with blood pressure oscillation the sensorineural hearing loss was observed.

3. There is no correlation between OAE results and biochemical blood parameters of uraemia.

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Otrz.: 1999.11.30

STRESZCZENIE

Przeprowadzone badania ABR u dzieci poddanych hemodializie wykazały wydłużenie przewodnictwa wewnątrzpniowego.

Celem niniejszej pracy była ocena wydolności ucha wewnętrznego w badaniu OAE. Analizie poddano 9 dzieci w wieku 6–18 lat, u których badania otoemisji akustycznej wykonano przed i po hemodializie.

Wyniki uzyskanych badań audiologicznych poddano korelacji, uwzględniając wybrane parametry biochemiczne.