VISUAL EVOKED POTENTIALS IN HEMODIALYSIS PATIENTS

Aytül Mutlu* / Münevver Çelik* / Fatma Karakullukçu / Hulki Forta***

* *M.D., Department of Neurology, Şişli Etfal Hospital, İstanbul, Turkey*
** *M.D., Department of Internal Medicine, Samatya Social Security Hospital, İstanbul, Turkey*

ABSTRACT

Objective: In this study, the subclinical involvement in visual pathways were investigated by means of pattern reversal visual evoked potentials (PVEPs) in chronic hemodialysis (HD) patients and the short-term effects of HD on PVEPs were evaluated.

Methods: PVEPs were recorded in 20 healthy subjects and in 18 patients who had no neurological and/or ophthalmological involvement on clinical examination. In patient group PVEPs were performed 2 hours and 26 hours after two sets of HD performed 4 months apart. Urea, creatinine and electrolytes were measured immediately before each PVEP examination. Pathological tresholds for individual P100 values were set at 3SD above the control means for both absolute latencies and interocular latency differences.

Results: Abnormalities regarding the P100 latencies could be detected in 23.5% of the patients. When compared the group mean values of patients with normal PVEPs, P100 latencies did not reveal any significant change between two tests in each admission. P100 amplitude was significantly higher in 2nd hour examination than in 26th hour examination only at second admission. There was no relationship between amplitudes and biochemical measurements. P100 latencies showed a significant correlation with urea measurements in one occasion and with creatinine in another occasion.

Conclusion: Standard PVEP examination can be beneficial in detecting subclinical abnormalities in HD patients. HD could have short-term effects on P100 amplitudes though this effect could not be established consistently and did not correlate with biochemical parameters.

Key Words: Hemodialysis, Visual evoked potentials

INTRODUCTION

Several electrophysiological methods have been used in hemodialysis (HD) patients to quantify the severity of central and peripheral nervous system complications, especially in the subclinical stage (1-3). Evoked potential measurements are used for this purpose (4,5).

Visual disturbances were frequently found in hemodialysis patients (6). It may result from the primary condition causing the renal failure, the uremic state itself, toxicity of concurrent medications, complications of dialysis or other intercurrent illnesses. Some authors reported immediate changes in visual evoked potentials (VEPs) with dialysis and others did not confirm it (3,7,8). The presence of a correlation between VEPs and biochemical determinants have been previously investigated (9,10).

The aim of our study was to assess the presence of subclinical involvement of the optic nerve in HD patients and investigate the short-term effects of HD on pattern reversal visual evoked potentials (PVEPs).

MATERIALS AND METHODS

Subjects

PVEPs were studied in 20 healthy subjects and 18 patients with chronic renal insufficiency not secondary to systemic disease such as diabetes. The control group consisted of 11 women and 9 men of a total of 20 healthy individuals aged between 21 and 61 years (mean 33.8). The patient group consisted of 10 men, 8 women aged 19-70 (mean 46.2) and were on HD for 4-132 months during their first admission for PVEP examination. Neurological and ophthalmological examinations were performed in all of them. Patients with symptoms and/or signs of neurological and/or ophthalmological involvement and with a visual acuity below 8/10 were excluded.

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PVEP examinations were recorded in each patient 2 hours and 26 hours after HD at first admission and were repeated four months later (second admission) again 2 hours and 26 hours after HD. PVEPs could be performed in one patient only during his first admission since he died thereafter. Thus, a total of 70 PVEPs were obtained. Abnormal P100 values obtained in at least one of the four examinations for each patient were evaluated in favour of subclinical involvement of the optic nerve. The short-term effect of hemodialysis on PVEP was investigated in patients with normal P100 values in all four examinations by comparing the mean P100 values obtained 2 and 26 hours after hemodialysis at each admission. Serum creatinine, urea and electrolytes were measured immediately before each test. Any correlation was searched for between biochemical measurements and subsequent P100 values obtained in each examination.

PVEPs

In control subjects and patients, PVEP examinations were carried out in a dark and quiet room in the same conditions with the same equipment. The examined subject were comfortably seated in an armchair. PVEPs were performed with a Medelec Sapphire EMG-EP machine and with a black and white checkerboard pattern-reversal stimulator reversing with a rate of 2Hz. The individual check size subtended an angle of 72 minutes. A small fixation point was provided at the centre of the screen. Full-field and half-field stimulations were used. Recordings were made monocularly. The montage for recording consisted of a transverse chain of three active surface electrodes (O1, Oz, O2) placed 5 cm above the inion and 5 cm apart on either side of the midline electrode. These were all referred to the vertex electrode (Cz). The ground electrode was placed on the forehead. The responses were recorded using a bandpass of 1 Hz-100Hz, an analysis time of 300 ms and a sensitivity of 20 μV. One hundred and twenty eight responses were averaged and the trial was repeated at least once to ensure the reproducibility of the results. The responses recorded from Oz were evaluated for full-field stimulation and those from O1 or O2 for ipsilateral half-field stimulation. The latency of the main positive peak P100 and the peak-to-peak amplitudes N75-P100 and P100-N135 were measured. Absolute latency in each eye, interocular latency difference and N75-P100 amplitude ratio of the two eyes were evaluated. P100-N135 amplitude was taken into consideration when N75 peak was absent.

Pathological thresholds were set at 3 SD above the control means for both absolute latencies (mean±SD:99,08ms±5.12; upper limit of normal value:114.5 ms) and interocular latency differences(mean±SD:1.6ms±1.07; upper limit of normal value: 5ms). The amplitudes were regarded as abnormal only if the interocular amplitude ratio was below 3SD of the control mean interocular amplitude ratio (mean±SD:88.4%±10.6; lower limit of normal value:below 55%) (11).

Statistical tests

In patients with normal PVEPs at full-field stimulation, paired data derived from Oz 2 hours and 26 hours after HD were analysed using paired t-test for latencies and Wilcoxon matched-paired-signed test for amplitudes. A correlational analysis was used to compare the mean P100 latency and amplitude obtained from the two eyes of each patient with the biochemical measurements.

RESULTS

Full-field PVEPs revealed abnormalities in 3 patients at first admission, and in another case at second admission (Table I). Patient 14 had prolonged interocular latency difference in all four examinations. Patient 18 had prolonged P100 latencies 2 hours after HD at first admission. She had normal absolute P100 latencies but prolonged interocular latency difference 26 hours after HD. At second admission, she developed prolonged P100 latencies in both eyes. Patient 5 had normal PVEPs 2 hours after HD at first admission. She again had normal P100 absolute latencies, but prolonged interocular latency difference 26 hours after HD. At second admission, she had prolonged P100 latency in the left eye. Patient 16 developed prolonged interocular latency difference at second admission, while she had normal examinations at first admission. Thus, the highest abnormality ratio raised to 23.5% at the end of the 4 examinations for each patient.

The amplitude ratios and half-field stimulations did not reveal any additional abnormalities.

Comparison of group mean P100 values of patients with normal PVEPs

Mean P100 latency and amplitude values of HD patients with normal PVEPs are shown in Table II. P100 latency values did not reveal any significant change between two tests in each admission (Table II). The amplitude values at second admission were significantly higher 2 hours after HD than those obtained 26 hours after HD (Table II). Biochemical values are summarised in Table III. A correlational analysis revealed significant correletion between P100 latencies and creatinine 2 hours after HD and between P100 latencies and urea 26 hours after HD at second admission (Table IV).

Table I. Hemodialysis patients with abnormal VEPs

patients	duration of HD	P100 latencies (ms)			
		first admission		second admission (4 months later)	
		2h. after HD	26h. after HD	2h. after HD	26h. after HD
14 L	84 months	85.5	88.2	87	90.3
R		92.7	94.5	96.9	96.9
ILD		7.2	6.3	9.9	6.6
18 L	12 months	115	103	125	120
R		120	112	119	118
ILD		5	9	6	2
5 L	60 months	112	113	135	135
R		110	104	104	110
ILD		2	9	31	25
16 L	12 months	106	110	103	102
R		110	110	114	114
ILD		4	0	11	12

HD: Hemodialysis; h: hours; L: Left; R: Right; ILD: Interocular latency difference

Table II. Comparison of P100 latencies and amplitudes 2 and 26 hours after hemodialysis at first and second admission of individuals with normal PVEP's

group		cases	optic nerves stimulated	mean±SD	p
latencies					
first	2h after HD	14	28	101.17±8.22	0.897
admission	26h after HD	14	28	101.08±7.54	
second	2h after HD	13	26	101.89±7.01	0.064
admission	26h after HD	13	26	100.85±7.58	
amplitudes					
first	2h after HD	14	28	10.08±5.15	0.718
admission	26h after HD	14	28	9.55±4.09	
second	2h. after HD	13	26	10.38±4.39	0.011*
admission	26h after HD	13	26	8.75±3.20	

h: hours; HD: Hemodialysis; *: statistically significant difference

Table III. Mean values of biochemical parameters obtained before each test

group		urea (mmol/l)	creatinine (mmol/l)	sodium (mmol/l)	potassium (mmol/l)
first admission	2h after HD	14.53	599.0	139.7	4.19
	26h after HD	20.64	779.0	139.1	5.63
second	2h after HD	13.75	594.2	139.9	4.58
admission	26h after HD	19.90	760.0	138.7	5.37

h: hours; HD: Hemodialysis

Table IV. Correlation between electrophysiological and biochemical values

group		latencies				amplitudes			
		Na	K	urea	creat.	Na	K	urea	creat.
1. admission	r	-0.19	-0.18	-0.02	-0.30	-0.29	0.20	-0.23	-0.12
2h after HD	n	18	18	18	18	18	18	18	18
	p	0.45	0.48	0.93	0.21	0.91	0.42	0.36	0.64
1. admission	r	-0.29	0.11	-0.13	-0.37	-0.24	-0.22	0.12	-0.39
26h after HD	n	18	18	18	18	18	18	18	18
	p	0.23	0.66	0.59	0.13	0.34	0.37	0.64	0.11
2. admission	r	0.16	0.31	-0.35	-0.50	0.12	0.45	-0.06	0.24
2h after HD	n	17	17	17	17	17	17	17	17
	p	0.55	0.22	0.17	0.04*	0.64	0.07	0.82	0.35
2. admission	r	0.33	-0.04	-0.50	-0.34	-0.11	-0.01	-0.20	-0.40
26h after HD	n	17	17	17	17	17	17	17	17
	p	0.19	0.86	0.04*	0.19	0.69	0.98	0.43	0.11

Na: sodium; K: potassium; creat: creatinine; h: hours; HD: Hemodialysis; *: statistically significant relationship

DISCUSSION

In the present study, the highest PVEP abnormality was detected at second admission, in 4 of 17 patients (23.5%). Pagani et al. obtained abnormal VEPs in 41.7% of the eyes tested (12). Rossini et al. recorded PVEPs in different spatial frequencies in 32 non-dialysed and 11 dialysed patients and obtained abnormal PVEPs in 37.5% and 54.5%, respectively (10). They emphasized that the response was mainly abnormal when using checks covering 7.5' and 15' of the visual angle. The relatively low percentage of abnormalities obtained in our study reflects subclinical involvement only in HD patients when examined with standard methods. Regarding the P100 latencies 2 hours and 26 hours after HD, a short-term effect of HD could not be detected in our study. On the other hand, the amplitudes were found to be significantly higher 2 hours after HD compared to those 26 hours after HD at second admission, but not at first admission. In their study with 6 patients, Lewis et al. stressed the point that with flash stimulus evoked potential latency decreased during the first 24 hour following dialysis and then increased until next dialysis (8). They found a tendency for the highest amplitudes to be present 1 hour after dialysis (8). On the other hand, Lowitzsch et al. found that the latencies, shapes and amplitudes of PVEPs were within the normal range and that they did not change systematically when tested 3 times in each patient 1 hour before and 2 hours after HD (3). The immediate effect of dialysis on VEPs appeared only in 2 cases out of 9 in Kuba's study (7). The acute changes caused by dialysis seemed to be more evident in children than in adults in Ducati's study (13). According to our study, short term effect of HD on amplitudes was inconsistent although it was statistically on a significant level in one of the admissions. Our study revealed significant correlation between serum creatinine, urea and P100 latency measurements on two occasions whereas there was no correlation between P100 amplitudes and biochemical measurements. Many authors assess the validity of VEPs in uremic patients by looking for correlations between P100 values and biochemical parameters. Although some authors reported a correlation between them (10,14), others did not confirm this (7,8,15). Lewis emphasized that relatively large numbers of patients are necessary to establish this relationship in a statistically significant way (8).

In conclusion, standard VEP examination can be beneficial in detecting subclinical abnormalities in HD patients. HD could have short-term effects on P100 amplitudes though this effect could not be established systematically and did not correlate with biochemical parameters.

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