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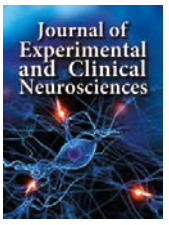

Research Article

Comparison of Visual Evoked Potentials in Patients Undergoing Peritoneal Dialysis and Hemodialysis and its Association with Blood Biochemical Profile

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Abstract

Purpose: Cranial nerve is one of the optic nerves to be influenced by uremia. The symptoms can be diagnosed by Visual Evoked Potential (VEP) tests. The present study was designed to evaluate the effect of peritoneal dialysis and hemodialysis upon VEP results and assess the association of VEP results with the results of blood biochemical tests and dialysis duration.

Methods: VEP was assessed in 30 patients undergoing peritoneal dialysis, 29 patients undergoing hemodialysis and 40 healthy controls. Moreover, blood biochemical tests involving urea, creartinine, potassium, cholesterol, triglyceride, hemoglobin, hematocrit, albumin, parathormon (PTH) were carried out in all subjects.

Results: In comparison with the control group, there were exclusively significant prolonged N140 and P100 latencies in hemodialysis and peritoneal dialysis group; notwithstanding non-significant P100 amplitude and N75 latency. Durations of renal failure and dialysis were not associated with VEP parameters. Of the blood biochemical parameters, P100 latency in the right eyes and N140 latency in the left eyes were exclusively associated with serum potassium.

Conclusion: The present study suggests that optic pathway can be affected by chronic renal failure; even so, there would be no marked difference in optic pathway involvement between patients undergoing hemodialysis and peritoneal dialysis. This may indicate the equal effects of hemodialysis and peritoneal dialysis upon subclinical damages of optic pathway.

Introduction

Chronic kidney disease (CKD) refers to an umbrella term for heterogeneous diseases influencing renal structure and function. The 2002 guidelines for definition and classification of this disease represented an important shift towards its recognition as a worldwide public health problem that should be managed in its early stages by general internists [1]. CKD arises from pathologically diminished number of nephrons. In spite of different causes of CKD, the final CKD sign is uremia, which affects the whole body. CKD is also said to be associated with cognitive impairment [2]. Uremia, a cluster of poisons in the body, exerts adverse impacts upon central, peripheral and autonomic nervous systems [3-6]. Cranial nerve is one of the optic nerves to be influenced by uremia. The symptoms may be either clinical, which present with visual failures, or subclinical [3-5], which can be diagnosed by specialized tests such as Electroencephalography (EEG) and Visual Evoked Potential (VEP) tests [7]. In spite of the fact that EEG can identify the CNS dysfunction in uremia, VEP assessment is more sensitive. VEP test is capable of assessing subclinical nervous involvements [8,9]. VEPs refer to electrical responses (amplitudes and latencies) of the brain to visual stimulation, and are recorded by electrodes attached to the head. The most crucial parameter amongst VEPs is P100 latency which is 100 ms in healthy people. In order to control uremic signs in end stage kidney disease, patients undergo peritoneal dialysis, hemodialysis and renal transplantation. These approaches may alleviate uremic signs; however, the effectiveness differs from one individual to another. The best effectiveness lies in renal transplantation, although impossible for all CKD patients.

Indeed, many patients, under specific circumstances, undergo peritoneal dialysis or hemodialysis. To date, only a few studies have assessed the effect of peritoneal dialysis and hemodialysis upon nerve in uremic patients; and thus, little is known about the involvement of nerves in this regard; Furthermore, these studies suffer from limited sample sizes. In the present study, we attempted to obviate the aforesaid drawback in order to achieve comprehensive and reliable results. Therefore, we aimed to evaluate the effect of peritoneal dialysis and hemodialysis upon VEP results and assess the association of VEP results with the results of blood biochemical tests and dialysis duration. In the present study, we specifically compare VEP results in patients undergoing peritoneal dialysis and hemodialysis and assess the association of VEP results with biochemical variables including for instance, urea, creartinine, potassium, cholesterol, triglyceride, hemoglobin, hematocrit, albumin, parathormon (PTH) dialysis duration and renal failure. It was hypothesized that VEP results did not differ in peritoneal dialysis and hemodialysis and no association existed between VEP results and biochemical variables, dialysis duration and renal failure.

Methods

In order to compare VEPs in patients undergoing peritoneal dialysis and hemodialysis, a descriptive-comparative design was selected. 32 patients undergoing peritoneal dialysis were selected, although two patients were dispensed with farther on in the study. 29 patients were subjected to hemodialysis. Therefore, we ultimately studied 30 patients with peritoneal dialysis and 29 patients with hemodialysis. The inclusion criteria of ageing between 20 and 60 were applied in the present study. The patients' selection continued from May, 2012 to July, 2012 at the dialysis ward of Emam Reza hospital, Tabriz University of Medical Sciences. Patients with visual problems encompassing retinal lesions, cataract, severe refractive eye problems, diabetes history and multiple sclerosis were excluded from the study. The selected cases were afterwards referred to Electrodiagnostic Ward & Neurosciences Research Center, Emam Reza hospital, Tabriz University of Medical Sciences for VEP assessment. Moreover, forty healthy controls without the history of renal failure and neurologic and visual problems were selected from the hospital. Demographic details of the cases and controls including age, gender, duration of renal failure, cause of renal failure, previous hemodialysis history, duration of peritoneal dialysis and high blood pressure history were recorded. In addition, blood biochemical tests involving urea, creartinine, potassium, cholesterol, triglyceride, hemoglobin, hematocrit, albumin, and parathormon (PTH) were carried out. VEP was assessed using Toennies Neuroscan R Plus. On this account, active, reference and earth electrodes were attached to the skin in occipital, vertex and frontal positions, respectively. Sweep speed for the apparatus was 50 ms and filter adjustments for low and high frequencies were 1 and 100 Hz, respectively. The contrast was 50 % and average number of 200 waves was recorded for each eye. A reversal pattern was used for the VEP tests. All the VEP tests were carried out in the morning in case daytime exerted an impact upon VEP. The assessed VEP parameters included N75 latency, N100 latency, N140 latency, P100 amplitude and N140amplitude. Finally, data were analyzed by means of SPSS statistical package (version 16). More specifically, T-test was applied for analyzing the means, as well as Pearson test for association assessment between variables. A P-value of 0.05 was considered statistically significant.

Results

Demographic findings

In the group undergoing peritoneal dialysis, 32 patients were initially selected; however, two patients did not have the tendency to pursue the study and were therefore dispensed with. Thirty patients with peritoneal dialysis were finally studied. This group included 12 male cases (40 %) and 18 female cases (80 %). The youngest case was 24 years old, the oldest one 59. The ageing range was 27 to 59 years for females with a mean of 45±10.06; the males ranged from 24 to 56 years old with a mean of 43.83±11.79. In these cases, there was a mean of 90.78±86.42 months for the duration of renal failure that ranged from 14.5 to 328.25 months. In females, there was a mean of 92.48±86.96 months for the duration of renal failure that ranged from 14.5 to 290.07 months. In males, however, there was a mean of 88.22±95.07 months for the duration of renal failure that ranged from 16.75 to 328.25 months.

In the group undergoing hemodialysis, 29 patients were selected who finished the tests. This group included 15 male cases (51.7 %) and 18 female cases (48.3 %). Their age ranged from 20 to 60 with a mean of 39.93±13.54. The aging range for females was 20 to 60 with a mean of 33.14±15.20; the males ranged from 31 to 57 years old with a mean of 42.27±7.95. In these cases, there was a mean of 35.23±23.20 months for the duration of renal failure that ranged from 9 to 90 months. In females, there was a mean of 38.28±23.08 months for the duration of renal failure that ranged from 12 to 86 months. In males, however, there was a mean of 31.93±23.68 months for the duration of renal failure that ranged from nine to 90 months.

Control group was composed of 40 healthy subjects including 11 males (27.5%) and 29 females (72.5%). The controls ranged from 12 to 59 years old with a mean of 30.57±9.87.

Fourteen patients undergoing peritoneal dialysis had a history of hemodialysis. In these subjects, dialysis lasted for 42 and 36 months in just two patients; others, however, suffered from 0 to 9 months of dialysis.

The peritoneal dialysis duration ranged from 12 to 66.5 months with a mean of 28.20±15.82 months; the hemodialysis duration ranged from three to 90 months with a mean of 26.27±24.01 months.

In the peritoneal dialysis group, 2 (6.7%), 5 (16.7%), 21 (70%) and 2 (6.7%) patients experienced 2, 3, 4 and 5 times of dialysis per day.

KT/V was determined to be higher than two for all the patients with peritoneal dialysis.

CKD in the group with peritoneal dialysis was caused by no apparent reason in 12 patients (40%), high blood pressure in 8 patients (26.7%), polycystic kidney in 6 patients (20%), infection in 2 patients (6.6 %), kidney stones in 2 patients (6.6%). However, in the group with peritoneal dialysis, it appeared for no apparent reason in 8 patients (27.6%)from high blood pressure in 15 patients (51.7%), infection in 2 patients (6.9 %), Lupus in 2 patients (6.9 %), kidney stones in 1 patients (3.4%) and trauma in 1 patients (3.4%).

In the group with peritoneal dialysis, 2 patients (16.7%) experienced hypertension history, notwithstanding 25 patients (83.3%) without hypertension history.

VEP findings

Compared to the control group, there was a significant difference in N75 latency of the right eye (P=0.007), P100 latency of the right eye (P=0.013), P100 latency of the left eye (P=0.004), N140 latency of the right (P=0.007) and left (P=0.003) eyes between patients with peritoneal dialysis.

In comparison with controls, a significant difference was observed in P100 latency of the right eye (P=0.000), P100 latency of the left eye (P=0.003), N140 latency of the right (P=0.000) and left (P=0.001) eyes between the group undergoing hemodialysis.

No significant difference existed in VEP parameters between the groups undergoing peritoneal dialysis and hemodialysis. Table 1 illustrates comparisons of VEP parameters amongst controls, peritoneal dialysis group and

hemodialysis group. Similar to patients undergoing peritoneal dialysis, in the group undergoing hemodialysis, no significant difference was found in VEP parameters between males and females (Table 2).

There was no significant difference in VEP parameters between patients with the peritoneal dialysis with the CKD duration of shorter than 90.78 months and longer than 90.78 months. No significant difference was seen in VEP parameters between patients with the hemodialysis with the CKD duration of shorter than 35 months and longer than 35 months (Table 3).

There was a significant difference in P100 latency of right eye between patients with the peritoneal dialysis duration of shorter than 28.20 months and longer than 28.20 months (P=0.02). No significant difference was seen in VEP parameters between the patients with hemodialysis duration of shorter than 35 months and longer than 35 months (Table 3).

With regard to biochemical parameters, P100 (P=0.05) and N140 (P=0.05) latencies of the right eye in the patients undergoing peritoneal dialysis were associated with the serum potassium; nonetheless, the association between VEP parameters and the other biochemical parameters including urea, creartinine, cholesterol, triglyceride, hemoglobin, hematocrit, albumin and parathormon (PTH) was non-significant.

Table 1. Comparisons of VEP parameters amongst controls, peritoneal dialysis group and hemodialysis group.

VEP Parameters	Control	Peritoneal dialysis group		Hemodialysis group		(P value)
	mean±SD	mean±SD	(P value) compared to controls	mean±SD	(P value) compared to controls	Peritoneal dialysis group compared to hemodialysis group
RN75 Lat	78.8±3.9	84.57±10.62	0.007*	82.20±11.37	0.119	0.4
LN75 Lat	78.88±4.9	82.66±11.78	0.089	80.91±8.37	0.2	0.51
RP100 Lat	110.23±4.49	116.92±13.55	0.013*	118.28±10.37	0.000*	0.67
P100 Lat	110.43±5.3	118.81±14.47	0.004*	114.95±7.48	0.003*	0.2
RN140 Lat	144±10.27	153.74±18.13	0.007*	157.90±14.22	0.000*	0.33
LN140 Lat	143.83 ± 9.6	154.55±18.24	0.003*	152.84±13.12	0.001*	0.68
RP100 Amp	8.72±5.7	8.26±5.26	0.646	9.27±4.91	0.55	0.45
LP100 Amp	7.99±5	8.16±5.64	0.86	8.90±5.29	0.36	0.6

Note: * pvalue≤ 0.05 was considered as statistically significant

Table 2. Comparisons of VEP parameters in peritoneal dialysis and hemodialysis groups based on gender.

VEP Parameters	Peritoneal dialysis group			Hemodialysis group		
	females mean±SD	males mean±SD	P value	females mean±SD	males mean±SD	P value
RN75 Lat	75.09±12.4	85.85±7.89	0.76	80.74±5.74	83.56±14.96	0.51
LN75 Lat	80.88±12.28	85.3±10.97	0.32	78.68±5.73	83.0±10.0	0.17
RP100 Lat	117.64±16.78	115.9±7.5	0.74	116.36±8.38	120.07±8.30	0.34
P100 Lat	116.64±13.62	122.05±15.69	0.32	113.31±6.39	116.48±8.30	0.26
RN140 Lat	155.31±20.69	151.52±14.32	0.58	154.93±15.60	160.68±12.70	0.28
LN140 Lat	154.58±17.42	154.5±20.20	0.99	150.86±12.44	154.69±13.89	0.44
RP100 Amp	9.67±6.09	6.26±3.01	0.08	9.84±5.62	8.74±4.27	0.55
LP100 Amp	9.53±6.55	6.1 ± 3.15	0.1	9.42±5.40	8.42±5.33	0.62

Note: pvalue≤ 0.05 was considered as statistically significant

Table 3. Comparison of VEP parameters in patients undergoing peritoneal dialysis and hemodialysis based on dialysis duration.

VEP Parameters	Peritoneal dialysis group		Hemodialysis group	
	Comparison (P value) between patients with dialysis duration of <28.20 and ≥ 28.20 months	Comparison (P value) between patients with dialysis duration of <90.78 and ≥ 90.78 months	Comparison (P value) between patients with dialysis duration of <26.27 and ≥ 26.27 months	Comparison (P value) between patients with dialysis duration of <35 and ≥ 35 months
RN75 Lat	0.21	0.15	0.41	0.65
LN75 Lat	0.46	0.63	0.82	0.86
RP100 Lat	0.17	0.40	0.37	0.72
P100 Lat	0.23	0.76	0.74	0.47
RN140 Lat	0.09	0.51	0.99	0.68
LN140 Lat	0.10	0.83	0.45	0.44
RP100 Amp	0.02*	0.59	0.49	0.90
LP100 Amp	0.11	0.73	0.48	0.90

Note: *pvalue≤ 0.05 was considered as statistically significant

Discussion

The nervous system can be affected by CKD. Cranial nerve involvement in CKD has been investigated in several studies; nonetheless, far too little attention has been paid to VEP results in CKD. The present study thereby sought to assess VEP findings in CKD patients who underwent peritoneal dialysis and hemodialysis.

Lewis et al. studied 8 patients undergoing hemodialysis by using Flash-VEP and demonstrated that there were prolonged latencies and bigger amplitudes in controls, in comparison with study cases [10]. The authors stated that no association existed between evoked potential results and blood biochemical results [10]. The results of this study were consistent with our findings in that P100 and N140 latencies in patients under hemodialysis were longer than those of controls. However, no significant difference was seen in P100 amplitude between the group under hemodialysis and controls.

Lowitzsch et al. studied PR-VEP findings in 2 CKD patients 3 times before hemodialysis and 3 times after it [11]. Latencies, amplitudes and shape of waves were finally demonstrated to be normal in both patients [11]. In contrast to this study, our findings showed a significant difference in latencies of waves in patients under hemodialysis, compared to the control group; however, there were no significant differences in amplitudes.

Rossini et al. assessed VEP parameters in 11 CKD patients under hemodialysis by using Flash-VEP [12]. P100 latency was found to be longer in 63.6% of patients under hemodialysis; even so, there were shorter amplitudes [12]. The prolonged latencies in VEP were associated with BUN but were not in association with CRF of dialysis duration [12].

The extent of involvement of central and peripheral nervous system in CKD has been investigated in several studies. However, cranial nerve involvement and its association with different CKD therapies (peritoneal dialysis, hemodialysis, and renal transplantation) are less explicitly treated since their results have not yet clarified the ambiguity in this regard.

Kuba et al. assessed RR-VEP in 3 groups with CKD intervened by hemodialysis, drug treatment and renal transplantation. The authors mentioned that there was significant prolonged P100 latency and decreased P100 amplitude in hemodialysis group, compared to controls [13]. However, our results demonstrated no significant difference in P100 amplitude compared to the control group.

Marsh et al. studied 86 patients undergoing hemodialysis divided based upon dialysis duration into 3 groups (<5 years, 5-10 years and >10 years). VEP parameters were shown to have significant differences in the 3 groups compared to controls; in spite of a non-significant difference in VEP results among the 3 groups [14]. Our findings, however, showed no significant association between VEP parameters and dialysis duration, despite an increase in amplitudes in parallel with the increase in dialysis duration. Derici et al. stated that P100 latency was long prior to hemodialysis; nonethless, it reached to normal level 24 hours subsequent to hemodialysis [15].

Tilki et al. investigated Event-related potential (ERT) in 25 patients undergoing hemodialysis and 9 patients undergoing peritoneal dialysis. This study showed increased ERT in hemodialysis group compared to peritoneal dialysis and control groups [16].

Demirbilek et al. assessed VEP parameters in 19 children undergoing hemodialysis and peritoneal dialysis, and compared them with control group. The authors found no significant differences in VEP results between cases and controls [17]. In this study, the results were not compared between the 2 case groups. Our findings showed a significant difference in P100 latency between 2 case groups, notwithstanding the normal nervous signs.

In comparison with hemodialysis, studies indicated a positive effect of renal transplantation in improvement of VEP parameters [18,19]. In a study carried out by Seymen et al., no significant differences were found between hemodialysis and peritoneal dialysis results, despite a positive association between hemodialysis and PTH [20]. Our results did not corroborate the association of PTH with neither hemodialysis nor peritoneal dialysis.

A few studies have thus far devoted attention to the comparison of VEP parameters in hemodialysis and peritoneal dialysis. Moreover, the main weakness of these studies was the limited sample size. Therefore, we tried to address this issue by selecting more samples.

In the present study, irrespective of a significant association between serum potassium level and P100 latency, which was not corroborated by other studies, no association was found between VEP results and biochemical parameters.

In conclusion, hemodialysis and peritoneal dialysis exert similar influences upon visual nervous system, which was not associated with blood biochemical tests indicating multifactorial nervous involvement of uremia. Finally, it is suggested that further investigations to do with VEP parameters before and after dialysis and in different periods after treatment would be useful are to assessing the progress of nervous symptoms in dialysis.

Conflict of interests: The authors declare no conflict of interest.

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