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RESEARCH ARTICLE

EVALUATION OF THE EFFECT OF HEMODIALYSIS TREATMENT ON THE SPATIAL DISTRIBUTION OF ATTENTION IN END-STAGE RENAL DISEASE PATIENTS

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ABSTRACT

Background: We aimed to evaluate the change in attention and concentration after hemodialysis (HD) treatment in patients with chronic renal failure by line bisection test.
Material and Method: 40 chronic renal failure patients (17 women, 23 men) with a mean age of 64.65±10.24 who had HD treatment and 40 controls with a mean age of 64.88±10.07 were included in the study. The control group was selected from HD patients with similar demographic characteristics. A line splitting test was performed twice, and just once before the end of HD and immediately after the end of HD.
Results: There was no difference between HD patients and controls when analyzing the mean mean score of all lines, before and after dialysis, nor when HD patients were compared with the control group (p=0.348).When separated into short and long lines, there was no difference between the groups either on HD nor after HD on long lines.
Conclusion: According to our data hemodialysis procedure doesn't have any effect on attention. Further testing is needed to test this hypothesis.

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INTRODUCTION

The spatial distribution of attention describes how our attention is directed to anything in our visual field. For example it is about things which we pay more attention. Studies consistently show that our attention is directed asymmetrically around a center. Accordingly, right-handed individuals seem to be more prone to pay attention to their left side. This is defined as pseudo-neglect (Joseph, 2013; Mesulam, 2002). The line bisection test is the one of the tests which are used for evaluating the spatial distrubition of attention. In this test, participant is requested to sign the middle of line on paper. Right-handed normal individuals usually are inclined to sign near left side of midline. The reason of this condition is dominant role of right hemisphere. According to Mesulam (Mesulam, 2002), right hemisphere directs attention to right side dominantly, and left side slightly. Left hemisphere directs attention to just right side. Therefore left hemisphere lesions don't result with serious defects on attention, but right lesions result unilateral neglect syndrome on left side. For example patients don't shave left side of their face, don't eat left side of their plate etc (Mesulam, 2002; Mark *et al.,* 1988; Mesulam, 1981). Laterality is a general term involving the asymmetry of hemispheres in various functions. The most obvious example of laterality is hand preference. Many functions such as language and mathematic skills are executed asymmetrically by hemispheres in addition to attention and hand preferences. Although mechanisms of laterality are totally unclear, number of micro- and macrostructurel alteration descriptions are increased. The one of most important hypothesis' is as symetric dopamine neurotransmission hypothesis. According to this hypothesis, we pay more attention to contra lateral of striatum which owns higher dopamine activity. Otherwise, relationship between the attention pattern and electroencephalogram waves also varies. Mentioned activity differences are mainly observed on high frequency waves. High frequency waves (α and β), are known as reflection of local neuronal activity, and related with GABA and glutamine (Mark *et al.,* 1988; Mesulam, 1981; Smith *et al.,* 2010). Evaluation of the factors which affect to laterality is crucial, for both understanding laterality and hemisphere's structural differences. One of such as these factors is hemodialysis as both acute or cronically. During hemodialysis process, moment alterations can be observed as results of either chronic kidney disease systemic effects or hemodialysis' own effect. In hemodialysis (HD) patients, the blood levels of many substances, mainly urea, are different

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from normal people. This can cause many changes in the body and brain of people who are receiving HD treatment. In addition, HD treatment is usually performed 3 days a week; the urea values of patients are increased, level of many substances and fluid balance alters between the two HD sessions. This can lead to different physiological or pathological changes in many parts of the body due to processing in HD patients (Mesulam, 2002; Mesulam, 1981; Smith *et al.,* 2010; Li *et al.,* 2016; American Psychiatric Association, 2012). In this study, we aimed to research effects of hemodialysis on spatial distribution of attention, indirectly on brain.

MATERIALS AND METHODS

Participant groups:40 hemodialysis patients (17 females, 23 males) and 40 healthy participants as control group are included to study. Control groups have normal renal functions but similar to HD patients in terms of characteristics such as age, sex, diabetes mellitus and/or hypertension comorbidity. All participants were right-handed and they didin't have neurological problem such as dementia or cerebrovascular disease.

Line Bisection Task

Test was performed to HD group two times as before and after HD procedure once. Control group was tested once. Line bisection test is a easily performed test about neglect. In this study, 12 straight lines ranging from 8 cm to 24 cm in length were presented in random order, and marking of the middle point of each of them was requested from the participant. Individuals participating in the study calculated its deviation from the midpoint for a line in millimeters (by the midpoint of the line will be negative value to the left, positive value to the right). This value describes neglect amount. Some participants signed so far from middle point or out the line. Then two blind estimators were appointed and were requested the individuals assessed which participants are 'oriented' or 'not oriented' to test.

Statistical Analysis

Between groups Chi-square test was performed to detect orientation to test and then groups were defined. Line bisection task results were analysed. The mean deviation amounts for short and long lines were compared with the Student t test between groups. The average deviation amounts before and after HD in the HD group were calculated by comparing the deviation amounts of short and long lines (comparison of long line average deviation before HD, long line average deviation after dialysis and application of the same for short line) compared with Paired t test. This study started after Kırıkkale University Clinical Research Ethics Committee approval. This observational study was conducted in accordance with the Declaration of Helsinki. Written consent was obtained from all participants.

RESULTS

40 hemodialysis patients (17 females, 23 males) and 40 healthy participants as control group are included to study. Mean age of HD group was 64.65±10.24 and mean age of control group was 64.88±10.07 (p=0, 93). Control groups have normal renal functions but similar to HD patients in terms of characteristics such as age, sex, diabetes mellitus and/or hypertension comorbidity. Other demographic characteristics were shown in Table1.

Twenty one participants from hemodialysis group, 9 paticipants from control group were excluded by estimator. Chi-square test was performed with aim to detection of participants' orientation to test. It is calculated as χ^2 6,839 p=0,03 (Table 2). There was no significant difference in both short and long lines between the HD group and control group (p=0,348 and p=0,456). In HD group there was no significant differences in both short and long lines (respectively p=0,344 and p=0,787). Results were shown in Table 3.

Table 1. Baseline characteristics of participants

		Hemodialysis group Number (%)	Healthy controls Number (%)	Total	p value
Age	Mean±SD	64.65±10.24	64.88±10.07		0.93
Sex	Male	17 (%45.9)	20 (%54.1)	37 (%46.2)	0.32
	Female	23 (%53.5)	20 (%46.5)	43 (%53.8)	
Education	Illiterate	4 (%40)	6 (%60)	10 (%12.5)	
	Literate	4 (%6.2)	3 (%6.0)	7 (%8.8)	0.45
	Primary	20 (%47.6)	22 (%52.4)	42 (%52.5)	
	Secondary	8 (%57.1)	6 (%42.9)	14 (%17.5)	
	High School	4 (%80)	1 (%20)	5(%6.2)	
	College	0 (%0)	2 (%2.5)	2 (%2.5)	
Monthly income	Under 500 USD	8 (%20)	19 (%70.4)	40 (%50)	
	Above 500 USD	32 (%60)	21(%39.6)	40 (%50)	0.009
Working situitation	Retired	22 (%55)	18 (%45)	40 (%50)	
	Active	0 (%0)	3 (%100)	3 (%3.8)	0.180
	Other	18 (%48.6)	19 (%51.4)	37 (%46.2)	

Tablo 2. Participants' rates of orientation to test

Groups	Orianted N (%)	Not orianted N (%)	Total N (%)
HemodialysisN (%)	20 (% 50)	20 (% 50)*	40 (%50)
Control groupN (%)	9 (%22.5)	31 (%77.5)*	40 (%50)
TotalN (%)	29 (%36.2)	51 (%63.8)	80 (%100)

*χ2 (2, N=80)=6,839; p=0,03;
Abb: HD: Hemodialysis NA: Not applicable

DISCUSSION

The spatial distribution of attention describes how our attention is directed to anything in our visual field. This can be assessed with line bisection test. In literature, it was observed that line size affected deviation from the middle point. (Joseph, 2013; Mesulam, 2002; Mark *et al.,* 1988; American Psychiatric Association, 2012; Schenkenberg *et al.,* 1980). In our study, any significant difference wasn't found both comparison of before/after hemodialysis and baseline comparison of procedure and hemodialysis patients/control groups. Pseudo-neglect wasn't observed contrary to recent studies (Friedman, 1990; Mankowska *et al.,* 2017; Varnava *et al.,* 2011; Heilman *et al.,* 2000; Fisher *et al.,* 2009). Studies have shown that patients with the right frontal- subcortical regions injuries due to the diseases such as stroke often subsequently develop ipsilateral neglect, line bisection toward the contralesional side of the middle line (toward left). This leftward bias is thought to be result of disinhibition of the right parietal lobe (Halligan and Marshall, 1998; Harciarek *et al.,* 2016). The first study, which was investigated defective ability to allocate spatial disribution of attention in chronic renal failure patients who received hemodialysis, belongs Mańkowska *et al.* (2017). According to this study, 18 hemodialysis patients and 18 healthy controls were compared. It was detected that patients receiving dialysis had a significantly greater leftward bias than healthy controls. They didn't explain mechanism of this bias. But they thought hemodialysis might induce right frontal sub cortical dysfunction. Our study may be the first study that was investigated the spatial distribution of attention before and after hemodialysis. According to our data, the hemodialysis procedure does not lead to any significant change or deterioration on attention. This data needs to be supported by different advanced methods. Though our data didn't support study data of Mankowska *et al.* (2017). There are several limitations in our study. The number of samples was low, it made in a spesific and small population, and some of the participants cannot understand the test. Especially hemodialysis patients had orientation problem more. This condition can be another subject of study which is about cognitive dysfuncions or orientation problems to attention test.

Conclusion

According to our data hemodialysis procedure doesn't have any effect on attention. Further testing is needed to test this hypothesis.

Conflict of Interest: The authors declare that they have no conflict of interests.

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