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Institutionalized schizophrenic patients' performance in clock drawing test

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Abstract

Clock drawing test (CDT) as a neuropsychologic tool is recently used to assessment the cognitive functions. This study was aimed to determine the difference in performance of Institutionalized schizophrenic patients and normal subjects in drawing a clock test. To achieve the purpose 45 subjects who were diagnosed as chronic schizophrenic patients by psychiatrists in Isfahan psychiatry hospital, Isfahan, Iran were randomly selected. The normal subjects were selected among the families of patients and their mental health was confirmed after clinical interview (n=30). The schizophrenic group and normal subjects were assessed by CDT in two stages to determine the differences. The data was analyzed using ANOVA and χ^2 . The results of the study showed that there was significant difference between two groups in all the scores of CDT in two stages of test (first stage: $F_{1,73}= 59.64$, $P<0.0001$; and second stage: $F_{1,73}=121.82$, $P<0.0001$). Also the frequency of errors in schizophrenic group was significantly more than the normal control. It is concluded that a two stages of CDT may used to find the abnormality of executive functions in schizophrenia.

1. Introduction

Schizophrenic patients have overall difficulty in the cognitive dysfunction especially in verbal memory, learning, attention and visual-motor information processing. Schizophrenia as a chronic neuropsychiatric disorder may change the functions of frontal lobe[1,2] and its outcomes can be assessed by various neuropsychologic tasks like Wisconsin card sorting test[3], Trail Making Test[4], and Stroop test [5]. Disability in cognitive inhibition, attention deficits and negative priming processing may cause abnormality in brain function of schizophrenic patients related to different processing of left and right hemispheres compare with normal subjects [6]. Drawing a clock test (CDT) is known a test to screening the cognitive impairment [7] that may show the neuroanatomic features of a wide range of disorders [8]. Because of its basis of neuroscience clock drawing test can be used to assessment the cognitive and visual functions related to brain damages.

Clock drawing and inserting the hands at a specific location need to understand the audio instructions, the ability to continue the drawing stages, and remembering the structures of visual perception. Some of the previous studies suggested that CDT can determine cognitive functions that are often related to mild cognition impairments [9]. As a conclusion, CDT is considered as a useful tool for the evaluation of dementia, the ADHD [10] and depression [7]. According to cognitive impairments in schizophrenic

patients, the aim of this study was to compare the clock drawing in patients with chronic schizophrenia and normal individuals in Isfahan, Iran.

2. Materials and Methods

2.1. Subjects

The subjects of this study were randomly selected among schizophrenic patients (n=45) from Modares and Farabi hospitals, Isfahan, Iran. The schizophrenic patients in the age group of 20 to 45 years were paired with normal subjects (n=30). Normal participants were selected among the families of patients and their mental health was confirmed after clinical interview. The schizophrenic patients were selected from institutionalized patients who 1. had enough ability to understand the instruction of test and draw a clock (the minimum education level was 5 academic years) 2. did not suffer from visual or motor disabilities, 3. had enough insight and a proper and stable level of mental status to complete the task.

Family members of schizophrenic patients who were considered as normal group were asked about the history of

psychologic, psychiatric and neurologic disorder history and after clinical interview their normality were proved.

2.2. Test

After recording the demographic variables, the instruction of test was given to the participant. The test was individually performed in two stages. The first stage was conducted without the guidance of the examiner and the second phase under the guidance of her. In the first phase a sheet was placed in front of the participant on the table and she/he was told that draw a clock on this paper with its numbers that show 10 after 11, draw the clock completely clear and legible. There was no guidance after starting the test. In second phase he/she was told "Now in this circle I draw a clock which shows 11:10. You see drawing and then draw this clock again". Then the examiner drew 12, 6, 3 and 9 and the other number from 1 to 11 finally the hour and minute hands were drawn. Both hands were shown as arrows. After completing this stage, the participant was asked to draw the same clock again. Using a chronometer the time was spent for first and second phases was assessed.

The test was scored according table 1.

Table 1. scoring of CDT

Items	score	Stage	
		1	2
The shape is similar to the clock	1		
There is external environment (drawing a line as environment of clock)	1		
Diameter of 1 inch (2.54 cm)	1		
All numbers are within the circle	1		
The first numbers' insertion is 12,6,3,9	1		
Number insertion is correct (symmetry on both sides of the axis of 6-12)- if yes, the next item will not be scored	2		
If there is mistakes in number insertion, he/she is corrected them or omitted the errors	1		
The numbers are written in English (or in Persian- not mixed)	1		
The sequence from 1 to 12 is correct. There is not added or omitted numbers	1		
There are 2 hands (minute hand and hour hand)	1		
Both hands are shown as arrows	1		
Hour hand is between 11 and 12	1		
Minute hand is longer than hour hand	1		
None of the following items			
• the hand shows 4 or 5			
• it is written 11:10 digitally			
• or wrist watch there is not a graph of hand	1		
• There is letters or words			
• There is exceed from the circle			
total	15		

2.3. Statistical Techniques

The data collected from two groups (schizophrenic patients and normal subjects) were statistically examined for significant differences by applying oneway ANOVA and χ^2 with the help of SPSS package. In determining the significance of F ratio the confidence interval was fixed at 0.05 level, which is considered appropriate enough for the psychologic studies.

3. Results

In Table 2, descriptive indicators of ages in two groups are

presented.

Table 2. descriptive indicators of ages in two groups

Group	n	mean	SD	minimum	maximum
Normal participants	30	32.2	5.10	25	40
Schizophrenic patients	45	32.8	5.94	23	42

According to the effects of ages on scores of CDT, the mean ages of two group were compared (see table 3, 4) and it is revealed that there is not statistically significant between ages of two groups (F_{1,73}=0.21, P<0.64).

Table 3. Test of Homogeneity of Variances of age

Levene Statistic	df1	df2	Sig.
1.305	1	73	.257

Table 4. ANOVA for compare the mean of age in two group

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.72	1	6.72	0.213	.64
Within Groups	2309.27	73	31.63		
Total	3216.00	74			

The other important index in CDT is the time takes to complete in stage 1 and 2. In diagram 1 the time spent to complete task in stage 1 and 2 are shown. As it can be seen the spent time in stage 1 is more than stage 2 and the

schizophrenic patients complete the test in a longer period of time in comparison with normal group. This difference in spent time is in both stage 1 and 2.

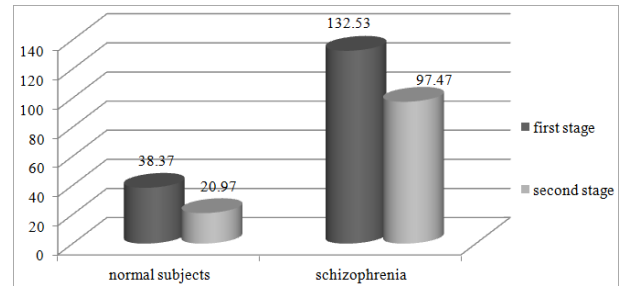


Diagram 1. spent time in stage 1 and stage 2

Table 5. descriptive indicators of scores in stage 1 and 2

variable	group	N	Mean	Std. Deviation	Std. Error
Score in stage1	Normal subjects	30	11.95	1.91	0.35
	schizophrenia	45	6.44	3.57	0.53
	Total	75	8.64	4.04	0.46
Score in stage 2	Normal subjects	30	13.20	1.16	0.21
	schizophrenia	45	9.48	1.57	0.23
	Total	75	10.97	2.31	0.26

In the first stage of CDT, as it can be seen in table 6, the mean scores of schizophrenic patients and normal subjects show statistically differences ($F_{1,73} = 59.64, P < 0.0001$).

Table 6. ANOVA for scores in stages 1 and 2 in two groups

		Sum of Squares	df	MS	F	Sig.
Score in stage1	Between Groups	545.601	1	545.601	59.64	0.00
	Within Groups	667.78	73	9.148		
	Total	1213.387	74			
Score in stage 2	Between Groups	247.902	1	247.90	121.82	0.00
	Within Groups	148.54	73	2.035		
	Total	396.44	74			

In second phase of CDT, the mean scores of schizophrenic patients in this stage is significantly less than normal subjects ($F_{1,73} = 121.82, P < 0.0001$).

t-test were shown in table 7 and 8. Mean scores of stage 1 and stage 2 are 6.44 and 9.48 and the difference between them is significant ($t = 5.90, df = 44, p < 0.0001$). So it can be concluded that practice and learning may increase schizophrenic performance in the second stage.

To find the difference between scores of schizophrenic patients in stage 1 and 2, we used two paired t-test. Results of

Table 7. Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Scores of stage1	6.44	45	3.57	0.53
Scores of stage2	9.48	45	1.57	0.23

Table 8. Paired Samples Test

Paired Differences			t	df	Sig. (2-tailed)
Mean	Std. Deviation	Std. Error Mean			
3.04	3.45	0.51	-5.90	44	.000

In table 9 the frequencies of errors in stage 1 (according to table 1) in schizophrenic patients and normal subjects can be seen.

Table 9. The frequencies of errors in stage 1 in two groups and χ^2

Items	score	schizophrenia	normal	χ^2 (df=1)	p
The shape is similar to the clock	1	14	0	11.47	0.001
There is external environment (drawing a line as environment of clock)	1	3	0	2.08	0.14
Diameter of 1 inch (2.54 cm)	1	12	7	0.10	0.74
All numbers are within the circle	1	17	2	10.27	0.006
The first numbers' insertion is 12,6,3,9	1	42	10	30.47	0.000
Number insertion is correct (symmetry on both sides of the axis of 6-12)- if yes, the next item will not be scored	2	33	4	34.27	0.000
If there is mistakes in number insertion, he/she is corrected them or omitted the errors	1	--	-	--	---
The numbers are written in English (or in Persian- not mixed)	1	11	3	5.15	0.076
The sequence from 1 to 12 is correct. There is not added or omitted numbers	1	20	4	8.007	0.005
There are 2 hands (minute hand and hour hand)	1	21	2	13.54	0.000
Both hands are shown as arrows	1	19	1	13.92	0.000
Hour hand is between 11 and 12	1	44	14	26.82	0.000
Minute hand is longer than hour hand	1	40	4	42.37	0.000
None of the following items					
• the hand shows 4 or 5					
• it is written 11:10 digitally					
• or wrist watch there is not a graph of hand	1	15	2	7.30	0.007
• There is letters or words					
• There is exceed from the circle					
total	15				

According to table 9, there are three similarities in errors: A. two groups drew a line as environment of clock, B. the diameter of clock was 1 inch (2.54 cm) or more than one inch, and C. The numbers were written in Persian. The frequencies of other items were statistically different in two groups and the errors of schizophrenic patients were more than the normal subjects.

4. Discussion

The results obtained from this study on differences between schizophrenic patients and normal subjects in drawing a clock test, clearly shoes that there is functional abnormality in schizophrenia in comparison with their non-patients family members. It is noticeable that CDT is used in recent researches to survey some disorders like schizophrenia. One of the cognitive dysfunctions that can be assessed in schizophrenia is executive function. Executive function is related to task that need verbal understanding, short term and long term memory, planning, start the task and stop it in a proper time. As it mentioned in previous studies draw a clock test is a good neuropsychologic task to assess these functions and brain structures that are basis of such abnormalities. For example it is reported that CDT scores is related to visuo-spatial and constructional disability in schizophrenia [11] also a lower CDT score is correlated with a higher intercaudate ratio, indicating greater caudate atrophy [12]. In this study it is showed that practice after first stage may improve the scores in second stage. It is possibly related to the effect of learning on short term memory of schizophrenic patients. These results were also in line with the previous literature that found frontal lobe performance and its effect on executive functions are not normal in schizophrenic patients [13]. Moreover, similar results have been reported in dementia [14], Alzheimer [15] and other neuropsychiatric disorders. The deficits like numbers setting may be caused by disabilities in planning and spatial functions. This errors can

be seen in attention deficits disorders [16] especially deficits in parietal lobe of right hemisphere. This finding is agreed with the important role of right hemisphere in schizophrenic symptoms [6]. Frequencies of errors in drawings in items like "All numbers are within the circle", "The first numbers' insertion is 12,6,3,9", "Hour hand is between 11 and 12", and "Minute hand is longer than hour hand" are caused by abnormalities in planning and spatial functions and show impairments in subcortical parts, parietal lobe or corpus callosum. CDT is sensitive to varieties of verbal instructions and because of abnormality in temporal lobe (its effect on memory and language process), right parietal lobe (its effect on visu-spatial abilities) and frontal lobe (its effect on executive functions) can assess large parts of brain functions. The present study shows that the schizophrenic patients' ability in visu-spatial task and executive processing is statistically worse than the control group. While the basic concept of clock is not changed (items: "drawing a line as environment of clock" and "Diameter of 2.54 cm"), the errors in discrimination of the size of hands and organizing the clock (items: "There are 2 hands", "Minute hand is longer than hour hand", "symmetry on both sides of the axis of 6-12" and "The first numbers' insertion is 12,6,3,9") related to impairment in planning in schizophrenia.

5. Conclusion

Schizophrenia is associated with subtle differences in brain structures that change cognitive processing. Cognitive impairment in schizophrenia is known as a various range of significant disabilities that cause abnormalities in occupational, social, and economic functioning. These impairments may make more disabilities in daily activities related to information processing. CDT is one of the neuropsychologic tasks that can easily show the impairments in routine but fundamental functions of brain. It is concluded that draw a clock test is as a screening test and cognitive

status evaluation can be assessed the abnormalities of executive functions related to frontal lobe in schizophrenic patients. Therefore it is suggested that in future studies gender differences in CDT be considered and the neuroanatomic abnormalities of schizophrenia related to errors in drawing will be specified.

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