Short-term Memory in Croatian War Veterans with Posttraumatic Stress Disorder

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Aim To assess short-term memory impairment in war veterans with combat-related posttraumatic stress disorder (PTSD).

Method The study included 20 war veterans diagnosed with PTSD and 21 control subjects matched for age, sex, and education level. Both groups were tested with the Rey-Osterrieth Complex Figure Test (ROCFT), consisting of Copy, Immediate Recall, and Delayed Recall steps, and Benton Visual Retention Test (BVRT). Subjects with visuoperceptive and visuoconstructional deficits, as indicated by their ROCFT Copy scores were excluded from the analysis, because this type of cognitive deficit could interfere with the results of the next two ROCFT steps measuring short-term memory.

Results Subjects with PTSD scored significantly lower than control subjects on both Immediate Recall (mean ± standard deviation [SD], 16.3 ± 6.4 vs 26.7 ± 4.5, respectively; $P<0.001$, *t*-test for independent samples) and Delayed Recall tests (15.7 ± 6.1 vs 26.3 ± 4.6, respectively; $P<0.001$, *t*-test for independent samples) on ROCFT test. Intragroup comparison showed that both groups scored significantly lower on Immediate Recall test in comparison with Copy test (19.3 ± 6.4 for veterans and 8.9 ± 4.5 for controls; $P<0.001$ for both, *t*-test for dependent samples), whereas no significant score difference was found between Immediate and Delayed Recall scores in either group (0.7 ± 2.4 for veterans, $P = 0.239$, *t*-test for dependent samples; and 0.5 ± 1.8 for controls, $P = 0.248$, *t*-test for dependent samples), which indicated greater difficulties with acquiring new information than with recalling already memorized information. Subjects with PTSD made significantly more errors on the BVRT for visuoperceptive and visuoconstructional abilities than control subjects (7.8 ± 2.9 for veterans; 4.0 ± 1.88 for controls; $P<0.001$, *t*-test for independent samples).

Conclusion War veterans with PTSD had impaired short-term memory and visual retention, but these cognitive deficits could not be related to traumatic experiences with certainty.

Chronic posttraumatic stress disorder (PTSD) is accompanied with pathophysiological and biological changes in the brain structures such as hippocampus, amygdale, cortex, nucleus accumbens, striatum, and midbrain (1). These changes may be caused by traumatic experience and responsible for the appearance of PTSD symptoms (1). According to the modern concept of PTSD, it is a psychobiological phenomenon that includes neurobiological dysregulation and psychological dysfunction (2). Studies using sophisticated methods for brain imaging found the dysfunction of the frontal-limbic system as the biological correlate of PTSD (3). Magnetic resonance imaging studies showed that in chronic PTSD patients the volume of the hippocampus was reduced, which affects the learning and memory processes (3-5). The hippocampus atrophy is suspected to result from oversensitivity of the glucocorticoid receptors and increased concentration of glucocorticoids in persons exposed to stress (3,5). However, these changes in hippocampus are not caused by the traumatic experience alone. The trauma is constantly reexperienced through flashbacks and dreams, which are characteristic elements of the clinical picture of PTSD (3). In many PTSD patients, other cognitive dysfunctions are also present, such as intellectual deterioration (3,6), impaired executive functions (3), decreased concentration (7-9), memory deficits (7-9), and forgetfulness (9,10).

Due to the high prevalence of PTSD among veterans from 1992-1995 war in Croatia, the degree of PTSD symptoms in this population is frequently assessed (11). Improving our knowledge about memory deficits in PTSD patients would facilitate the severity assessment of the disorder for the purposes of work fitness evaluations and therapy planning (12,13).

The aim of this study was to determine the short-term memory deficit in Croatian war veterans with PTSD by comparing their immediate and delayed recall and visual retention abilities with those of healthy controls.

Subjects and methods

Subjects

The study was conducted on war veterans who came for diagnostic procedure in the Regional Psychotrauma Center at Split University Hospital, between September and December 2004. Inclusion criteria were age between 25 and 60 years and the diagnosis of PTSD as a consequence of traumatic experiences while serving in the Croatian Army units. Exclusion criteria were psychotherapy or pharmacotherapy treatment due to PTSD, central nervous system disease, alcohol and drug addiction, acute psychosis, subnormal intelligence, as well as impaired visuoperceptive and visuoconstructional abilities. A total of 127 war veterans were examined. Twenty of them did not meet the inclusion criteria, 73 received psychotherapy or pharmacotherapy, 5 were alcoholic, and 4 had a psychotic disorder.

The study included 25 war veterans. They had been diagnosed with PTSD according to the 10th version of the International Classification of Diseases (14), Mississippi Scale for Combat related PTSD (M-PTSD) (15), Clinician Administered PTSD Scale (CAPS) (16), and Minnesota Multiphasic Personality Inventory (MMPI 2) (17).

Each of them was either exposed to the threat of death or serious injury or witnessed the threat to physical integrity of others in the period of more than two years during the 1991-1995 Croatian war.

All war veterans participating in the study were men, with mean age (±standard deviation, SD) of 38.1 ± 5.7 years. There were 17 veterans with high-school education, one with a college degree, and 2 with university level education.

The control group included 23 healthy subjects matched for age, sex, and education, who were all employed in the Croatian daily newspaper, *Slobodna Dalmacija*. The mean±SD age of control subjects was 38.0 ± 6.0. Eighteen con-

trols had high-school education, 2 finished college, and 1 had a university degree.

The study subjects were tested between February and April 2005 in Split, Croatia. War veterans were tested at the Regional Center for Psychotrauma, and control subjects at their workplace. All subjects gave their verbal informed consent and the study was approved by the Ethics Committee of the Split University Hospital.

Method

Each study participant was tested individually for short-term memory deficits and attention difficulties. The first test applied was Rey-Osterrieth Complex Figure Test (ROCFT), consisting of three steps – Copy, Immediate Recall, and Delayed Recall – with a 30-minute delay between the second and third step (18). During that 30-minute window, the second test, Benton Visual Retention Test (BVRT), was applied (19). Before the administration of each test, the participants were read the standard instructions (18,19).

ROCFT (18). ROCFT is an objective and standardized instrument that measures visuospatial constructional ability and visual memory. It consists of three steps. At the first step (Copy), the subject is shown a complex geometric figure and asked to draw the same figure, ie, to copy it. At the second step (Immediate Recall), subjects have to draw what they remember. Then, after a 30-minute delay, they are asked to draw the same figure once again (Delayed Recall). The test lasts approximately 45 minutes, including a 30-minute interval between the second and the third step (18). The drawings are scored with respect to the accuracy and location of the elements in the figure, with the same scoring criteria for all three drawing trials. Unit scores range from 2 (accurately drawn, correctly located) to 0 (inaccurately drawn, incorrectly located, unrecognizable, or omitted). The ROCFT assesses 5 domains of neuropsychological functioning as follows: visuospatial recall memory, visuospatial recognition memory, response bias, processing speed, and visuoconstructional ability. It reliably discriminates among brain damaged, psychiatric, and healthy subjects. The cut-off value of the ROCFT Copy step is 32 points, and the maximum score is 36. Subjects who score below 32 points on the ROCFT Copy step are considered to have visuoperceptive and visuoconstructional impairment. The next two ROCFT steps cannot discern subjects with visuoperceptive and visuoconstructional impairment from those with reduced short-term memory, which is the reason why the former had to be excluded from the study.

BVRT (19). BVRT is used for the assessment of visual perception, visual memory, and visuoconstructional abilities, and reveals difficulties with memory, spatial orientation, and motor behavior. It consists of 10 different designs, each containing one or more figures. The subject is shown a design and required to draw it immediately from the memory. The subject reproduces the drawings from the Stimulus Booklet. As each error is scored, higher score means poorer visual perception, memory, and constructional abilities. Inter-rater reliability coefficient for the total number-error score was reported to be 0.98 (20). The test can be administered in about 5 minutes.

Statistical analysis

Results were presented as mean±SD. Distribution of the test results was normal. Independent samples were analyzed with *t* test for independent samples, whereas the differences between paired measurements (Copy vs Immediate Recall and Immediate Recall vs Delayed Recall) were analyzed with *t* test for dependent samples. Statistical analysis was performed with the Statistical Package for the Social Sciences, version 12.0 (SPSS Inc., Chicago, IL, USA). The level of significance was set at $P<0.05$.

Results

ROCFT

Both study groups were tested with ROCFT. Of 25 war veterans, 5 scored less than 32 on the ROCFT Copy step and were excluded from the analysis, since they were considered to have visuoperceptive and visuoconstructional impairment. Also, 2 of 23 controls were excluded for the same reasons. Eight subjects (5 war veterans and 3 control subjects) scored between 32 and 35 points on the ROCFT Copy step. Since qualitative analysis showed that these errors were omissions of less important details in the figure that could not be related to visuospatial disturbances, these subjects were retained in the analysis. The remaining subjects scored the maximum 36 points without any errors. Thus, the final sample included 20 war veterans with PTSD and 21 control subjects with intact visuoperceptive and visuoconstructional functions.

The two groups did not differ in their mean ROCFT Copy score, but subjects with PTSD scored significantly lower than control subjects on both the Immediate Recall and the Delayed Recall tests (Table 1). Both groups scored significantly lower on Immediate Recall step than on the Copy step, ie, they made significantly more errors when they had to draw the figure from memory than when they had to copy it ($t = 13.57$; $P<0.001$ for veterans and $t = 9.13$; $P<0.001$ for controls). Subjects with PTSD made twice as many errors as control subjects. There were no significant differences between the Immediate Recall and the Delayed Recall scores within either group ($t = 1.22$; $P = 0.239$ for veterans and $t = 1.19$, $P = 0.248$ for controls).

Table 1. Rey-Osterrieth Complex Figure (ROCFT) test scores (mean ± standard deviation) for patients with posttraumatic stress disorder (PTSD) and healthy controls

	Subjects			
ROCFT test	PTSD (n = 20)	control (n = 21)	*t* test	*P**
Copy	35.6 ± 0.8	35.8 ± 0	1.19	0.278
Immediate Recall	16.3 ± 6.4	26.7 ± 4.5	5.99	<0.001
Delayed Recall	15.7 ± 6.1	26.3 ± 4.6	5.67	<0.001

BVRT test

The mean total number of errors made by the control subjects was 4 ± 1.88, which is in line with the existing standards for this age group (19). Mean total number of errors made by subjects with PTSD was 7.8 ± 2.97, ie, on average they made around 4 errors more than control subjects ($t = 4.82$, $P<0.001$) and 3-4 errors more than expected for their age group.

Discussion

We found no impairments in visuoperceptive and visuoconstructional function in our sample of war veterans with PTSD, which is not in accordance with similar studies (8,10). Neither PTSD nor control group in our study manifested any significant loss of information between the Immediate and Delayed Recall; however, the veterans with PTSD performed significantly worse than control subjects on both of these tests. Both groups had lower score on Immediate Recall step in comparison with Copy step, and subjects with PTSD scored significantly lower than control subjects. These results indicate that the veterans with PTSD had more difficulties with acquiring new information (Copy vs Immediate Recall) than with recalling the already memorized information (Immediate vs Delayed Recall). These results are in line with previous findings that indicated deficits in immediate recall function, with preserved delayed recall in patients with PTSD (12).

Our sample of veterans with PTSD made more errors than control subjects on the BVRT as well. According to some authors, large number of errors on BVRT may indicate cognitive function deficit (18). Short-term memory deficits in patients with PTSD have been established previously (21) and explained by focal deficits attributable to influences of the trauma, ie, PTSD, on the hippocampal function (5,10). Decreased volume and atrophy of the hippocampus, often

found in persons exposed to war trauma, result in deficits in short-term memory, executive functions, and consolidation of memory traces. Hyperarousal (concentration difficulties and hypervigilance) in PTSD patients may also be one of the reasons for the larger number of BVRT errors (2).

Our results are in line with previous studies reporting that patients with PTSD show cognitive deficits on the tests of attention (7), short-term memory (8), acquisition of new information (8), and IQ, in comparison with the premorbid state (9). On the other hand, unlike the previous studies using ROCFT, we tried to control for the possible influence of perceptive disorders on the short-term memory tasks by excluding the subjects with visuoperceptive deficits from the study. This approach enabled us to relate the obtained results to the influences of the mnestic function deficits alone.

Tests results were not compared with normative data because test standardization was not done with respect to sex and education. Also, these tests cannot determine the exact degree of cognitive deficit, only confirm its existence.

We found short-term memory deficits in war veterans with PTSD, but the measurement instruments we used did not allow us to reach any conclusions about their causes, which is the main limitation of the study. Another limitation was a relatively small number of study subjects, which was the reason why the conclusions of the study could not be generalized to the whole population of Croatian war veterans with PTSD. Reaching more reliable and generalizable conclusions would require larger sample size, the use of sophisticated neuroimaging methods, and a comprehensive battery of neuropsychological tests, including the ROCFT and BVRT. Further research should establish if the intensity of PTSD symptoms could be associated with the neuropsychological test results (ROCFT and BVRT).

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