

Depression vs. Dementia: A Comparative Analysis of Neuropsychological Functions

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Previous studies concerned with neuropsychological aspect of depression, detected comparatively specific profile of cognitive deficiencies, including the disorders of attention, memory and executive functions. Although the classical depression is recognized as pseudodementia, or reversible dementia, these two entities frequently overlap in the elder population. Many patients who are at first depressive, become demented later, and the initial stages of dementia are not rarely accompanied with mood changes.

The aim of this study is the establishing of differences between neuropsychological profiles of depression and dementia.

The sample included three groups: the first group represented the patients with endogenous depression, the second – the patients with dementia, and the third one – healthy individuals. The participants have been tested by a neuropsychological battery. Two patient groups were tested during the stage of remission/adequate mood.

Abilities most susceptible to depression are: attention, executive functions and memory. Cognitive flexibility and general cognitive ability are preserved in depressive patients.

Depressive patients express cognitive disorders of moderate degree during the remission stage. Impairment pattern in the group of depressive patients does not indicate intellectual degradation of the dementia type. Neuropsychological deficiencies of the patients with endogenous depression suggest frontal limbic dysfunction.

Excesses in cognitive functioning of demented patients are more serious and massive in comparison with cognitive difficulties in depressive patients.

Key words: *endogenous depression, dementia, neuropsychological tests, cognitive functions*

Depression is one of the frequent psychiatric disorders, especially in elderly patients. Difficulties of depressive patients with cognitive tasks, even when their disorder is in remission (Portella et al., 2003), indicate a comparatively specific profile of cognitive dysfunction, including disorders of attention, memory and

executive functions (Castaneda et al., 2008a; Keilp, Gorlyn, Oquendo, Burke, & Mann, 2008; Elderkin-Thompson, Mintz, Haroon, Lavretsky, & Kumar, 2007).

Although cognitive deficiencies are usual in depressive episodes, their basis is unclear (Castaneda, Tuulio-Henriksson, Marttunen, Suvisaari, & Lonnqvist, 2008b). According to the hypothesis of effort, the performance of tasks requiring elaborated processing is impaired out of proportion in depressive subjects, in comparison with their performance of automatic tasks. The hypothesis of cognitive rapidity states that depression is characterized with cognitive retardation, and that this is the source of cognitive dysfunction.

Although there is an agreement on the presence of cognitive deficiencies in depression, the problem of distinction between depression and dementia still persists. This problem is based on the findings of lowered cognitive skills in depressive patients, especially within the domains of learning and memorizing (McQuade & Young, 2000). In both disorders, clinical signs are apathy, sleeping and appetite disorders, loss of interests, withdrawal from social life (Draper, 1999). Although classical depression is described as pseudodementia, i.e. reversible dementia, overlapping of these two conditions is frequent (Pavlović, 2002). Epidemiologic studies mostly find that depression in elderly may represent the first symptom of dementia (Heun, Ptak, & Kockler, 2002).

Although depression and cognitive impairment affect about 25% of individuals above 65 years (Blazer, 1994; Kokmen, Beard, O'Brien, & Kurland, 1996), connection between these two conditions is complex. Numerous studies reveal that depression is correlated with poor success with cognitive tests and that even may produce reversible dementia or "pseudodementia" (Poon, 1992). Almost 30% individuals with irreversible dementia like Alzheimer's disease or dementia connected with cerebrovascular disease, suffer from depression syndrome, ranging between depressive symptoms and acute depressive disorder (Forsell & Winblad, 1998).

Pseudodementia in younger patients leads to cognitive disorder similar to those in older individuals. Prospects are better in young than in old patients, although in some cases the syndrome may become chronic, and put the patient in a position extremely dependent on caregivers (Peritogiannis, Zafiris, Pappas, & Mavreas, 2008).

Actually, the relation between depression and dementia is triple: depression may disturb short-time memorizing, attention and general cognitive level (pseudodementia); depression may be the first visible reaction to initial dementia (reactive depression with maintained insight in cognitive loss); simultaneous existence of dementia and depression in the same patient, either as two distinct disorders, or as the expression of one and same disease (Pavlović, 2002). When depressive patients show cognitive difficulties, neuropsychological approach could be useful in distinguishing between depression and an early stage of dementia both through investigation and comparison of cognitive profiles of these patients (Wright & Persad, 2007).

In spite of numerous methodological problems accompanying neuropsychological assessment (demographic characteristics of patients, pharmacotherapy, types of tests applied, various strategies in evaluation of the results of neuropsychological studies, etc.), it is nevertheless possible to establish the presence of the most frequent deficiencies in depression. On the other hand, the difference between depression and dementia is not quite clear, which is shown by the investigations of patients with unipolar depression, finding impairments of attention, declarative memorizing, ability of changing cognitive set and manipulative skills independent on age, of a degree insufficient for establishing the diagnosis of dementia (Totić-Poznanović, 1999). Besides, investigations also indicate an abnormal fronto-limbic activation in clinical depression (Rose, Simonotto, & Ebmeier, 2006; Schoning et al., 2008).

AIMS OF THE STUDY

The aim of the present study is to establish the differences in cognitive functioning between depressive and demented patients in all domains of cognition which, according to previous investigations, appeared as dysfunctional in depressive patients. Specifically, these domains are: attention, memory and executive functions. This approach allows application of the results as a contribution to the routine differential diagnostics of depression versus dementia.

Method

Subjects: The investigation included three groups of subjects of both genders, aged between 31 and 60. The first group consisted of patients with endogenous depression, the second one included demented patients (dementia in Alzheimer's disease, vascular dementia, multi-infarct dementia, unspecified dementia), and the third group represented healthy subjects. The first and the second groups were hospitalized, due to endogenous depression or dementia at the Institute of psychiatry and Institute of neurology, within the Clinical Center of Serbia and the Neuropsychiatry Hospital "Dr Laza Lazarevic" and it was diagnosed according to the ICD-10 criteria.

Procedure: Exclusive criteria for the first group included: appearance of clinical depression within schizophrenia, somatic or neurological diseases; recorded neurological disorder (brain insult, epilepsy, head trauma); recorded abuse of substances or alcohol.

Exclusive criteria for the second group included: occurrence of dementia syndrome within schizophrenia, HIV, head trauma, Huntington's, Parkinson's or Creutzfeldt-Jakob's disease; occurrence of dementia syndrome within general health condition; records on substance or alcohol abuse.

The third group is involved in the research to form the cognitive profile which would represent the standard and it estimates the presence and severity of cognitive deficits in the first and the second group. Within personal and family background of the subjects in the third group, there were no records on psychotic, neurological or affective disorders, alcohol or substance abuse.

For defining and estimation of depressiveness, in the first and second groups, appropriate scales were applied: Hamilton Rating Scale for Depression – HRSD (Hamilton, 1967) and Beck Depression Inventory – BDI (Beck & Beamesderfer, 1974), at two occasions, at the beginning of hospitalization and during an euthymic phase. Investigating of cognitive functioning was performed during the euthymic phase, i.e. during the interval of adequate mood, which was defined by the following criteria:

- the total score at HRSD was reduced to 7 or less, which represents the limit score for describing the patients as euthymic;
- the total score at BDI was reduced to 9 and less, which describes individuals that are not depressive.

Instruments: All the subjects were submitted to the following neuropsychological tests: Mini Mental State Examination – MMSE (Folstein, Folstein, & McHugh, 1975); TMT – Trail Making Test (Reitan, 1958); RCF – Rey-Osterrieth Complex Figure (Rey, 1941; Osterrieth, 1944); RAVLT – Rey Auditory Verbal Learning Test (Rey, 1964); WCST – Wisconsin Card Sorting Test (Berg, 1948).

Results

Table 1. Main demographic characteristics of the groups

	Depressive subjects		Demented subjects		Healthy subjects	
Data	$\bar{X} \pm SD$	min max	$\bar{X} \pm SD$	min max	$\bar{X} \pm SD$	min max
Age	48,25 \pm 7,80	31–56	50,48 \pm 5,70	40–60	47,73 \pm 6,59	36–59
Educational level	13,37 \pm 2,70	9–19	12,12 \pm 3,15	8–19	13,56 \pm 2,54	11–20

The groups did not differ in the general demographic characteristics, they were of similar age ($F(2,90) = 1,435$, $p>0,05$) and educational level ($F(2,90) = 2,368$, $p>0,05$).

Table 2. Characteristics of depression syndrome

	Depressive subjects		Demented subjects	
Data	$\bar{X} \pm SD$	min – max	$\bar{X} \pm SD$	min – max
HRSD I	30,21 \pm 4,65	3–7	12,64 \pm 2,11	9–15
HRSD II	6,01 \pm 2,17	0–7	3,06 \pm 3,17	0–7
BDI I	36,41 \pm 4,61	30–52	16,31 \pm 1,61	12–18
BDI II	7,34 \pm 1,53	4–9	5,34 \pm 3,53	1–9

HRSD I – Hamilton Rating Scale for Depression in the beginning of treatment

HRSD II – Hamilton Rating Scale for Depression (in remission)

BDI I – Beck Depression Inventory in the beginning of treatment

BDI II – Beck Depression Inventory (in remission)

The scores of depressive subjects at HRSD and BDI indicate the presence of severe depressive episode. At the time of the neuropsychological test application, it was found that the patients were in the phase of adequate mood, which had been confirmed by the scores at HRSD and BDI applied once more after clinical recovery. Depressive symptoms of demented patients, at the beginning of the

treatment, were mild to moderate, and after clinical recovery, the depression was completely reduced.

Significant difference between the groups was noticed in MMSE values ($F(2,90) = 61,916$, $p<0,01$) meaning that demented patients have poorer achievements. General cognitive level of depressive and healthy subjects varied within normal values, which was confirmed by the scores at MMSE, the average of which amounted to $27,37 \pm 2,64$ for depressive patients, and $27,60 \pm 1,24$ for healthy subjects. The average value of MMSE score in the group of demented subjects amounted to $22,87 \pm 1,45$ which indicates a mild cognition loss, i.e. these patients were at an early stage of dementia.

Table 3. Achievements of the groups in neuropsychological tests

	Depressive subjects $\bar{X} \pm SD$	Demented subjects $\bar{X} \pm SD$	Healthy subjects $\bar{X} \pm SD$
Variable			
TMT A	$58,31 \pm 27,46$	$120,25 \pm 51,05$	$47,00 \pm 10,68$
TMT B	$161,81 \pm 59,92$	$258,16 \pm 73,98$	$92,06 \pm 19,52$
RCF	$10,56 \pm 7,31$	$4,01 \pm 2,96$	$14,15 \pm 4,35$
RAVLT t	$41,25 \pm 8,41$	$24,09 \pm 10,22$	$46,50 \pm 7,83$
RAVLT e	$7,50 \pm 2,63$	$3,67 \pm 3,17$	$8,90 \pm 1,09$
RAVLT r	$11,00 \pm 2,82$	$6,96 \pm 3,21$	$12,93 \pm 1,11$
WCST ca	$2,87 \pm 2,29$	$1,32 \pm 1,59$	$5,36 \pm 1,06$
WCST fms	$1,31 \pm 1,37$	$0,87 \pm 1,20$	$0,26 \pm 0,52$
WCST pr	$48,36 \pm 24,54$	$69,83 \pm 30,96$	$36,25 \pm 27,20$

TMT A – Trail Making Test form A

TMT B – Trail Making Test form B

RCF – postponed visual memorizing of the Rey-Osterrieth Complex Figure

RAVLT t – total number of repeated words in five attempts in the Rey Auditory Verbal Learning Test

RAVLT e – number of repeated words after 30 min (evocation) in the Rey Auditory Verbal Learning Test

RAVLT r – number of correctly recognized words (recognition) in the Rey Auditory Verbal Learning Test

WCST ca – categories achieved in the Wisconsin Card Sorting Test

WCST fms – failures to maintain set in the Wisconsin Card Sorting Test

WCST pr – perseverative responses in the Wisconsin Card Sorting Test

Significant differences between the investigated groups in the times necessary for performing TMT were found both at the form A ($F(2,90) = 41,154$, $p<0,01$) and the form B ($F(2,90) = 66,752$, $p<0,01$). Achievements at TMT A show time prolongation, as an indicator of decreased rate of mental trailing, in favor of the healthy group in comparison with the depressive subjects. The depression group also showed significantly poorer achievements at TMT B which represents an indicator of splitting attention efficiency, in comparison with the healthy group. The group of demented individuals is distinctive at the both forms, in the prolongation of time necessary for the test performance, in comparison with both the control group and the depressive patients.

Significant inter-group differences were found at RCF in postponed visual memorizing after 40 min delay ($F(2,90) = 29,438$, $p<0,01$). Delayed recollection of

complex figures is significantly poorer in the patients with depression in comparison with the healthy group. By estimation of visual memorizing of the two patient groups, significant differences were found in favor of the depressive group.

At RAVLT, depressive patients lag behind at certain stages of learning and memorizing of verbal material (Fig. 1) during multiple repetitions, in comparison with healthy subjects. However, at all learning and repeating stages, the depressive group is significantly more successful than the group of demented patients. The analysis of the results (Fig. 1) shows that the repeating as a factor of learning affects the achievements in all three groups equally, however, the effect of repeating is group-dependent; thus, the healthy group learns more successfully than the two other groups, which may be concluded from the number of repeated words in each further attempt, while the depression group is more successful in the learning ability than the group of demented patients. The effect of repeating is also confirmed by the total number of repeated words (Table 3), showing that the healthy individuals learn more quickly than the both patient groups ($F(2,90) = 53,414, p < 0,01$).

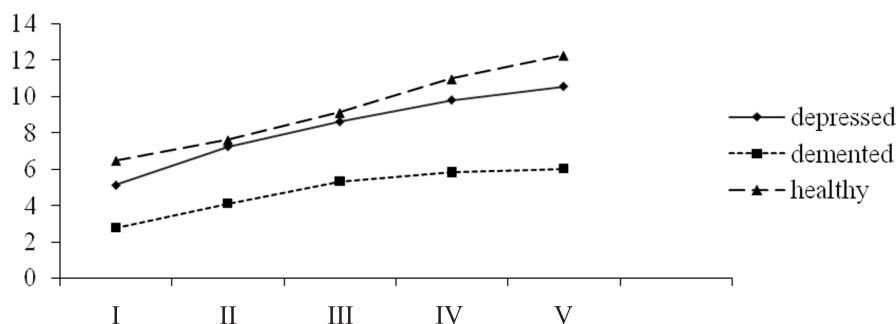


Figure 1. RAVLT: Success in learning the list of 15 words (5 attempts)

Depressive patients (Fig. 1) were more successful than the demented patients at the 1st attempt, but in comparison with healthy subjects, the repetition is comparatively poor ($F(2,90) = 42,891, p < 0,01$). Yet, the number of repeated pieces of information in depressive patients is at the lower limit of normal range of memory (5 pieces of information). At II and III attempts, the group of depressive patients approached the healthy group, in the number of repeated words, thus overcoming the difference between the two groups at this stage, while the group of demented patients was significantly worse than the remaining two groups (II attempt ($F(2,90) = 32,681, p < 0,01$; III attempt ($F(2,90) = 30,038, p < 0,01$)). At the IV and V attempts the three groups are different from one another (IV attempt ($F(2,90) = 50,580, p < 0,01$; V attempt ($F(2,90) = 58,706, p < 0,01$)), the group of demented patients being the worst of the three. Depressive patients were significantly more successful, but still lagged behind the healthy ones.

During five attempts in row, the depressive group improves from one attempt to the other, the learning curve being productive, the same as the

learning curve of the control group, but eventually the depressive group failed in comparison with the healthy subjects (Table 3). Demented patients also improve from one to the other attempt, but their advance is negligible, learning rate drastically slower in comparison with the depression and healthy groups; thus, the learning curve of these subjects is unproductive, with a plateau between III and IV attempts.

Free recollection of previously learned material (evocation) was significantly poorer in depressive patients in comparison with the healthy group ($F(2,90) = 36,493$) $p<0,01$), while the demented group lagged behind both the depression and healthy groups.

Recognition – ability to recognize previously learned words is significantly reduced in the depression group in comparison with the healthy group ($F(2,90) = 42,952$, $p<0,01$). The group with dementia had significantly lower scores at this parameter in comparison with both the depressive patients and healthy subjects.

Significant differences between the groups were found at all investigated parameters of WCST. The both patient groups achieved significantly lower number of categories, i.e. they show difficulties in working memory functioning, in comparison with the control group of healthy individuals ($F(2,90) = 41,722$, $p<0,01$). Between the two groups of patients, the difference was also found at this parameter, at the expense of the patients with dementia.

The groups with depression and dementia had significantly more breaks of set as an indicator of poorer prolonged attention, than the control group of healthy individuals ($F(2,90) = 6,949$, $p<0,01$), while no significant differences of this parameter were found between the two patient groups.

As for the parameters reflecting the total number of perseverative responses, the depressive patients did not significantly differ from the healthy group, while the group of demented patients had significantly more perseverative answers in comparison with the two remaining groups ($F(2,90) = 11,859$, $p<0,01$).

DISCUSSION

The results of our investigation show that attention, memorizing (verbal and visual modality) and working memory are most susceptible to the effects of depression, because the achievements of the group of depressive patients differ significantly from the group of healthy individuals at exactly those tasks which include the mentioned functions. In the tasks that estimate general cognitive ability (MMSE) and mental flexibility (WCST– perseverative responses), no significant differences were found between depression and healthy groups.

The groups with depression and dementia have similar achievements at the tasks which estimate prolonged attention. Between healthy and demented subjects, discrepancy is noticed at all applied tests. The tests estimate general cognitive ability, attention, verbal and visual memorizing, and executive functions.

General cognitive ability, on the basis of MMSE scores, indicates that the functioning of depressive patients and the control group of healthy individuals is within normal limits. Expected lower achievements at MMSE in demented patients, indicate a mild loss of general cognitive ability (20–24) in this group.

A significant difference was recorded in the time needed for completion of TMT A, which represents the measure of simple conceptual trailing, between the groups of depressive and healthy subjects. Also, depressive patients showed a significant prolongation of the time needed for the tasks of complex visual conceptual trailing (TMT B) in comparison with the control healthy group, which is in accordance with previous results (Ravnkilde et al., 2002; Sarosi, Balogh, Szekely, Sasvari, & Faludi, 2007). The group of demented subjects was significantly worse both in TMT A and TMT B in comparison with the remaining two groups. Such achievements support an impaired rate of mental trailing and damaged attention in the both patient groups.

Psychomotor retardation contributes significantly to the decreased achievements at the tests including motor component, like TMT A, TMT B (Rogers, Rogers, Lees, Smith, Trimbel, & Stern, 1987; Austin, Dougall, Ross, & Muray, 1992) as well as at those which are time-limited. Although the effect of anti-depression therapy on the achievements can not be excluded, the obtained results are, as it had been shown (Riso et al., 2003; Portella et al., 2003) most likely a reflection of psychomotor retardation which persist even during the remission. While some authors connect the severity of the clinical appearance of depressive patients with the degree of psychomotor retardation (Elderkin-Thompson et al., 2003), others consider it to be independent of the general effect of the depression symptom expression (Grant, Thase, & Sweeney, 2001), while some mention it as “nucleus of cognitive dysfunction in depression” independently of the disorder severity (Den Hartog, Derix, Van Bemmel, Kremer, & Jolles, 2003). Disagreement of the available data suggests that psychomotor retardation should be investigated as an individual dimension, separately from the depression severity, thus enabling by a better understanding of the psychomotor retardation a better understanding of cognitive functioning in depression, too.

During the learning of word list (RAVLT), where, together with immediate memorizing, learning strategies are engaged and learning curve is formed, difficulties are noticed in the group of depressive patients. Because the words are not originally organized, cognitive effort is necessary, which is lacking in depressive patients, for the grouping of the words, i.e. for the organization of the presented material.

Due to the difficulties in shifting the attention from one to another stimulus when passing to a new task, the depressive patients have significantly lower score at the first repetition in comparison with healthy subjects. This is followed by an improvement at the second and third repetitions, but also, due to

an impairment of prolonged attention (WCST – set break), by further failure in the fourth and fifth repetition, in comparison with the healthy control group. The demented patients are much worse at each of the five attempts in comparison with the other two groups. However, the number of words at the first repetition, which represents the measure of immediate memorizing, is at the lower limit of the average value in depressive patients (five words), considering that the capacity of short-time memory is 7 ± 2 pieces of information.

Learning curve is productive in depressive subjects, as well as in the control group of healthy individuals, although the achievements are poorer. This means that the depressive patients show a significant effect of verbal learning improvement by repetition, which is in accordance with other studies (Fossati, Gilles, Raoux, Ergis, & Allilaire, 1999; Kinderman & Brown, 1997). Learning curve of the demented patients is poorly productive, indicating that the effect of repetition is weakest in this group.

As for the delayed recollection (recognition) which was analyzed on the basis of the results at RAVLT test, a significant difference is present between the depression and control groups, while the group of demented subjects is significantly more insufficient in the domain of recollection in comparison with the depression and control groups. Recognition includes simpler strategies of browsing, where the strategy of recollection is narrowed to minimum and represents the measure of both retention and decoding/encoding. The tasks of delayed recollection require maintained split and prolonged attention, which is not the case in the group of depressive subjects, in order to simultaneously approach the information in the deposits of recent long-term memory and browse quickly several data rows (Leposavić & Leposavić, 2004).

As for the free recollection (evocation), the depression group significantly lags behind the healthy group, while the group of demented is less efficient in this domain in comparison with the other two groups. Free recollection is a more sensitive measure of memory than immediate memorizing, because it is less dependent on the effect of attention. The quantity of material that can be reproduced by a person depends primarily on the quantity of stored pieces of information, as well as on browsing and finding the pieces in the long-term memory and on the organization of recalled material. This implies maintained capacity for the establishment of a strategy supported by the functioning of the frontal lobe. Studies show that the functioning of this memory modality is significantly more vulnerable by negative depression effects than other forms of memory (Ilsley, Moffoot, & O'Carroll, 1995; Burt, Zembar, & Niederehe, 1995). This memory deficiency in the depression group is, most likely, a consequence of impaired ability to form recollection strategy and of reduced cognitive effort in these patients.

Disorder of verbal memory in depression patients is, most likely, a consequence of impaired attention which reduces the range of memorized information, and deficient strategies of remembering and recollection damage the presentation of verbal memory.

Drawing of remembered complex figure (RCF) is a test of visual memory which also includes a visual-spatial component. The both patient groups have significantly poorer visual memory than the control healthy group, the group of demented being significantly worse than the depression group. Consolidation of memory trails, which should enable their transient or permanent storage in the systems of short- or long-term memory, is damaged in the group of depressive patients. These difficulties are recorded on the basis of free recollection of previously learned visual material. The pattern of visual memory disorder in depressive patients is identical to the pattern of verbal memory disorder, and includes, beside consolidation troubles, the recollection troubles, i.e. more difficult finding of pieces of information in the long-term memory. This finding is confirmed by the results of other studies (Ellwart, Rinck, & Becker, 2003; Elderkin-Thompson et al., 2003).

Although the disorders of memory are common in severe depressive episodes, their characteristics are unclear. While a group of authors state that for cognitive functions in depressive disorder the reduction of information processing rate in automatic tasks is characteristic (Den Hartog et al., 2003), other argue that in depression cognitive operations requiring effort are more seriously impaired (Totić-Poznanović, 1999). The results of our investigation do not support either of these hypotheses, considering that in the depression group there were recorded cognitive disorders both at the tasks of recognition requiring less cognitive efforts and at the tasks of free recollection/evocation which are more difficult in cognitive sense. Such patterns of memory disorder in the depression group is also encountered in other studies (Portella et al., 2003), independently on the actual patient condition. This finding suggests that memory disturbances in these patients are the results of more permanent disorders.

The achievements of the depression group are significantly different from the control healthy group at WCST in the parameters showing the number of achieved categories and total number of set breaks. The demented patients fail significantly in all the tested parameters at WCST in comparison with the remaining two groups.

Significantly lower number of achieved categories in the depression group indicates troubles in the working memory. In depressive patients, the disturbance of working memory functioning makes more difficult the designing, both the design imagining and its realization, considering that each further act of card matching at WCTS must be designed by reasoning connected with previous matches. Rose et al. (2006) found that the profile of cognitive dysfunctions in depressive patients may reflect a deficiency in the control executive system representing a component of working memory. Demented patients show more massive difficulties in the functioning of working memory in comparison with the depression group.

Closely connected with the disturbances of the mentioned functions is also the impossibility of longer focusing on one stimulus (Pavlović, 2002), preventing

thus the depressive individuals to remember what they should remember. These difficulties# of prolonged attention are noticed at WCST in the sense of more frequent cognitive set breaks. In the group with dementia, these difficulties are still more drastic. A subspecies of prolonged attention is vigilance which involves capacity of shifting from one to another stimulus (the act of sorting and feed-back information from the investigator are changing alternately), which represents a difficulty for depressive patients. Norwegian authors (Egeland et al., 2003) conclude that the reduced attention in depressive patients occurs due to unspecific reduction of agility and the loss of vigilance.

Perseverative answers did not make significant difference between the depressive and healthy subjects, although it could be expected as a consequence of the incapability of behavior change as an answer to a feed-back information. Actually, the group of depressive patients is capable to change the actual principle of card sorting when he/she gets feed-back information on the incorrectness of the answer. This means that the depressive patients maintained a satisfying level of mental flexibility, which enables them to change the concept in appropriate circumstances. Demented patients have significantly more perseverative answers in comparison with the healthy and depressive subjects.

Neuroanatomical correlate of executive functions involves frontal lobes, which suggests that the noticed disorders in the group of depressive patients have a clear neuroanatomical basis. Dysfunction of dorso-lateral prefrontal cortex which also involves limbic system in severe depressive episode is suggested on the basis of functional magnetic resonance imaging diagnostics (fMRI) and comparative neuropsychology (Rose et al., 2006; Schoning et al., 2008), which supports our results. There is, mainly, an agreement on the findings that the frontal lobe syndrome is recorded within the specter of mood disorders only in patients with endogenous depression (Moreaud et al. 1996; Elderkin-Thompson et al., 2003).

The group of depressive patients shows difficulties at WCST in designing and choosing of appropriate strategy, as well as inability to maintain the existing cognitive set, in comparison with healthy subjects. Concept formation, however, as well as the change of already established cognitive set, takes place in depressive patients without great difficulties.

As for the maintained cognitive functions in the group of depressive patients, considering that neuropsychological testing was not performed during the acute stage of the disease, it remains unsolved whether the maintenance is the result of a recovery in remission stage due to "cognitive consolidation", or they were not impaired even during depressive episode. Also, there remains the doubt if the noticed deficiency is of the same degree during the active stage or there occurred an improvement of cognitive functioning during clinical recovery.

Are depressive disorders connected with further cognitive decrease (dementia development or milder cognitive impairment) is a debatable question. Several studies (Wilson et al., 2002; Paterniti, Verdier-Taillefer, Dufouil, & Alperovitch, 2002; Wilson, Mendes de Leo, Bennett, Bienias, & Evans, 2004;

Saez-Fonseca, Lee, & Walker, 2007), showed that depressive disorders are connected with increased risk of dementia. Other studies either did not find such connection (Dufouil, Fuhrer, Dartigues, & Alperovitch, 1996; Henderson et al., 1997), or they found it in correlation with education (Geerlings et al., 2000) or with previously existing cognitive impairments (Bassuk, Berkman, & Wypij, 1998). Two factors may influence inconsistency of previous results. Some of these studies are limited by small samples or retrospective designs. Other used designs that complicated establishing of causes and consequences, considering that almost one third of demented patients have depression symptoms. Additionally, the interpretation of the results presented a problem because the symptoms used for depression diagnosis, like attention disorders, lack of energy, changes in sleeping routine, lack of interest for activities, are frequently found also in patients with dementia. The results of our investigations do not contain data which could confirm cited data, considering that the design of the study was not prospective, and the sample included middle-aged adults.

The basis of the link between depressive symptoms and cognitive decrease is unknown. Depressive symptoms may be a reaction to cognitive impairments, but also early indicators of the presence of neurodegenerative disorders, like cerebrovascular diseases, dementia in Alzheimer's or Parkinson's disease, which also affect the decrease of cognitive abilities.

Estimation of cognitive functioning of depressive patients is made additionally difficult because their poorer achievements at certain tests may be the result of the influence of many unspecific factors, and not only the consequence of dysfunction of some brain region. The most obvious deficiency does not necessarily imply a basic cognitive disorder in a disease (Totić-Poznanović, 1999). Such reasoning may be applied on the results of our investigation. They indicate that the most obvious deficiency is found at the tasks of delayed recollection. Analysis of the remaining functions excluded primary memory disorder, but indicated instead that the basic disorder is that of attention and executive functions.

The results of our investigations confirm that in endogenous depression there exists, to a moderate degree, cognitive dysfunction in the remission phase. Such finding is also confirmed by recent studies, suggesting that in depressive patients in remission there occurs only incomplete cognitive recovery (Gallassi, Di Sarro, Morreale, & Amore, 2006). Our results show that the indicators of fronto-limbic dysfunction could be the result of permanent characteristics, considering that they appear in the remission phase. The investigations suggest connection between depressive disorder and reduction in metabolic activity of the prefrontal cortex (Dolan et al., 1992; Drevets, 2000) on one hand, and neural atrophy in limbic structures like hippocampus and amygdale (Sheline, Gado, & Price, 1998; McEwen & Magarinos, 2001), on the other. The studies using positron emission tomography recorded circulation reduction in frontal lobe and limbic system (Starkstein et al., 1996; Mayberg, 1994).

There is large number of neuropsychological studies concerning the relation between cognitive dysfunctions and depressive episode severity. Most of them show connection between the severity of depression and cognitive problems, confirming that the patients with more serious clinical appearance of depression also show more serious cognitive dysfunctions (Emilien, Penasse, & Waltregny, 1998; Elderkin-Thompson et al., 2003; Airaksinen, Larsson, Lundberg, & Forsell, 2004). Other investigations, however, do not confirm this connection, suggesting that recorded cognitive disorders are not in correlation with the severity of depression (Moreaud et al., 1996; Portella et al., 2003). Differences between the findings arise from uneven methodology, types of applied tests, including of both psychotic and non-psychotic patients in the same group, various ages or educational levels, etc.

In our sample, it was not possible to estimate directly the participation of the intensity of depressive symptoms in cognitive functioning. Considering that the depressed patients were tested in the remission phase, the degree of depressiveness is excluded as a factor directly affecting neuropsychological state. This fact leads to the conclusion that cognitive deficiency is not only the result of the disorder severity, i.e. symptom intensity, but also of other factors which determine the occurrence and the degree of cognitive damage. This opens a wide field for future multidisciplinary investigations.

The finding that our patients in remission phase showed such neuropsychological pattern that is similar to the patterns of cognitive impairments found in the presence of depression (Deuschle et al., 2004; Gallassi et al., 2006), indicates that the recorded cognitive dysfunction in endogenous depression is a permanent disorder.

CONCLUSIONS

Cognitive dysfunction was found in the patients with endogenous depression in the remission/euthymic phase. Neuropsychological deficiency includes the disturbance of attention, memory and executive functions. General cognitive level and mental flexibility are maintained. Such deterioration pattern indicates the following:

- a) primary attention disorder leads to the reduction of the range of memorized pieces of information, and deficient strategies of recollection and evocation, impair the presentation of verbal and visual memory;
- b) impaired working memory makes designing and choosing of appropriate strategy difficult, while the disorder of prolonged attention is reflected on the ability of maintaining the cognitive set.

Neuropsychological deficiencies of the patients with endogenous depression suggest cortex-subcortex frontal-limbic dysfunction.

The groups of depressive and demented patients have similar achievements at the tasks which estimate the prolonged attention. At the remaining applied tests, those estimating recent long-term memory and executive functions great differences are found, at the expense of demented patients.

Excesses in cognitive functioning of demented patients are more serious and massive in comparison with cognitive problems of depressive patients. The pattern of impairment in the group of depressive patients is of a moderate degree and does not support intellectual deterioration of dementia type.

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