Platelet Monoamine Oxidase Activity, Ego Strength, and Neuroticism in Soldiers with Combat-Related Current Posttraumatic Stress Disorder

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Aim. To assess possible differences in platelet monoamino oxidase-B (MAO-B) activity, ego strength, and neuroticism in combat-experienced soldiers with or without current posttraumatic stress disorder (PTSD).

Method. The soldiers with current PTSD (N=36) and a control group of 34 healthy soldiers were matched in combat experience, time passed between combat experience and the study, demographic variables (age, marital status, education), and smoking status. Platelet MAO-B was assayed fluorometrically, ego strength was measured by the Croatian version of the Ego Identity Scale, and neuroticism by the N-scale from Eysenck’s EPQ-R questionnaire.

Results. Soldiers with combat-related current PTSD had lower platelet MAO-B activity than the control group (9.1±3.9 vs. 11.9±4.0; p<0.05), as well as lower ego-strength (86.3±8.3 vs. 108.6±13.4; p<0.05) and higher neuroticism (23.5±13.2 vs. 5.9±4.7; p<0.05). There was no association of ego strength or neuroticism with platelet MAO-B activity.

Conclusion. Ego identity strength and emotional stability are associated with successful coping with combat trauma. The involvement of platelet MAO-B activity in biological basis of ego strength and neuroticism could not be demonstrated.

Key words: Croatia; ego; monoamine oxidase; neurotic disorders; personality tests; psychotrauma; PTSD; veterans; war

Preclinical and clinical studies of the serotonergic mechanisms in the pathophysiology of posttraumatic stress disorder (PTSD) and treatment trials involving serotonergic agents are limited, but indicate considerable promise, especially in the treatment of hyperarousal symptoms and intrusive recollection of traumatic experiences (1). Some data suggest the presence of two neurobiological subgroups of patients with PTSD, one with sensitized noradrenergic system and the other with sensitized serotonergic system (2). The involvement of serotonin in posttraumatic stress disorder is suggested by its role in regulating mood, arousal, and sleep (3), and by the similarity of obsession in obsessive-compulsive disorder and intrusive thoughts in PTSD (4).

Platelet monoamine oxidase B (MAO-B) activity has been proposed as an indicator of serotonergic system (5), and the structural identity between neuronal and platelet MAO-B (6) has been demonstrated. Low platelet MAO activity was proposed as a psychopathological risk factor for many conditions, such as alcoholism, antisocial behavior, psychopathic criminal offenders, and schizophrenia (7). Platelet MAO activity was correlated with specific symptoms in depression such as anxiety, depressed mood, weight loss, agitation and hypochondriasis (7). In PTSD, only a subgroup of subjects with a history of alcohol abuse had lower platelet MAO activity than controls (8).

On the other hand, the serotonergic system seems to be involved in the biological basis of ego strength and neuroticism. Ego strength correlates inversely with a serotonin metabolite, 5-hydroxyindolamin acid (5-HIAA) (9). Neuroticism showed nonlinear association with platelet MAO activity in one study (10), but not in others (11-13). Intense stress can also decrease ego strength (14) and increase neuroticism (15,16). Veterans with combat-related PTSD have lower levels of identity achievement (17), and higher neuroticism than the control group (18), confirming the relationship between stress and both ego strength and neuroticism.
The first aim of the study was to assess possible differences in platelet MAO-B activity, ego strength, and neuroticism in combat-experienced soldiers with or without current PTSD in an attempt to relate PTSD with these biologic and personality parameters. The second aim was to explore the relationship among platelet MAO-B activity, ego strength, and neuroticism.

Subjects and Methods

Subjects

The group of soldiers with combat-related PTSD consisted of 36 men, aged 19-39 years (mean±SD, 27.9±4.5). As they were drafted for active military service, they passed rigorous entrance tests, which ensured that they had not had any abnormal personality trait or disorder. At the start of the study, they all fulfilled the research criteria for PTSD of the International Classification of disorders (ICD-10) (19), as well as Watson's criteria for PTSD, based on Diagnostic and Statistical Manual of mental disorders, 3rd revised edition (DSM-III-R) (20).

The control group comprised 34 healthy soldiers with combat experience, aged 19-38 years (27.5±4.0). According to the ICD-10 research criteria and Watson's criteria for PTSD, none of them had PTSD or any other posttraumatic state.

The two groups were matched in the duration of combat experience (3.1±0.7 years), time passed between combat experience and the study (1.9±0.8 years), age, marital status (mostly married), education (secondary school mostly), and smoking status (about half of the subjects were smokers).

Medical Examination

Current PTSD-positive group and control group were selected during the obligatory medical examination in the army service. They underwent complete individual medical and psychiatric examination, performed by a general practitioner and two psychiatrists. The subjects were explained the aim of the study and all of them gave informed consent. All were free of any psychotropic medications.

For evaluation of psychological distress due to the war trauma exposure, all subjects underwent a structured clinical interview according to the research version of ICD-10 criteria (19). Two psychiatrists performed this part of the evaluation, each of them examining independently all the subjects. After medical and psychiatric examination, a clinical psychologist applied a set of questionnaires. A full agreement between two psychiatrists and a psychologist in regard to psychiatric disturbances was required for each subject to enter the study.

Subjects filled the questionnaires individually and anonymously. After this, the blood was taken for the analysis of biochemical parameters. Blood was taken always in the morning, to ensure the synchronisation of the secretion cycle of serotonin metabolism. The questionnaires were coded, as well as blood samples, and design was double blind, in order to control for the Rosenthal's effect (21).

Psychological Measurements

Ego strength was measured by the Ego Identity Scale according to Erikson's theory (22). The test has been standardized in Croatian population (23). It consists of 80 statements reflecting the criteria of health and illness for the first six psychological stages as described by Erikson (14): Trust, Autonomy, Initiative, Industry, Identity, and Intimacy. The scale yields an Identity Score, formed as a linear composite of six subscales. Each subscale has 12 items, and the lie scale has 8 items. The items are randomly ordered and presented in a questionnaire format suitable for group or individual administration to respondents of about 13 years of age or older. The scale was shown to have adequate psychometric properties: Cronbach's alpha (24) for six subscales ranged from 0.75-0.98.

Neuroticism was measured by the N-scale from Eysenck's Personality Questionnaire-Revised, EPQ-R (25). Croatian translation of EPQ-R has demonstrated adequate psychometric properties (data not shown).

In order to confirm the presence or absence of PTSD, all subjects were psychometrically reevaluated for the posttraumatic symptoms psychometrically by Watson's PTSD questionnaire based on the DSM-III-R criteria (20), in addition to the psychiatric assessment.

The data in Table 1 show average values of platelet MAO-B activity, ego identity strength, and neuroticism in combat experienced soldiers with current PTSD and combat experienced soldiers without PTSD. Combat-experienced soldiers with current PTSD showed significantly (p<0.05) lower platelet MAO activity, lower total ego strength, and higher neuroticism than combat experienced soldiers without PTSD (control group).

Correlation of ego strength or neuroticism with platelet MAO-B activity in combat experienced soldiers with or without current PTSD are presented in Table 2. As expected, ego strength correlated inversely and moderately with neuroticism in both groups.

Neither ego strength nor neuroticism correlated with platelet MAO-B activity. Although the correlations failed to reach statistical significance at level of probability less than 0.05, the directions of correlations were congruent: the correlation between ego strength and platelet MAO-B activity was in positive direction and that between neuroticism and platelet MAO-B activity was in negative direction.

Discussion

Our study demonstrated that soldiers with combat experience and current PTSD had lower platelet MAO-B activity than soldiers with combat experience who remained psychologically healthy, i.e., had not developed PTSD. Davidson et al (8) found an overall significantly lower MAO activity in PTSD patients. When the PTSD patients were divided into those with or without history of alcohol abuse, only the former group differed significantly from control subjects (8). Our group included no
subject with a history of alcohol abuse, but in spite of that the group demonstrated lower MAO activity than the control group. Low platelet MAO activity is a risk factor for a variety of psychopathological states and is also associated with some types of PTSD comorbidity (PTSD and alcoholism, PTSD and depression) but it is not clear whether low platelet MAO results from or precedes different psychopathology (29). We did not assess symptoms connected with PTSD, such as depression and anxiety, in our patients, although low platelet MAO activity may increase the risk of developing depression, as well as alcoholism (8). To prove this hypothesis, it will be necessary to study depressive symptoms in PTSD patients in relation to platelet MAO activity. Also, low platelet MAO activity may independently increase the risk of developing PTSD. Thirdly, it would be necessary to study the relationship between platelet MAO activity and different clusters of PTSD symptoms. PTSD syndrome is a complex state and consists of hyperarousal, intrusive, and avoidance symptoms. The suggestion that PTSD may be a member of the family of affective disorders comes from the reports on the treatment effects of monoamine oxidase inhibitors (MAOIs) in PTSD, since platelet MAO-B activity has been unequivocally correlated with specific symptoms in depression (avoidance) (30). Patients with avoidance symptoms are often less severely depressed and free of vegetative symptoms of depression. Avoidance symptoms of PTSD respond less promptly to pharmacotherapy and may be less important in characterizing PTSD than the intrusive recollection of traumatic events and hyperarousal symptoms (29,30).

The group of soldiers with PTSD showed lower total ego identity strength and higher neuroticism than the control group, in line with the other studies in PTSD (17,18), as well as in line with Erikson’s theory (14), which assumes that lower ego strength is associated with increased psychopathology. Our results indicate that higher ego strength and higher emotional stability may be associated with successful coping with combat trauma. A study of firefighters, showing that neuroticism and a past history of treatment for a psychological disorder were better predictors of post-traumatic morbidity than the degree of exposure to the disaster or the losses sustained (31), suggests neuroticism as an indicator of stress vulnerability. The design of our study does not allow the differentiation whether lower ego strength and higher neuroticism in the PTSD group were the result of poor coping with combat war stressors or the precursor of combat trauma, since the study groups were not evaluated for ego strength and neuroticism before the war. It is known that there are people who cope well with trauma (32) and who remain healthy, without detectable psychopathology, in spite of being exposed to trauma stressors. They can even experience some positive changes following trauma (33). An explanation for our data may be that successful coping with trauma increases ego strength and emotional stability, whereas unsuccessful coping acts in the opposite direction. It is also possible that lower ego strength and higher neuroticism are indicators of stress vulnerability. One could also assume that both hypotheses are true.

Ego strength has been associated with several neurotransmitter systems. It correlates negatively with concentrations of norepinephrine in cerebrospinal fluid, plasma dopamine β-hydroxylase activity (13), and dopamine metabolite homovanillic acid (HVA) (9), but also with serotonin metabolite 5-HIAA (9). In our study, ego strength did not correlate with platelet MAO-B activity. To our knowledge there is no other published study investigating this relationship. Our study showed that neuroticism was not related to platelet MAO-B activity. An inverse relationship between neuroticism and enzyme monooamine oxidase was found inconsistently in other studies (10-13). Neuroticism was related to other neurotransmitter systems. It correlated negatively with the calcium levels in cerebrospinal fluid and with the principal metabolite of norepinephrine, 3-metoxy-4-hydroxyphenylglycol (13), whereas no relationship between neuroticism and serotonin metabolite 5-HIAA was found in the study of Ballenger et al (9). Some authors maintain that the significance of platelet MAO-B is in its relationship with dopamine neurons in the human brain (34), while others stress its relationship with serotonergic system in the brain (5,35).

We found negative correlation between ego strength and neuroticism in both PTSD and non-PTSD soldiers,

<table>
<thead>
<tr>
<th>Tested parameter</th>
<th>PTSD</th>
<th>Control</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelet MAO-B activity (nmol 4-HQ/10^6 platelets/hour)</td>
<td>9.1±3.9</td>
<td>11.9±4.0</td>
<td>2.965*</td>
</tr>
<tr>
<td>Ego identity strength (total score)</td>
<td>86.3±8.3</td>
<td>108.6±13.4</td>
<td>8.421*</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>2.3±13.2</td>
<td>5.9±4.7</td>
<td>6.866*</td>
</tr>
</tbody>
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α<0.05 (t-test with Bonferroni correction). bβ-hydroxyquinoline.

α<0.01. β<0.05.

| Table 2. Pearson’s correlations of ego strength and neuroticism with platelet monoamine oxidase-B (MAO-B) activity in combat experienced soldiers with current posttraumatic stress disorder (PTSD) (N=36) and combat experienced soldiers without PTSD (N=34) |
|-------------------------------------------------|----------------|----------|---------|
| Soldiers                                        | Correlation coefficients |
|                                                  | Neuroticism | MAO-B activity |
| With PTSD                                       | Ego identity | -0.73*  | 0.22    |
|                                                  | Neuroticism  | −        | -0.17   |
| Without PTSD                                    | Ego identity | -0.42*  | 0.25    |
|                                                  | Neuroticism  | −        | -0.22   |

Table 1. Platelet MAO-B activity, ego strength, and neuroticism in combat experienced soldiers with current posttraumatic stress disorder (PTSD) (N=36) and combat-experienced soldiers without PTSD (control group, N=34)
which is in line with theoretical predictions (14,15) and the study in which ego strength was measured by a scale derived from the Minnesota Multiphasic Personality Inventory (13).

In conclusion, higher ego strength and emotional stability are associated with successful coping with combat trauma. Our results do not support the involvement of platelet MAO-B in the biological basis of ego strength and neuroticism. We believe that the measurement of platelet MAO activity may be a useful tool in understanding PTSD with regard to different clinical manifestations of PTSD, e.g., subtypes of PTSD (36). Further assessment of platelet MAO activity in relation to different clinical manifestations or specific symptoms of PTSD may contribute to a better understanding of this disorder and its treatment.

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