

Emotional and cognitive features of patients with post-traumatic stress disorder and visual impairment

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Емоційні та когнітивні особливості пацієнтів з посттравматичним стресовим розладом та порушеннями зору

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Abstract

Purpose: To determine the features of social and general personality functioning and emotional and cognitive changes in visually impaired patients with post-traumatic stress disorder (PTSD).

Material and methods. Totally, 72 male patients were under observation. These included PTSD patients with ocular injury and either reduced visual function ($n = 6$) or total visual loss ($n = 9$), PTSD patients with no visual impairment ($n = 20$), and patients with ocular injury but no PTSD ($n = 37$). MINI PTSD module was used to determine whether a patient had PTSD. The PTSD Checklist for DSM-5 (PCL-5)

was used to assess symptom severity. Personal and Social Performance Scale (PSP) was used to assess personality and social functioning, and Hospital Anxiety and Depression Scale (HADS), to evaluate depression and/or anxiety. Neuropsychological examination included the assessment of immediate memory, delayed memory, attention, language, and working memory. Perceived social support was also assessed.

Results. Compared to PTSD patients without visual impairment, those with total visual loss exhibited a 61.4% reduction in personality and social functioning scores ($p < 0.001$, $z = 4.465$), 24.1% reduction in immediate memory scores ($p = 0.001$, $z = 3.65$), 21.1 % reduction in attention scores ($p = 0.047$, $z = 2.41$) 50% reduction in perceived social support scores ($p = 0.034$, $z = 2.53$), and a 23.1% increase in depression scores ($p = 0.021$, $z = -2.7$). Personality and social functioning scores were 4.7 times lower in PTSD patients with partial visual loss than in those without visual impairment ($p < 0.02$, $z = 3.371$). Delayed memory scores were 51.7% higher in PTSD patients with total visual loss than in those with partial visual loss ($p = 0.014$, $z = 2.82$).

Conclusion. The course of PTSD in patients with visual impairment or visual loss is accompanied by the development of a specific functional and psychological profile which is characterized by reduced social and general personality functioning, increased depression symptoms, and impaired attention, immediate verbal memory, and perceived social support.

Keywords: ocular injury, post-traumatic stress disorder, clinical psychology, neuropsychology, rehabilitation

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Резюме

Мета. Визначити особливості соціального і загально-го особистісного функціонування, емоційних та когнітивних змін при ПТСР у пацієнтів з порушеннями зору.

Матеріал та методи. Під спостереженням знаходились 72 пацієнти з посттравматичним стресовим розладом і травмою ока зі зниженням зорових функцій (6 осіб) або повною втратою зору (9 осіб), з посттравматичним стресовим розладом без порушень зору (20 осіб), та пацієнти з травмою ока без посттравматичного стресового розладу (37 осіб). Наявність ПТСР встановлювали за відповідним модулем структурованого клінічного інтерв'ю MINI, вираженість посттравматичних симптомів оцінювали за PCL-5. Загальне особистісне і соціальне функціонування визначали за шкалою PSP, тривожну й депресивну симптоматику – HADS. Нейропсихологічне обстеження включало оцінювання безпосередньої та відстроченої пам'яті, уваги, мовлення і робочої пам'яті. Окремо аналізували суб'єктивне сприйняття соціальної підтримки.

Результати. У пацієнтів з ПТСР і повною втратою зору порівняно з пацієнтами з ПТСР без порушення зору виявлено нижчі показники особистісного та соціально-

го функціонування на 61,4% ($p < 0,001$, $z = 4,465$), безпосередньої пам'яті на 24,1% ($p = 0,001$, $z = 3,65$), уваги на 21,1% ($p = 0,047$, $z = 2,41$) та соціальної підтримки вдвічі ($p = 0,034$, $z = 2,53$); показник депресивної симптоматики був вищим на 23,1% ($p = 0,021$, $z = -2,7$). У пацієнтів з частковою втратою зору виявлено лише зменшення показників особистісного та соціального функціонування в 4,7 рази ($p < 0,02$, $z = 3,371$) порівняно з пацієнтами з ПТСР без порушень зору. У пацієнтів з повною втратою зору і ПТСР показники відстроченої пам'яті перевищували показники пацієнтів з ПТСР і частковою втратою зору на 51,7% ($p = 0,014$, $z = 2,82$).

Висновок. Перебіг ПТСР у пацієнтів з порушеннями або втратою зору супроводжується формуванням специфічного функціонально-психологічного профілю пацієнтів, провідними компонентами якого є зниження загального особистісного і соціального функціонування, посилення депресивної симптоматики, порушення уваги та безпосередньої вербальної пам'яті, а також суб'єктивного сприйняття соціальної підтримки.

Ключові слова: травма ока, посттравматичний стресовий розлад, клінічна психологія, нейропсихологія, реабілітація.

Introduction

Modern military conflicts have led to a rise in the incidence of post-traumatic stress disorder (PTSD). Approximately 7% of the U.S. adult population has met the diagnostic criteria for PTSD in their lifetime, with a substantially higher prevalence of 12%–30% among military personnel [1]. The course of the disease may be influenced by comorbid combat injuries [e.g., mild traumatic brain injury (mTBI) and severe ocular injury accompanied by a partial or total loss of vision] [2, 3].

The major feature of modern combat eye injury is combined anterior and posterior segment lesions with severe orbital and facial comorbidities. A bilateral eye injury with a persistent visual impairment or irreversible loss of vision is common [4, 5]. The very fact of eye injury and loss of vision may cause a short-term or long-term psychological or mental disorder. Such patients are at high risk of depression, PTSD, etc. [6]. Our previous study [7] demonstrated that, in patients with eye injury and mild traumatic brain injury, the most prominent cognitive deficits occurred in the domain of executive function (including cognitive control and planning and problem-solving skills). These deficits had a substantial impact on attention and memory and significantly affected the patient's capacity for independent functioning [7].

According to diagnostic criteria for PTSD, vision loss in itself is generally not considered as a traumatic event (visual loss as a medical consequence is not the same as the traumatic event, but the event that caused this loss may be the one outlined in Criterion A of PTSD) [8]. With regard to the features of the course of PTSD in patients

with traumatic visual impairment, establishing temporal relationship and inferring causality between ocular trauma and psychological outcomes (particularly, PTSD) is important for developing and evaluating the efficacy of integrated mental health care in ophthalmic settings [9]. Given the above, it is deemed relevant to explore the features of the course of PTSD in patients with post-traumatic visual impairment or loss of vision in an attempt to lay the ground for developing novel methods for the diagnosis and correction of the disease.

The purpose of the study was to determine the features of personal and social performance and emotional and cognitive changes in visually impaired patients with PTSD.

Methods

Clinical observations were conducted at the Odesa Regional Medical Center for Mental Health (a municipal non-commercial healthcare enterprise of the Odesa Regional Council), Branch 1 of the Lisova Polyana Veterans Mental Health and Rehabilitation Center (Ministry of Health of Ukraine), and Expert Health Medical Center within the framework of a Laboratory of Educational Psychology (H.S. Kostiuk Institute of Psychology)-led research project entitled "Potential of Genetic Psychology in the Study of the Interaction of Subjects in the Educational Space" (State Registration No. 0121U107603). The study was conducted in accordance with the standards set forth in the Helsinki Declaration and written informed consent was obtained from all study subjects.

Totally, 72 male patients aged 25–45 years were under observation. The investigation group ($n = 15$) included PTSD patients with eye injury-associated and low vision ($n = 6$) or total visual loss ($n = 9$). Control group 1 ($n = 20$) included PTSD patients with no history of eye trauma and no visual impairment, and control group 2, patients with no PTSD but a history of eye trauma and either post-traumatic low vision ($n = 23$) or total visual loss ($n = 14$). PTSD, if present, was associated with combat exposure.

All patients were examined by a psychiatrist, a neuropathologist and an ophthalmologist. They did not require special special neurological or ophthalmological treatment when they were staying at the rehabilitation center. Patients were psychologically and neuropsychologically examined by a clinical psychologist while they were treated and rehabilitated at the appropriate center as inpatients.

All visually impaired patients had a history of either closed globe injury or Zone 1 or Zone 2 open globe injury, as per the Birmingham Eye Trauma Terminology [10]. More than one half (55.7%) of ocular lesions were bilateral. All wounded patients underwent reconstructive microsurgical treatment. Patients underwent psychological and neuropsychological examination on completion of their ophthalmological treatment. The presence of ocular injury or lesion secondary to combat traumatic injury was determined on the basis of medical records. Total visual loss was defined as the complete lack of light perception and form perception. In the group with low vision secondary to combat eye injury, visual acuity was less than 0.3 in both eyes.

The inclusion criteria were age 25–45 years, the presence of eye injury and/or PTSD, and average or above-average intelligence as measured by scores on the Raven's Progressive Matrices. Exclusion criteria were (1) a high risk of suicidal behavior; (2) personality disorders or traits that may affect treatment compliance or determine an increased risk of impulsive, uncooperative, sexually uninhibited and/or aggressive behavior; commonly exhibiting marked disorders of consciousness, speech and/or behavior; commonly exhibiting marked disorders of consciousness, speech and/or behavior; (3) acute psychotic symptoms; (4) marked side effects of treatment; (5) the presence of other factors seriously impeding the establishment and maintenance of long-term productive contact, or (6) presence of the neurological condition preventing participation in the study.

The following methods were used: (1) formalized interview; (2) certain scales of the Mini-International Neuropsychiatric Interview (MINI), such as Suicidality, Post-traumatic Stress Disorder, Alcohol Dependence, and Drug Dependence scales [11]; (3) Raven's Progressive Matrix scale [13] for differentiation among subjects based on their Raven's test scores as measures of general intelligence; (4) The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5) [12]; (5) Personal and Social Performance Scale (PSP) [13]; (6) Hospital Anxiety and

Depression Scale (HADS) [14, 15]; and (7) Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) to assess cognitive impairment in Immediate Memory, Visuospatial/Constructional, Language, Attention, and Delayed Memory domains [16].

The methods employed in this study had been included in the list of valid methods of psychological diagnosis that can be used for psychological diagnosis and assessment of the quality of psychological care [17].

Neuropsychological and Psychological Study Design

The M.I.N.I PTSD module was used to determine whether a patient had PTSD. In the first phase of the study, the PSP scale was used to estimate the personality and social functioning in PTSD patients with no visual impairment; HADS was employed to evaluate the presence and severity of anxiety and depression; the PCL-5 was administered to evaluate the severity of post-traumatic symptoms.

Patients underwent neuropsychological examination using the RBANS. The PCL-5 was not administered in patients who did not meet the criteria for PTSD (as assessed with the MINI). In patients with total visual loss and no PTSD, the PCL-5 was administered, while taking the severity of trauma into account, and these patients had expected low scores. The neuropsychological examination in patients with total visual loss involved the identification and analysis of only available characteristics (verbal immediate memory, verbal delayed memory, verbal attention, verbal language and verbal working memory). Social support was analyzed separately. It was self-assessed with a formalized interview wherein the interviewee used a score of 0–5, where 10 is maximum social support.

In the second phase of the study, similar characteristics were assessed in PTSD patients with a total or partial loss of vision. Depending on the extent of visual loss, patients were divided into a group with traumatic partial loss of vision and a group with traumatic total loss of vision. The above characteristics were also measured in patients with no PTSD but a history of eye trauma and either post-traumatic low vision or total visual loss.

Three independent groups (PTSD patients with no visual impairment; PTSD patients with partial visual loss, and PTSD patients with total visual loss) were compared to determine the features of the psychological profile depending on the severity of visual deficit.

PTSD patients with partial visual loss and those with total visual loss were pooled into a single group for comparing with PTSD patients with no visual loss and assessing a total contribution of visual loss depending on its severity.

Groups of patients with and without PTSD were compared to assess a contribution of PTSD in patients with traumatic partial visual loss.

Descriptive and variance statistical analyses were employed. The distributions of quantitative variables were tested for normality. Non-parametric tests (like

the Mann-Whitney U test) were performed for further analysis. The Kruskal-Wallis H test followed by Dann–Bonferroni pairwise test was performed to assess general differences among the three PTSD groups. Resultant data are presented as median [interquartile range (IQR)]. Two-tailed asymptotic P values were used for analysis. The level of significance was set at $P < 0.05$.

Results

Characteristics of the psychological status of PTSD patients with no visual impairment were obtained as a result of examinations (Table 1). Based on HADS-A score, 9 patients (45%) had no clinically significant level of anxiety, 2 (10%) had a subclinical level of anxiety, and 9 (45%) had a clinically significant level of anxiety. Based on HADS-D score, 10 patients (50%) had no clinically significant level of depression, 6 (30%) had a subclinical level of depression, and 4 (20%) had a clinically significant level of depression. Immediate memory was normal in 65%, moderately impaired in 25.0%, and markedly impaired in 10.0%. Language scores were within a normal range in all patients in this group. The RBANS showed normal attention in 70%, moderately impaired attention in 15%, and markedly impaired attention in 15% of patients. Delayed memory was normal in 15% and moderately impaired in 85.0% of patients. Mild, moderate and marked difficulties with PSP functioning were found in 60%, 10% and 30%, respectively, of PTSD patients with no visual impairment.

In the subsequent phase of the study, PTSD patients with visual impairment were compared with those without visual impairment regarding the examined characteristics to elucidate the effect of post-traumatic visual impairment on the course of PTSD. PSP functioning was lower in

PTSD patients with visual impairment than in those without visual impairment, 25 (17.5; 28) versus 72.5 (40; 80), $U = 6.5$; $p \leq 0.001$. HADS-D scores were higher in the former patients, 10 (7.5; 12) versus 6.5 (2.75; 10), $U = 220.5$; $p = 0.019$. Immediate verbal memory was lower in PTSD patients with visual impairment than in those without visual impairment, 69 (65; 70.5) versus 91 бал (74.5; 93.5), $U = 60$; $p = 0.003$. Attention scores were lower in the former patients, 75 (72; 83.5) versus 95 (88; 98), $U = 62$; $p = 0.003$. Median PTSD symptoms severity as assessed by PCL-5 was lower in PTSD patients with visual impairment than in those without visual impairment, 48 (37; 52.75) versus 65 (53.5; 70), $U = 64.5$; $p = 0.009$. Self-perceived social support was also lower in the former patients, 4 (2; 5) versus 8 (4.75; 8), $U = 65.5$; $p = 0.004$.

There was no significant difference ($p > 0.05$) in HADS anxiety, learning, delayed memory or working memory scores between the group of PTSD patients with partial or total vision loss and the group of PTSD patients without visual impairment.

Because these findings suggested the need for a more detailed analysis of effects of the severity of visual loss on the course of PTSD, subsequently, the group of PTSD patients without visual impairment was compared with the group of PTSD patients with partial or total vision loss with regard to the features of psychological profile (Table 1).

The Kruskal-Wallis H test found significant differences between these groups in personal and social functioning as measured by the PSP scale, HADS-D scores, RBANS immediate memory, attention, and delayed memory scores, PTSD symptom severity, and self-perceived social support, but not in HADS-A scores or language scores.

Table 1. Effects of post-traumatic visual loss on the psychological profile scores of patients with post-traumatic stress disorder [median (interquartile range)]

Characteristic	PTSD with no visual impairment, n = 20	PTSD with partial visual loss, n = 6	PTSD with total visual loss, n = 9	H; p
PSP	72.5 [40; 80]	15.5 [13; 18.75]* ¹	28 [25; 30] * ¹	H=25.03; p<0.001
HADS-Anxiety	9 [3.75; 13.25]	7 [6; 8.75]	12 [10; 13]	H=3.28; p=0.198
HADS-Depression	6.5 [2.75; 10]	11.5 [10.25; 12]	8 [5; 12]* ¹	H=7.59; p=0.022
Immediate memory	91 [74.5; 93.5]	61 [54; 65]	69 [69; 81]* ¹	H=13.54; p=0.001
Language	100 [99; 105]	94 [77.25; 101]	100 [96; 102]	H=1.93; p=0.381
Attention	95 [88; 98]	73.5 [60; 75]	75 [75; 85]* ¹	H=8.8; p=0.012
Delayed memory	78 [75; 78.5]	58 [53; 66.75]	88 [80; 90]* ²	H=7.95; p=0.019
PCL	65 [53.5; 70]	43.5 [40.25; 52.75]	50 [35.75; 52.25]	H=7.06; p=0.029
Social support	8 [4.75; 8]	3 [0.5; 4.75]	4 [3; 5]* ¹	H=8.65; p=0.013

Note: *¹, $p < 0.05$ compared to PTSD patients with no visual impairment; *², $p < 0.05$ compared to PTSD patients with no partial visual loss; n, number of patients in the group. The Kruskal-Wallis H test followed by Dann–Bonferroni pairwise test was performed for statistical analysis

A post-hoc Dunn's test found that, compared to PTSD patients without visual impairment, those with total vision loss had 61.4% lower personal and social functioning as measured by the PSP scale ($p < 0.001$, $z = 4.465$), 24.1% lower immediate memory scores ($p = 0.001$, $z = 3.65$), 21.1% lower attention scores ($p = 0.047$, $z = 2.41$) and 50% lower scores for self-perceived social support ($p = 0.034$, $z = 2.53$), and 23.1% higher HADS-D scores ($p = 0.021$, $z = -2.7$).

Additionally, compared to PTSD patients without visual impairment, those with partial vision loss had 4.7 times lower personal and social functioning scores as measured by the PSP scale ($p < 0.02$, $z = 3.371$).

Of note were changes in delayed memory scores in PTSD patients with visual loss. First, there was no significant difference in delayed memory scores between PTSD patients without visual loss and those with partial or total vision loss. Second, delayed memory scores were 51.7% higher in PTSD patients with total visual loss than in those with partial visual loss ($p = 0.014$, $z = 2.82$). Finally, delayed memory scores were 25.6% lower in PTSD patients with partial visual loss than in those without visual impairment, but the difference in delayed memory scores between the latter and the former (unlike PTSD patients with total visual loss) was not significant ($p > 0.05$).

Although there were significant differences in PCL-5 scores among the three groups of patients (Table 1), post hoc analysis revealed no significant difference between any pair of these groups. Therefore, further research is required with a larger sample size.

In an attempt to clarify the contribution of PTSD in the psychological status of patients with traumatic partial loss of vision, patients with partial loss of vision and PTSD were compared separately with those with no PTSD. Compared to patients with partial loss vision and no PTSD, those with total loss vision and no PTSD had 2.21 times higher PSP scores ($p < 0.0001$), 13.1% ($p = 0.008$) higher immediate memory scores, and 14.7% ($p = 0.045$) higher delayed memory scores.

Additionally, compared to patients with partial loss vision and no PTSD, those with partial loss vision of vision and PTSD had 9.7% higher PSP scores ($p < 0.0001$), two times higher self-perceived social support scores ($p = 0.020$), but 42.9% lower anxiety scores ($p < 0.0001$) and 65.22% lower depression scores ($p = 0.001$). Moreover, compared to patients with total loss of vision and PTSD, those with total loss of vision and no PTSD had 33.9% higher PSP scores ($p < 0.0001$), 19.6% higher immediate memory scores ($p = 0.013$), 50% higher self-perceived social support scores ($p = 0.004$), 21% higher attention scores ($p = 0.028$), 1.7% higher delayed memory scores ($p = 0.021$), two times lower depression scores ($p = 0.004$), and 63% lower PCL-5 scores ($p = 0.001$).

Our findings indicate that, in the presence of the same visual deficit, the presence of PTSD was most strongly associated with emotional abnormalities and low self-perceived social support.

Therefore, PTSD with posttraumatic visual impairment was characterized, above all, by marked decline in personal and social functioning. In PTSD patients with total loss of vision, we found higher depression scores and lower immediate memory, attention and self-perceived social support scores than in PTSD patients with partial loss of vision. However, compared to a partial loss of vision, a total loss of vision was accompanied by higher delayed memory scores. This indicates that functional, emotional and cognitive changes were not linear but heterogeneous and depended on the severity of posttraumatic visual loss.

Discussion

The results of the present study indicate that post-traumatic visual deficit changes the clinical profile of patients with PTSD predominantly through increased functional and social limitations and selected changes in emotional and cognitive domains. The psychological state of PTSD patients without visual impairment was characterized by significant heterogeneity, with almost half of them exhibiting a clinically significant level of anxiety, whereas marked depression was observed less frequently. This confirms that, in PTSD, anxiety and depression manifestations do not necessarily change in parallel, and can vary in severity within a clinical group.

The cognitive profile of PTSD patients without visual impairment did not show global cognitive decline. Immediate memory and attention scores in the majority were normal, and the language was well preserved as measured by the RBANS in all of the above patients.

Our findings are, to some extent, consistent with the conclusion on the need for research on emotional and cognitive shifts in stress-related disorders for developing new diagnostic, therapeutic and psychotherapeutic approaches to their treatment [18].

In the present study, moderately reduced delayed memory scores were the most prominent cognitive change. Well preserved language abilities and relatively preserved immediate memory in a portion of patients, however, may be considered resources the psychologist may rely on when providing psychological care or rehabilitation.

PSP scores indicated that, of PTSD patients without visual impairment, the majority exhibited mild difficulties, and one third, marked difficulties with personal and social functioning. Therefore, PTSD can significantly limit activities of daily living, the ability to perform social functioning and the capacity to perform customary roles. The severity of functional loss, however, varied from patient to patient, which stresses the clinical heterogeneity of PTSD. Our comparison of PTSD patients with visual impairment with those with no visual deficit demonstrated that it was general functioning that was most markedly affected by the presence of visual impairment. Significantly reduced PSP scores indicated that visual deficit aggravates the difficulties with independent functioning, mobility, independently performing activities for daily living, social interaction, and resuming pre-injury roles and routines.

Table 2. Features of the psychological profile of patients with post-traumatic visual impairment and no post-traumatic stress disorder [scores, median (interquartile range)]

Characteristic	Patients with partial visual loss and no PTSD n=23	Patients with total visual loss and no PTSD n=14	PTSD patients with partial visual loss n=6	PTSD patients with total visual loss n=9
PSP	17 [14.5; 18] * ² (U=0.00; p<0.001; r=0.83)	37.5 [30; 77]	15.5 [13; 18.75] * ¹ (U=9.50; p<0.001; r=0.70)	28 [25; 30] * ² (U=0.00; p<0.001; r=0.78)
HADS-Anxiety	4 [3; 4.5]	4.5 [3; 7]	7 [6; 8.75] * ¹ (U=21.00; p<0.001; r=0.62)	12 [10; 13]
HADS-Depression	4 [2.5; 5]	4 [3; 5.75]	11.5 [10.25; 12] * ¹ (U=22.50; p=0.001; r=0.60)	8 [5; 12] * ² (U=7.00; p=0.004; r=0.65)
Immediate memory	73 [57; 77] * ² (U=76.50; p=0.008; r=0.44)	82.5 [78; 94]	61 [54; 65]	69 [69; 81] * ² (U=12.00; p=0.013; r=0.55)
Language	96 [85; 102.5]	90 [75.25; 94.25]	94 [77.25; 101]	100 [96; 102]
Attention	88 [77; 94]	90.5 [85; 98]	73.5 [60; 75]	75 [75; 85] * ² (U=15.50; p=0.028; r=0.49)
Delayed memory	78 [62; 86.5] * ² (U=97.50; p=0.046; r=0.33)	89.5 [76.25; 98]	58 [53; 66.75]	88 [80; 90] * ² (U=14.00; p=0.021; r=0.52)
PCL	-	18.5 [12.75; 27.5]	43.5 [40.25; 52.75]	50 [35.75; 52.25] * ² (U=0.00; p=0.001; r=0.78)
Social support	6 [5; 8]	6 [5; 7]	3 [0.5; 4.75] * ¹ (U=49.00; p=0.020; r=0.41)	4 [3; 5] * ² (U=7.50; p=0.004; r=0.65)

Note: *¹, p < 0.05 compared to patients with partial visual loss and no PTSD; *², p < 0.05 compared to patients with total visual loss and no PTSD; n, number of patients in the group. The Mann-Whitney U test was performed for statistical analysis

Our assumptions are consistent with the conclusions on the necessity of studies aimed at elucidating the behavioral features of PTSD patients with visual abnormalities when they identify their needs for qualified care and its type [8].

PTSD patients with total loss of vision had higher depression scores than those without visual impairment, but there was no difference in anxiety between these groups. This suggests that the emotional changes associated with post-traumatic visual deficit are largely associated with depressive experience, loss of capacity for independent functioning, change in self-esteem and social role, and increased anxiety scores. Consequently, this may serve as a target for psychotherapeutic interventions during rehabilitation.

Cognitive features were most prominently expressed in PTSD patients with total visual loss in whom the immediate memory and attention scores were lower than in PTSD patients with no visual loss. Such changes can result in difficulties with concentration on instructions, task switching, and orientation in a complex environment, mastering new activities, and the psychotherapeutic and rehabilitative process in general.

Delayed memory scores were lower, however, in PTSD patients with total visual loss than in those with partial visual loss. This confirms that the relationship between the severity of visual loss and cognitive function worsening is not linear. The above finding is likely to be explained by the already formed memorization strategies, previous rehabilitation experience, and more systematic use of compensatory skills.

Well-preserved verbal functions can be an important compensatory resource. It is they that the psychologist may rely on during psychological educational activities and learning sessions on verbally mediated strategies for memorization and while using spatial instructions and digital assistive technologies.

The Kruskal-Wallis test suggested statistically significant heterogeneity among the groups in terms of PCL-5 scores, but post hoc pairwise differences were not significant. Consequently, median PCL-5 scores in the groups with visual impairment can be viewed only as an indicator of direction of an identified tendency, but not a significant difference between specific groups. A mismatch between PCL-5 scores and marked functional impairment

may, however, indicate that a total PCL-5 score does not reflect completely the clinical burden of the disease for a patient with a severe sensory deficit.

It may be supposed that, in the presence of post-traumatic vision loss, some clinical problems shift from purely symptomatic to functional adaptive. Reliance on aid, limited mobility, and difficulties with independently performing activities for daily living, the loss of pre-injury social roles and the need for developing new ways of interacting with the environment come to the fore. Such a shift in the balance of emotional, cognitive, social, and functional manifestations can be considered a possible PTSD pathomorphosis induced by post-traumatic visual impairment.

The finding of a lower self-perceived social support in PTSD patients with total visual loss than in those without visual loss was clinically important. Social support may have an impact on motivation for rehabilitation and maintaining social activities. Self-perceived social support, however, is not equivalent to the actual extent of personal daily living care, support or supervision provided. The patient may have continuous supervision or substantial personal daily living care but not perceive it as an adequate emotional support. Overcare, on the contrary, may increase the feeling of dependence.

Our separate comparison of patients with both posttraumatic partial vision loss and PTSD to those with posttraumatic partial vision loss alone made it possible to isolate partially the contributions of PTSD and the visual deficit proper. Higher anxiety and depression scores in PTSD patients suggested that, for the same severity of visual loss, it is PTSD that is largely responsible for the emotional component of the clinical profile. Low self-perceived social support may reflect not only an actual care deficit, but also a change in the assessment of care in the presence of post-traumatic symptoms and depressive experience.

Our comparison of PTSD patients with no visual loss to those with posttraumatic partial vision loss and those with posttraumatic total vision loss demonstrated that an increase in the severity of visual loss was not accompanied by a consistent deterioration of all the parameters examined. This means that the clinical condition cannot be explained just by the amount of residual vision. Patient functioning is likely to depend additionally on whether compensatory skills have been developed, previous rehabilitation experience, the ability to use digital assistive technologies, and the type of routine and social supervision provided.

Somewhat better certain cognitive scores in patients with total visual loss than in those with partial visual loss may be associated with the fact that a portion of these patients have already mastered orientation, mobility and cane skills and the skills of using verbal prompts and other compensatory means. This is another point in favor of the need for early rehabilitation and the social involvement, which would be also an active and effective approach to cognitive function training.

Our comparison of patients with partial visual loss and PTSD to patients with partial visual loss and no PTSD demonstrated that it was depression and anxiety scores that were most markedly affected by the presence of PTSD. This made it possible to isolate partially the emotional contribution of PTSD from the contribution of the visual deficit proper. For the same severity of visual loss, patients with PTSD may have more difficulties with emotional controls than those without PTSD.

These findings justify the need for a brief neuropsychological screening of patients with post-traumatic visual loss. The latter is consistent with the view pointing to the necessity of early psychiatric screening and long-term monitoring of mental health among PRSD patients with visual loss [6]. We believe that such screening should be adapted to a sensory deficit. It is reasonable to measure auditory attention, immediate verbal memory, and delayed recall, working memory, verbal executive control and planning.

The practical value of such an examination consists in determining (1) whether the patient is ready for certain steps, including the possibility of undergoing psychotherapeutic sessions, or (2) a potential psychotherapeutic approach for a particular patient. Additionally, our findings indicate the feasibility of developing adapted therapeutic programs for PTSD patients with traumatic visual loss. Some trauma-focused psychotherapeutic methods for PTSD do not take into account the features of practical implementation in patients with visual loss, but, if adapted, would be required as effective and evidence-based psychotherapeutic methods.

Psychological rehabilitation in vision loss should involve adapted trauma-focused interventions, orientation and mobility training, compensatory strategy formation, daily living skills training and working with families. It is well known that the key points of the diagnostic assessment for PTSD are not only establishing the presence of the disorder, but also determining the features of the course of the disease in a particular patient and evaluating the effectiveness of the correction [19].

Therefore, post-traumatic vision loss in PTSD is associated not with a uniform deterioration of psychological cognitive functions, but rather with the formation of the specific profile of changes. The key component of the disorder is a loss of general personal and social function, which was found both in patients with total and partial visual loss. Additionally, patients with total visual loss had higher depression scores and lower attention, immediate memory and self-perceived social support scores. However, compared to a partial loss of vision, a total loss of vision was accompanied by higher delayed memory scores, which indicates that cognitive changes were not linear, and that the compensatory strategies formed before the traumatic event may have a role. Our findings confirm the need for the comprehensive evaluation of a PTSD patient, which should determine not only the severity of PTSD symptoms, emotional condition, the level of functional independence

and cognitive readiness for learning and psychotherapy, but also the type of social support provided and whether compensatory skills have been developed.

In conclusion, the course of PTSD in the presence of post-traumatic visual impairment or loss is accompanied above all by reduced personal and social functioning and selective emotional and cognitive changes. The most marked differences were related to depression, immediate memory, attention and self-perceived social support scores, with these changes depending non-linearly on the severity of visual loss. Our findings justify the need for early initiation of multicomponent sensory-adapted assessment and rehabilitation of such patients, while taking into account the emotional condition, cognitive abilities, and the level of functional independence and social support.

Authors' Contribution

Bakuridze NG: development of the concept, study design, and conduct of the study; data analysis and interpretation, preparation of the manuscript; Lunov V: development of the concept, study design; data analysis and interpretation; Khramtsov DM: development of the concept, study design; data analysis and interpretation; Ulyanov VO: concept development, research design; data analysis and interpretation. All authors reviewed the results and approved the final version of the manuscript.

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Disclaimer

The opinions expressed in this article are the authors' own and do not represent the official position of the institution.

Conflicts of Interest

The authors have no actual or potential conflicts of interest (financial, personal, professional, or other interests) that could influence their views on the subject or the materials presented and discussed in this manuscript.

Statement of Ethical Compliance

This work was conducted with human participants. This study was approved by the local bioethics committee of the G.S. Kostyuk Institute of the National Academy of Pedagogical Sciences of Ukraine. All patients provided informed consent to participate in the study. The study was conducted in accordance with the Declaration of Helsinki. No animals were included in this study.

Statement on Data Availability

The data obtained and analyzed during this study are available from the corresponding author upon reasonable request.

Abbreviations

HADS, Hospital Anxiety and Depression Scale; MINI, Mini International Neuropsychiatric Interview; PCL-5, post-

traumatic stress disorder Checklist for DSM-5; PSP, Personal and Social Performance scale; PTSD, post-traumatic stress disorder; RBANS, Repeatable Battery for the Assessment of Neuropsychological Status

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