

Visual function in patients followed at a Veterans Affairs polytrauma network site: An electronic medical record review

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KEYWORDS

Traumatic brain injury;
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Abstract

BACKGROUND: This observational study describes the “Polytrauma System of Care” used by the Veterans Health Administration to guide medical care and rehabilitation of injured military personnel serving in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) and reports the visual function of patients with polytrauma and/or traumatic brain injury (TBI) at the Hines, Illinois, Polytrauma Network Site (PNS).

METHODS: A retrospective medical record review was performed for 103 patients with polytrauma seen at the Hines PNS from October 2005 through March 2008 and 88 patients with TBI seen in the Hines TBI Clinic from December 2007 through March 2008.

RESULTS: Visual symptoms were self-reported by 76% of patients with polytrauma and 75% of the patients with TBI. Problems with reading (polytrauma 60% and TBI 50%) and accommodation (polytrauma 30% and TBI 47%) were frequently found on eye examinations. Spectacles were the treatment most frequently prescribed (polytrauma 62% and TBI 78%).

CONCLUSIONS: It is important for optometrists to be aware of the high rates of self-reported symptoms and visual problems in military personnel returning from deployment to the wars in Iraq and Afghanistan. Post-traumatic stress disorder and depression may complicate optometric evaluation and management.

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This observational study reports the visual function of patients with polytrauma and/or traumatic brain injury (TBI) at the Hines, Illinois Polytrauma Network Site (PNS).

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Background

Brain and eye injuries are well-recognized consequences of war. The etiology of these injuries reflects the “wounding patterns of the war.”¹ More than 1.5 million U.S. military personnel have been deployed to Iraq or Afghanistan since military operations started in 2001.² Service members serving in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) have survived injuries that would

have been fatal in previous wars because of speedy evacuation, timely acute trauma care, and improvements in protective body armor.^{1,2}

Blast injuries are the most common injuries in the current conflicts, and military personnel may be exposed to multiple blast waves during deployment.¹ Blast wave injuries occur from "changes in atmospheric pressure (primary blast injury), from objects put in motion by the blast that then hit people (secondary blast injury), and by individuals themselves being put in motion by the blast and then hitting something, such as the ground or the inside of a military vehicle (tertiary blast injury)."¹ Reports from the military confirm that approximately two thirds of army war zone evacuations are a result of these injuries.³

The provision of medical care and rehabilitation for those military personnel injured in the current conflict is a major priority for the Department of Veterans Affairs, Veterans Health Administration (VHA). VHA created an infrastructure referred to as the *Polytrauma System of Care* to guide medical care and rehabilitation of these patients.⁴⁻⁶

Polytrauma is defined as "two or more injuries to physical regions or organ systems, one of which may be life threatening, resulting in physical, cognitive, psychological, or psychosocial impairments and functional disability."⁶

The Polytrauma System of Care includes polytrauma rehabilitation centers (PRCs), regional polytrauma network sites (PNSs), and polytrauma points of contact (PPOC).^{5,6} The nomenclature used for the various Veterans Affairs (VA) settings implies a common "polytrauma" patient population. However, the definition of *polytrauma* is not applied consistently, and patients with polytrauma have different functional impairments, e.g., traumatic brain injury, hearing loss, amputations, fractures, burns, or visual impairment. The population of patients followed at VA facilities also differs as some facilities have blind rehabilitation centers, spinal cord injury centers or offer other specialty services.

There are 4 PRCs located in Minneapolis, Minnesota; Palo Alto, California; Richmond, Virginia; and Tampa, Florida. The PRCs provide acute inpatient medical and rehabilitation care for patients with "polytrauma" who have experienced severe injuries. Twenty-one regional polytrauma network sites manage postacute sequelae of polytrauma in consultation with the PRCs. Interdisciplinary evaluation and care coordination for inpatient and outpatient rehabilitation, day programs, and transitional rehabilitation are provided.

Finally, 130 polytrauma support clinic teams (PSCTs) and PPOC provide support by managing those who are medically stable. PSCTs are established rehabilitation teams that include a physiatrist, physical therapist, occupational therapist, speech and language therapist, psychologist, and case manager. The PSCTs are usually located closer to a veteran's home. They manage polytrauma sequelae, provide follow-up and case management, and also consult with PNSs or PRCs as needed. The PPOC are

clinicians identified at other VA facilities who can complete the TBI screening, provide case management, and refer for follow-up and specialty care as necessary.

Awareness of the need for TBI ophthalmic care began when Goodrich et al.⁷ and Lew et al.⁸ from the Palo Alto Healthcare System provided the first reports of visual function of patients with polytrauma returning from the war in Iraq. The Palo Alto VA Healthcare System has a Polytrauma Rehabilitation Center and a Polytrauma Network Site.

Goodrich et al.⁷ reported on 50 patients with TBI who were seen in the Optometry Polytrauma Clinic at the Palo Alto PRC between December 2004 and November 2006. Half of all injuries reported were from blasts, improvised explosive devices (IEDs), rocket-propelled grenades (RPGs), and mortars or other explosive causes. Penetrating injuries occurred in 44% of cases. Self-reported visual complaints (blurred vision, sensitivity to light, missing parts of vision, bumping into objects or walls, blurred reading vision, or difficulty reading continuous text) were seen in 74% of patients. Legal blindness was present in 14% of the total sample, visual impairment (visual acuity 20/63-20/100) was present in 10% of the total sample. The authors reported that patients with polytrauma caused by blast injuries had more than double the risk of visual impairment (52%) compared with other sources of injury (20%), e.g., motor vehicle accidents, gunshot or shrapnel, assault, falls, or anoxia.

Lew et al.⁸ described the interdisciplinary team screening of 62 patients from the Palo Alto PNS that were assessed from July 2006 to February 2007. The disciplines represented on the polytrauma team included psychologists, physicians specializing in physical medicine and rehabilitation, neuropsychologists, social workers, occupational and physical therapists, speech-language therapists, and optometrists. The authors reported that most patients had normal to near-normal visual acuity and visual fields. In addition, 75% self-reported vision problems. Oculomotor problems were detected during vision screening in 70% of patients. These included convergence (46%), pursuit or saccadic (25%), accommodation (21%), strabismus (11%), and fixations or nystagmus (5%). Other symptoms that may be related to vision included visual disturbances (66%), balance problems (42%), and dizziness (40%).

The percentage of troops with a mild TBI is not known, although estimates by military officials reported in the news media have been as high as 18%.² Because of concerns about possible long-term effects of a mild TBI, VHA policies mandate the screening of all OIF/OEF participants.⁹ These TBI screenings are repeated before each deployment. Military personnel are questioned about exposure to blasts or explosions, vehicle accidents, wounds above the shoulders, falls, loss of consciousness, and post-traumatic amnesia. They are also questioned regarding common symptoms associated with a TBI including poor memory, balance or dizziness, sensitivity to light, increased irritability, headaches, and poor sleep. Patients who screen positive are referred to the Physical Medicine and Rehabilitation

Department for a second-level screening and a physical examination. The Neurobehavioral Symptom Inventory is used during this examination for patients to rate the severity of their symptoms and the extent to which these symptoms have disturbed them since their injury. Response choices are “none,” “mild,” “moderate,” “severe,” or “very severe.” The symptoms on the Neurobehavioral Symptom Inventory are listed in Table 1.

Previously, the VHA did not have a policy for the performance of TBI-specific ocular health and visual function examinations for patients with polytrauma. In October 2008, the Department of Veterans Affairs initiated a policy requiring that “every prior (since February 2005), current, and future patient with a diagnosis of TBI admitted to a Polytrauma Rehabilitation Center must have a TBI-specific ocular health and visual functioning examination performed by an optometrist or ophthalmologist.”¹⁰ The tests that must be included in the examination and documented within the electronic medical record are listed in Table 2. An assessment and a treatment plan based on the examination results must also be included. Each consult for TBI-specific ocular health and screening must be completed within 30 days. Ocular health and visual functioning examinations often are recommended but are not required for other patients followed up within the “Polytrauma System of Care.”

At the Hines Polytrauma Network Site, a polytrauma blind rehabilitation outpatient specialist (BROS) also conducts functional vision screening to elicit visual symptoms and concerns. The functional vision screening includes selected tests from Mary Warren’s Brain Injury Visual Assessment Battery for Adults¹¹ (measurement of visual acuity, visual field measurement, assessment of pupil function, and determination of eye dominance) and the Low Vision Functional Evaluation published by Ross et al.¹² A formal eye examination is recommended if visual symptoms are identified during the functional vision screening. Most of the eye examinations are performed by an optometrist in the hospital eye clinic. The tests administered are selected based on each patient’s symptoms and needs. The formal eye examination usually includes evaluation of ocular health, automated visual fields, oculomotor function, binocular vision assessment, refraction, and neuroimaging, if indicated. Ophthalmologic subspecialists are consulted as needed. The polytrauma BROS coordinates services with the ophthalmology clinic, low vision clinic, blind rehabilitation center, and visual impairment services team and serves as a resource for other clinicians.

Methods

Protocols for research on human subjects were followed. Written informed consent for this retrospective chart review was waived by the Hines VA Hospital Institutional Review Board.

A list of patients followed by the Hines Polytrauma Team and TBI Clinic was provided by a social work case

Table 1 Symptoms in patients with TBI

Symptoms*	No. (%)
Feeling dizzy	40/88 (45)
Loss of balance	35/88 (40)
Poor coordination	36/88 (41)
Headaches	75/88 (85)
Nausea	30/88 (34)
Blur/trouble seeing	55/88 (63)
Light sensitivity	52/88 (59)
Hearing difficulty	62/88 (70)
Noise sensitivity	59/88 (67)
Numbness or tingling	51/88 (58)
Changes in taste/smell	25/88 (28)
Loss/increased appetite	49/88 (56)
Poor concentration	67/88 (76)
Forgetfulness	69/88 (78)
Difficulty making decisions	55/88 (63)
Slowed thinking	57/88 (65)
Fatigue, loss of energy	66/88 (75)
Difficulty sleeping	74/88 (84)
Feeling anxious or tense	72/88 (82)
Feeling depressed or sad	63/88 (72)
Irritability	72/88 (82)
Poor frustration tolerance	69/88 (78)

* Symptoms of moderate or greater intensity on the Neurobehavioral Symptom Inventory.

manager and the Rehabilitation Service Line coordinator. The electronic medical record of each patient was reviewed, and information was extracted and entered into a database. This report includes data on 103 patients followed by the polytrauma team from October 2005 through March 2008 and 88 patients with TBI who were evaluated in the TBI Clinic from December 2007 through March 2008.

Results

The patients with polytrauma were mostly men (95%), with a mean age of 30 years. Most (85%) were injured in OEF or OIF. Mean visual acuity was 0.05 log MAR (Snellen Equivalent 20/20). Three percent had no light perception. Four percent were legally blind (less than 20/100 or a visual field of less than 20°), and 1% were visually impaired (VA less than 20/63 to 20/100). Seventy-six percent of patients with polytrauma self-reported visual symptoms.

The patients with TBI were mostly men (92%), with a mean age of 31 years. The majority (88%) were injured in OEF or OIF. Most (95%) presented with nonpenetrating injuries. The majority of patients had normal visual acuity; mean 0.06 log MAR (20/20 Snellen Equivalent). One percent had no light perception, 2% of the patients were legally blind (20/200 or worse or a visual field of less than 20°), and none were visually impaired (visual acuity less than 20/63 to 20/100). Seventy-five percent of the patients with TBI self-reported visual symptoms. A detailed list of

Table 2 TBI-specific ocular health and Visual Functioning Examination required for PRC patients**History:**

Ocular or periocular trauma, diplopia, reading difficulties, blurred vision (far or near), photosensitivity, flashing lights, floaters, dry eye symptoms, decreased night vision, ocular or periocular pain, brow or headache, missing part of or restricted field of vision, covering or closing one eye, face turn or head tilt, bumping into objects or walls when moving, balance problems or dizziness, and history of vision or reading problems.

Examinations:

- Visual acuity with central fixation (uncorrected and best refractive correction).
- Visual field screening followed by formal visual field testing if screening is positive for a visual field defect.
- Color vision with monocular testing.
- Pupil evaluation and assessment for relative afferent pupil defect.
- Refractive error determination (far and near).
- Oculomotor function evaluation including vergence testing with facility assessment; accommodation (tested monocularly and binocularly) as age appropriate with facility assessment; cranial nerve III, IV, VI assessment; presence of strabismus; phorias (horizontal and vertical); pursuits and saccades; fixation, nystagmus, and optokinetic nystagmus.
- Anterior segment examination including ocular surface, cornea, gonioscopy, lens, and intraocular pressure measurement.
- Dilated retinal examination including optic nerve findings, macular findings, and peripheral retinal examination results.

the symptoms that were reported in the Neurobehavioral Symptom Inventory is located in [Table 1](#).

Fifty-one percent of the polytrauma patients and 42% of the TBI patients received a vision examination by an optometrist or ophthalmologist. The patients who did not receive a vision examination did not report any vision problems nor did they have difficulty during the BROS screening; they declined an examination when it was offered or they failed to keep their scheduled appointment.

Problems identified during the eye examinations and treatments prescribed are listed in [Tables 3 and 4](#). The patients with polytrauma and TBI were separated out for these tables. Patients with both polytrauma and TBI are included in both lists.

The binocular vision problems most frequently found in patients with TBI included accommodative (47%) and convergence (28%) disorders. Accommodative disorders (30%) were most frequent in patients with polytrauma.

Table 3 Vision problems in patients with TBI and polytrauma

Problems	TBI	Polytrauma
Orbit/eye trauma	2/36 (6)	11/53 (21)
Optic neuropathy	2/36 (6)	3/53 (6)
Visual field loss (either eye)	5/36 (14)	12/53 (23)
Cranial nerve disorder	0 (0)	0/53 (0)
Strabismus	3 /36 (8)	2/53 (4)
Accommodative disorder	17/36 (47)	16/53 (30)
Convergence disorder	10/36 (28)	7/53 (13)
Pursuits/saccade disorders	2/36 (6)	5/53 (9)
Fixation disorders	0/36 (0)	3/53 (6)
Diplopia	3/36 (8)	8/53 (15)
Suppression	0/36 (0)	0/53 (0)
Reading	18/36 (50)	32/53 (60)

Note. Data shown as No. (%) of patients who received eye examinations.

Reading problems occurred in 60% of patients with polytrauma and 50% of patients with TBI.

Discussion

A VA TBI workgroup was formed for optometrists to share information and experiences working with OEF/OIF veterans during regularly scheduled conference calls. The VHA has recently issued a national directive that establishes a protocol for OIE/OEF eye examinations for patients admitted to PRCs. This policy does not mandate eye examinations or visual screening of patients followed at the other "Polytrauma System of Care Sites."¹⁰ The disciplines comprising the polytrauma team, vision screening procedures, and eye examination protocols vary, making it difficult to combine or compare data from different sites. A VA directive establishing a protocol for eye examinations, screenings, and reporting is needed to facilitate research on the incidence, natural course of recovery, and outcomes of brain injury treatment in all military personnel returning from the war.

Hines is the first VA site outside of Palo Alto to report on the prevalence of visual symptoms and the problems found

Table 4 Visual treatments prescribed for patients with TBI or polytrauma

Treatment	TBI	Polytrauma
Ocular surgery	0/36 (0)	2/53 (4)
Contact Lenses	1/36 (3)	1/53 (2)
Spectacles	28/36 (78)	33/53 (62)
Vision therapy	5/36 (14)	4/53 (8)
Blind rehabilitation	0/36 (0)	5/53 (9)
Low vision rehabilitation	1/36 (3)	1/53 (2)

Note. Data shown as No. (%) of patients who received eye examinations.

in eye examination results of patients who experienced polytrauma and/or TBI during military service in OEF and OIF. At the Hines PNS, the Palo Alto PRC, and Palo Alto PNS, approximately 75% of patients self-reported visual symptoms including difficulty reading. Although the binocular vision problems identified may contribute to frequent complaints of reading difficulties, patients also reported difficulty with memory and concentration. Patients with TBI are known to complain of many difficulties that have common origins in poor concentration or reduced "complex memory capacity."^{13,14} Although most patients self-reported that their reading problems started after their injury, reading tests or questionnaires to assess self-reported symptoms were not administered before deployment, and changes in visual function after combat could not be confirmed.

Coordination of information for patient care and research is expected to improve. In November 2007, the U.S. Department of Defense announced that a new "Center of Excellence to Address Traumatic Brain Injury and Psychological Health" will be fully functional by October 2009.¹⁵ The center will "coordinate existing medical, academic, research, and advocacy assets within the services with those of the VA and Health & Human Services; other federal, state, and local agencies; as well as academic institutions."¹⁵

The frequent occurrence of binocular disorders (convergence insufficiency and accommodative dysfunction) at the Hines and Palo Alto VA sites is also consistent with other reports in the civilian population. Ciuffreda et al.¹⁶ reported that 90% of patients with TBI had oculomotor dysfunction. Deficits in vergences (56.3%), versions (51.3%), accommodation (41.1%), and strabismus (25.6%) were the most frequently diagnosed in this retrospective analysis of 160 patient records. Thirty of 51 patients (59%) in a study by Schlageter et al.¹⁷ were determined to be impaired in pursuits, saccades, ocular posturing, stereopsis, extra-ocular movements, or near/far eso-exotropia. Other investigators reported vision problems at a lower frequency. From a series of 161 head injury patients, Kowal¹⁸ reported that 16% had poor accommodation, 14% convergence problems, and 19% pseudomyopia. These reports from the private sector add additional support for the inclusion of vision screening, eye examinations, and treatment in the "Polytrauma System of Care."

Treatment of patients with mild TBI is focused on alleviating symptoms and educating patients to understand current problems and the potential for change.^{2,19,20} The literature (based on civilian patients treated in clinics or hospitals) indicates that the neural injury of mild TBI that is expressed as memory and attention impairments usually passes within days in minor injuries or weeks to months in the more typical concussion.²¹ Reports indicate that 85% to 90% of patients recover, although some are still symptomatic after 1 year.^{2,21-23} The persistence of symptoms is reported to be associated with "medical disability and compensation processes as well as the beliefs that

patients have about their injuries."^{2,22} Caution should be used in generalizing these statistics from management of sports concussion and other causes of TBI in the civilian population to soldiers with TBI secondary to blast injury.²

TBI and polytrauma are frequently associated with other comorbidities. High rates of post-traumatic stress disorder, depression, and other mental health problems have been reported in soldiers returning from combat.^{2,24,25} In a recent study reported in the *Journal of the American Medical Association*, 19.1% of service members returning from Iraq and 11.3% of those returning from Afghanistan reported mental health problems.²⁴ Postdeployment assessments indicated that mental health problems were most frequently associated with combat experiences and that multiple deployments to a combat zone are an additional risk for post-traumatic stress disorder.²⁴ Other stressors or traumatizing events associated with mental health problems include "difficult living and working environment; sexual or racial harassment; concerns about life and family disruptions; perceived exposure to radiological, biological, or chemical hazards; perceived threats; insufficient preparedness; inadequate armaments; exposure of suffering of servicemen and civilians; exposure to death and depression."²⁵ The stress and depression experienced often did not appear until months after a soldier returned to home.²⁶

All OIF/OEF veterans serving in the Armed Forces, Reserves, or National Guard are entitled to 5 years of free care through the VA for most conditions.^{27,28} Veterans with service-related conditions must file a claim to have their diagnoses service connected in order to obtain lifelong medical care from the VA.²⁹ The Department of Defense and VA routinely provide information on local VA services. However, veterans or military personnel, especially those from the National Guard or Reserves who have private health insurance, may choose to use health care providers in the private sector. It is important for optometrists to be aware of the high rates of self-reported symptoms and to provide evaluation, management, and referral to other medical care providers when indicated.

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