

Posttraumatic Stress, Problem Drinking, and Functional Outcomes After Injury

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Hypothesis: Patients undergoing trauma surgery for injury who have subsequent posttraumatic stress disorder (PTSD) or problem drinking will demonstrate significant impairments in functional outcomes compared with patients without these disorders.

Design: Prospective cohort study.

Setting: Level I academic trauma center.

Participants: One hundred one randomly selected survivors of intentional and unintentional injuries were interviewed while hospitalized and again 1 year later. The investigation achieved a 73% 1-year follow-up rate.

Main Outcome Measures: Posttraumatic stress disorder was assessed with the Post-traumatic Stress Disorder Checklist and problem drinking was assessed with the Alcohol Use Disorder Identification Test. Functional status was assessed with the Medical Outcomes Study 36-Item Short-Form Health Survey.

Results: One year after injury, 30% of patients (n=22) met symptomatic criteria for PTSD and 25% (n=18) had Alcohol Use Disorder Identification Test scores indicative of problem drinking. Patients with PTSD demonstrated significant adverse outcomes in 7 of the 8 domains of the Medical Outcomes Study 36-Item Short-Form Health Survey compared with patients without PTSD. In multivariate models that adjusted for injury severity, chronic medical conditions, age, sex, preinjury physical function, and alcohol use, PTSD remained the strongest predictor of an adverse outcome. Patients with problem drinking did not demonstrate clinically or statistically significant functional impairment compared with patients without problem drinking.

Conclusions: Posttraumatic stress disorder persisted in 30% of patients 1 year after traumatic injury and was independently associated with a broad profile of functional impairment. The development of treatment intervention protocols for trauma patients with PTSD is warranted.

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FUNCTIONAL limitations and health-related quality of life are important measures of outcome following injury.^{1,2} Longitudinal investigations suggest that the type and severity of injury,³ age,⁴ preinjury physical function,⁵ income,⁶ and social support^{4,5} can contribute to functional disability after physical trauma. Although the nature and extent of the injury are important determinants of posttraumatic functional disability, recent investigation suggests that other factors may play an equally important role in determining the progression of postinjury impairment.⁵

Psychiatric and substance use disorders are leading causes of disability in the United States.⁷ These disorders occur frequently among patients who have been hospitalized for trauma surgery.⁸ Between 10% and 40% of trauma inpatients may go on to develop posttraumatic stress

disorder (PTSD).⁹⁻¹² Previous investigations in veteran, refugee, and civilian populations suggest that PTSD uniquely contributes to impairments in physical, role, and social functioning.¹²⁻¹⁵ Also, 20% to 55% of patients hospitalized for trauma surgery have problems with substance abuse or dependence.¹⁶⁻¹⁸ While alcohol intoxication has been linked to recurrent traumatic injury,^{19,20} few investigations have assessed the association between problem drinking in the weeks and months after surgical hospitalization and enduring functional impairments.

Failure to recover from comorbid psychiatric and substance abuse disorders may be an important yet infrequently examined contributor to ongoing disability in trauma patients. The purpose of this investigation was to comprehensively evaluate and follow PTSD, problem drinking, and functional impairment in a representative cohort of patients hospitalized for

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PARTICIPANTS AND METHODS

The University of California–Davis Medical Center (Sacramento, Calif) is the major level I trauma center in inland Northern California. The trauma center admits between 2500 and 3000 patients each year. Patients included in the study were hospitalized survivors of intentional and unintentional injuries, aged between 14 and 65 years, and were English-speaking. The study was approved by the University of California–Davis institutional review board and informed consent was obtained from all adult participating subjects and from parents or legal guardians of minors.

On weekdays, newly admitted inpatients undergoing trauma surgery were randomly selected for participation using numerical assignments from a random numbers table. Patients who were alert and oriented (Glasgow Coma Scale Score = 15)²¹ were approached for consent. Of 397 randomly selected patients, 156 met study criteria and were available for approach by the research associate. Of the 156, 29 declined participation and 10 consented to but did not finish the interview (8 subjects were transferred or discharged prior to completion and 2 subjects withdrew). Sixteen subjects were recruited into a pilot intervention protocol, leaving 101 participants in the longitudinal investigation. Patients who did not complete the 1 year interview were significantly more likely to be male ($\chi^2[1] = 4.8, P = .03$) assault survivors ($\chi^2[1] = 6.1; P = .03$) whose annual incomes were less than \$15 000 ($\chi^2[1] = 5.9; P = .03$). Patients with positive inpatient ward alcohol toxicology screens were just as likely to complete the 1-year interview compared with patients who did not have positive alcohol screens. Also, patients who did not complete the 1-year follow-up demonstrated significantly greater impairment in physical function as assessed by the Medical Outcomes Study 12-Item Short-Form Health Survey Physical Components Summary compared with patients who completed the study ($t[99] = 2.1; P = .02$).

INTERVIEWS AND MEASURES

Data were collected as part of a larger longitudinal study of posttraumatic psychological distress, functional impairment, and health service use among trauma patients.

Patients were interviewed while hospitalized and again 1 year later. The inpatient interview assessed current social

support, physical function prior to the injury, and PTSD symptoms that had occurred since the injury. The 1-year follow-up assessed PTSD, problem drinking, and functional impairment. Automated trauma registry data were then combined with the inpatient interview data and the 1-year follow-up telephone interviews.

Functioning and Quality of Life Outcomes

We used the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) to assess functional status 1 year after the traumatic injury. The SF-36 has established reliability and validity.²² The instrument includes 8 subscales that assess a broad profile of functioning and quality-of-life outcomes, including physical functioning, role functioning (physical and emotional), bodily pain, general health status, vitality, social functioning, and mental health status. The 8 subscales are scored from 0 to 100, with 100 equal to the best health. Population norms for the subscales have been established and normative scores are documented for patients with chronic medical and psychiatric disorders.²² To assess limitations in physical functioning in the month prior to the traumatic event, we used a modified version of the SF-12 Physical Components Summary (PCS) scale.^{23,24}

PTSD Symptoms

Levels of PTSD symptoms were assessed using the civilian version of the Post-traumatic Stress Disorder Checklist (PCL-C).²⁵ The PCL-C is a 17-item measure that elicits responses for each of the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*²⁶ diagnostic criteria for PTSD: intrusive (eg, flashbacks, memories, nightmares), avoidant (eg, restricted range of emotion, avoiding reminders of the event, feeling detached from others), and arousal (eg, insomnia, irritability, vigilance, increased startle) symptoms. Responses to each of the 17 items are recorded on a graded scale from “not at all” to “moderately” to “extremely.” At the 1-year follow-up interview, patients endorsing scores of greater than or equal to 3 for 1 intrusive, 3 avoidant, and 2 arousal symptoms were considered to meet symptomatic criteria for PTSD.²⁶ Blanchard et al²⁷ reported

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trauma surgery. Our goal was to assess the association between PTSD and functional impairment in these patients while controlling for relevant clinical and demographic characteristics. An additional aim of the investigation was to understand the association between problem drinking and functional recovery 1 year after traumatic injury.

RESULTS

The demographic and injury characteristics of study participants resembled the characteristics of all patients admitted for traumatic injury during the 9-month investigation (**Table 1**). There were no significant differences between the 2 groups in sex, injury type or severity, number of chronic medical conditions, age, and hospital length of stay. The percentage of patients who were screened

for alcohol use and whose results were positive was significantly higher in study patients. Thirty eight percent of hospitalized patients had toxicology screen results positive for alcohol and 28% of patients had blood alcohol levels of greater than or equal to 80 mg/dL. The mean (SD) inpatient PCL-C score was 38.5 (14.0). The mean (SD) PCS score for patients 1 month preinjury was 49.5 (10.5) and was not significantly different from scores on the PCS for the general US population (mean [SD], 50.12 [9.45]; $z = -0.5; P = .31$).²³

The investigation achieved a 73% ($n = 73$) 1-year follow-up rate. At the 1-year follow-up interview, 30% of patients ($n = 22$) met symptom criteria for PTSD (**Figure**). Twenty-five percent of patients ($n = 18$) had AUDIT scores greater than or equal to 8, indicative of problem drinking, and 8% of patients ($n = 6$) demonstrated comorbid PTSD and problem drinking at the 1-year assessment. Pa-

a correlation of 0.93 between the total PCL-C score and the gold standard PTSD diagnostic instrument, the Clinician Administered Post-traumatic Stress Disorder Scale.²⁷

Alcohol Intoxication and Use

Blood alcohol screens were used to assess alcohol intoxication at the time of the hospital admission. One year after the injury, alcohol use was assessed with the Alcohol Use Disorders Identification Test (AUDIT). The AUDIT is a 10-item self-report measure developed by the World Health Organization for screening for problematic alcohol use.^{18,28} The 10 AUDIT items assess the frequency, intensity, and maladaptive consequences of alcohol consumption. A score of 8 or more has been suggested as a cutoff point for problem drinking.²⁹

Injury Severity

Injury severity was abstracted from surgical records using a conversion software program³⁰ that transforms recognized codes from the *International Classification of Diseases, Ninth Revision, Clinical Modification*³¹ into the Abbreviated Injury Scale and subsequently, injury severity scores.³²

Chronic Medical Conditions

Comorbid chronic medical conditions were also derived from *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnostic codes. Ten conditions, including diabetes, hypertension, chronic liver disease, ischemic heart disease, degenerative nervous conditions, epilepsy, obesity, and coagulation defects previously shown to influence the course of recovery among trauma surgery inpatients were included.³³ We added human immunodeficiency virus infection to this list of medical comorbidities.

Social Support

Eight items from the Medical Outcomes Study Social Support Survey were used to assess social support at the time of the injury.³⁴ Five domains of social support are encompassed by the measure, including emotional

support, tangible support, feedback and guidance, evaluative support, and companionship in leisure and recreational activities.

STATISTICAL ANALYSES

Using trauma registry data, we first compared the demographic, injury, and clinical characteristics of patients included in the study with the characteristics of all patients admitted to the surgical service during the time of the investigation.

We next ascertained scores on the SF-36 subscales for the cohort and identified the percentage of patients meeting symptomatic criteria for PTSD and problem drinking 1 year after their injuries. Scores on the 8 SF-36 subscales for the study cohort were compared with national norms using the *z* statistic. We also compared scores on the subscales for patients with and without PTSD and for patients with and without problem drinking.

A literature review suggested that multiple clinical and demographic characteristics would be associated with functional outcomes and/or psychiatric disorders in trauma patients. We therefore assessed the bivariate associations between relevant injury, demographic, and clinical characteristics (eg, injury severity, age, sex, chronic medical conditions, income, social support, physical function in the month prior to the injury, measures of alcohol use and intoxication, PTSD symptom levels) and SF-36 subscale scores. Clinical and demographic characteristics that either demonstrated 1 or more statistically significant associations at the *P* < .05 level (eg, age) or were considered essential variables for inclusion in the models (eg, injury severity scores) were retained in the final multivariate analyses.

We developed 8 linear regression models. Each model included 1 SF-36 subscale score as the dependent variable and the following predictor variables: injury severity scores, age, sex, chronic medical conditions, preinjury PCS score, inpatient blood alcohol level, inpatient PCL-C score, problem drinking (yes/no), and PTSD (yes/no). To assess the independent associations between PTSD and problem drinking, and each of the 8 SF-36 outcome domains, we simultaneously entered all predictor variables into the regressions. The SPSS statistical package (SPSS Inc, Chicago, Ill) was used for all analyses.

tients who endorsed problem drinking were no more likely to have PTSD than patients without problem drinking ($\chi^2_1=0.11$; *P* = .73).

One year after traumatic injury, study patients had significantly decreased scores on all 8 SF-36 subscales compared with normative scores derived from the general population (**Table 2**). Patients with PTSD demonstrated mean 8 SF-36 subscale scores that were 10 to 40 points lower compared with patients without PTSD. Differences in role physical and emotional functioning, pain, general health, vitality, social functioning, and mental health subscales achieved statistical significance. In contrast, none of the bivariate comparisons for patients with and without problem drinking achieved statistical significance.

In multivariate analyses, PTSD at 1 year was the strongest independent predictor of diminished scores on

the SF-36 role functioning (physical and emotional), pain, general health, vitality, social functioning, and mental health subscales (**Table 3**). Posttraumatic stress disorder was not an independent predictor of limitations in physical functioning 1 year after the injury. Higher initial inpatient PTSD symptoms were associated with significantly lower SF-36 mental health subscale scores 1 year after injury.

In these multivariate analyses, problem drinking at 1 year did not significantly predict impairment for any of the 8 SF-36 subscales (Table 3). Similarly, after adjusting for PTSD, increasing injury severity and chronic medical conditions were not significant predictors of diminished scores for any of the 8 outcome domains. Higher preinjury SF-12 PCS scores were associated with higher SF-36 general health and role emotional subscale scores 1 year postinjury. Finally, increasing age was an inde-

Table 1. Demographic, Injury, and Medical Characteristics of Study Patients Compared With All Other Inpatients Admitted to the University of California–Davis Trauma Surgery Service Between 12/1/97 and 8/31/98*

Characteristic	Study Sample (n = 101)	All Others (n = 1336)	P Value
Female	35 (35)	409 (31)	.40
Mechanism of injury			.15
Unintentional	66 (65)	920 (69)	
Intentional	35 (34)	416 (31)	
≥1 Chronic medical diagnoses†	8 (8)	70 (5)	.25
Blood alcohol, mg/dL			.03
Negative	51 (50)	650 (49)	
1-79	10 (10)	75 (6)	
≥80	28 (28)	307 (23)	
Not tested	12 (12)	304 (23)	
Injury Severity score			.68
<9	69 (68)	847 (65)	
9-16	16 (16)	252 (19)	
>16	16 (16)	203 (16)	
Age, mean ± SD, y	33.5 ± 12.2	35.1 ± 13.3	.26
Length of stay, mean ± SD, d	5.3 ± 4.5	6.0 ± 10.3	.46

*Data are given as number (percentage) of patients unless otherwise indicated. Patients were aged between 14 and 65 years.

†Chronic medical diagnoses include trauma registry recorded *International Classification of Diseases, Ninth Revision, Clinical Modification*³¹ diagnoses of diabetes, hypertension, chronic liver disease, ischemic heart disease, degenerative nervous conditions, epilepsy, obesity, coagulation defects, and human immunodeficiency virus.

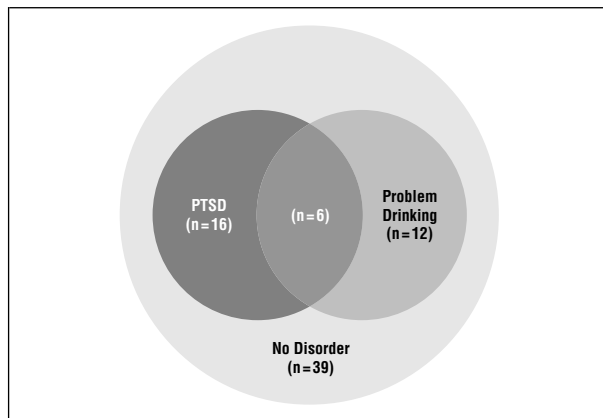
pendent predictor of lower scores on the SF-36 physical function subscale.

COMMENT

This investigation comprehensively assessed the associations among PTSD, problem drinking, and functional outcome in a representative cohort of trauma patients during the course of the year after injury. In the month prior to the injury, study patients reported levels of physical function equivalent to the general US population. One year after the injury, however, study patients manifested marked functional limitations and diminished quality of life.

Nearly half of trauma surgery patients met symptomatic criteria for PTSD and/or problem drinking 1 year after hospitalization. One year after the injury, patients with PTSD demonstrated clinically and statistically significant functional limitations. The statistically significant associations between PTSD and functional impairment persisted in linear regression models that controlled for the effects of injury severity, chronic medical conditions, baseline physical and mental functioning, alcohol use, and demographic characteristics. After controlling for PTSD, other predictors, such as injury severity scores and preexisting chronic medical conditions were not significantly associated with functional impairments at 1 year.

Two prior investigations support this finding of an independent association between PTSD and functional impairment in trauma patients. Michaels et al^{12,35} reported that after adjusting for injury severity, trauma pa-



Patients who met symptomatic criteria for posttraumatic stress disorder (PTSD) and problem drinking 1 year after surgical hospitalization (n=73).

tients with high PTSD symptom levels 6 to 12 months after surgical hospitalization were significantly more likely to report diminished mental and general health status and impaired work function compared with patients without PTSD. Holbrook et al¹⁵ found that higher levels of intrusive and avoidant PTSD symptoms at the time of hospitalization were independently associated with an increased risk of diminished well-being 12 to 18 months after the injury.

Somewhat surprisingly, bivariate and multivariate analyses revealed that problem drinking 1 year after the injury was not associated with significant functional limitations or diminished quality of life. The power to detect the ongoing effect of alcohol use on functional outcome may have been limited since only 18 patients endorsed at-risk drinking at 1 year. It is also possible that individuals who were experiencing the greatest functional impairment secondary to ongoing alcohol use did not complete the 1-year follow-up interview.

This investigation has several limitations. The sample size restricted the number of clinical and demographic characteristics that could be included in the multivariate analyses. Multiple psychiatric (eg, depression) and substance abuse (eg, stimulants) comorbidities have been described among trauma patients.^{8,12,15,36,37} Owing to sample size considerations, we limited our analyses to PTSD and alcohol use. Future larger-scale investigations should strive to assess multiple psychiatric and substance abuse disorders to facilitate a more complete understanding of the spectrum of psychiatric disorders that affect functional outcomes after traumatic injury.

The study was also limited in that assessments of preinjury physical functioning relied on retrospective reports derived from the postinjury inpatient interview. Also, this study may underestimate the magnitude of functional impairment present 1 year postinjury since study patients with greater baseline impairments were more likely to not complete the 1-year assessment.

Another consideration in interpreting the results of this investigation is the overlap between the PCL-C questionnaire items that assess PTSD and the SF-36 items that assess social function and mental health. Little item overlap, however, exists between the SF-36 pain, general

Table 2. Comparison of 1-Year SF-36 Subscale Scores in the Study Cohort vs the General Population,²² and in Study Patients With and Without PTSD and With and Without Problem Drinking*

Outcome Domain	Study Cohort (n = 73)	General Population (n = 2474)	P Value	With PTSD (n = 22)	Without PTSD (n = 51)	P Value	With at-Risk Drinking† (n = 18)	Without at-Risk Drinking‡ (n = 55)	P Value
Physical Functioning	64.5 (30.2)	84.2 (23.3)	<.01	54.9 (27.6)	68.6 (30.6)	.08	63.2 (32.3)	64.9 (29.8)	.84
Role Physical	49.2 (42.0)	81.0 (34.0)	<.01	20.5 (28.5)	61.6 (41.0)	<.01	39.8 (41.8)	52.3 (42.0)	.28
Role Emotional	64.8 (39.2)	81.3 (33.0)	<.01	36.4 (35.5)	77.1 (34.3)	<.01	59.3 (37.1)	66.7 (40.1)	.49
Pain	42.0 (25.6)	75.2 (23.7)	<.01	28.6 (15.2)	47.8 (27.1)	.03	41.1 (24.4)	42.3 (26.2)	.86
General Health	63.6 (23.6)	72.0 (20.3)	<.01	48.6 (22.7)	70.1 (21.1)	<.01	63.3 (24.4)	63.7 (23.6)	.95
Vitality	48.2 (14.8)	60.9 (21.0)	<.01	36.6 (9.8)	53.2 (13.8)	<.01	46.5 (9.4)	48.7 (16.2)	.58
Social Function	70.4 (28.2)	83.3 (22.7)	<.01	48.3 (27.6)	79.9 (22.8)	<.01	71.5 (28.7)	70.0 (28.3)	.84
Mental Health	56.7 (14.9)	74.7 (18.1)	<.01	42.9 (11.8)	62.7 (11.9)	<.01	54.7 (15.1)	57.4 (14.9)	.51

*Data are given as mean (SD) unless otherwise indicated. SF-36 indicates Medical Outcomes Study 36-Item Short Form Health Survey; PTSD, posttraumatic stress disorder.

†Posttraumatic stress disorder as assessed with the Post-traumatic Stress Disorder Checklist, Civilian Version.²⁵

‡Problem drinking as defined by scores of 8 or higher on the Alcohol Use Disorders Identification Test.²⁸

Table 3. Linear Regressions Predicting Functional Outcome* 1 Year After Injury†

	Physical Function	Role Physical	Role Emotional	Pain	General Health	Vitality	Social Function	Mental Health
Predictors								
ISS	-.13	-.07	-.17	-.25	-.10	.12	-.09	-.12
Problem drinking at 1 year‡	-.08	-.10	-.02	-.14	-.07	-.23	-.09	-.09
PTSD at 1 year§	-.12	-.40	-.35	-.25	-.41	-.52#	-.40	-.54#
Model** parameters								
F	1.63 _{9,59}	2.86 _{9,59}	3.92 _{9,59}	2.82 _{9,59}	4.29 _{9,59#}	3.68 _{9,59}	3.79 _{9,59}	5.04 _{9,59#}
Adjusted R ²	0.08	0.20	0.28	0.19	0.30	0.26	0.27	0.35

*Functional outcomes were assessed with the Medical Outcomes Study Short-Form Health Survey.²²

†Data are given as β unless otherwise indicated. PTSD indicates posttraumatic stress disorder.

‡Problem drinking was defined as scores of 8 or higher on the Alcohol Use Disorders Identification Test.²⁸

§Posttraumatic stress disorder symptoms were assessed with the Post-traumatic Stress Disorder Checklist, Civilian Version.²⁵

||P<.05.

||P<.01.

#P<.001.

**Independent variables entered into each regression model include Injury Severity Score, problem drinking at 1 year, PTSD at 1 year, age, sex, chronic medical conditions, preinjury physical function, blood alcohol level at inpatient admission, inpatient PTSD symptom levels.

health, role, and physical function domains and the PTSD intrusive, avoidant, and arousal symptom clusters. Finally, although the SF-36 assesses a broad profile of functional outcomes, recent commentary has suggested the use of injury-specific measures of outcome in conjunction with generic health status instruments such as the SF-36.¹

Beyond these considerations, this study demonstrates that the nature and extent of the physical injury alone does not account for variations in functional outcome among trauma patients. Trauma patients seem to be at high risk for enduring PTSD; 1 year after injury, PTSD is associated with marked functional impairment and diminished quality of life. Given the nearly 50% occurrence rate of psychiatric and substance abuse disorders in trauma patients, investigations into treatments to reduce disability that focus exclusively on anatomic injury will have limited impact. Thus, a comprehensive approach to minimizing disability and maximizing recovery for trauma patients should incorporate routine psychosocial evaluations that include treatment referrals for PTSD as indicated. Ultimately, evidence-based acute care screening and intervention procedures^{20,38} could

be developed for the millions of hospitalized physically injured Americans³⁹ who suffer from psychiatric and substance abuse comorbidities.

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Readership Poll

(1) Is it possible to develop a reasonable scoring system indicating quality care in surgery?

Yes
No

(2) Which system would you favor?

(a) POSSUM
(b) APACHE II
(c) VA System
(d) Other

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