

High Rates of Acute Stress Disorder Impact Quality-of-Life Outcomes in Injured Adolescents: Mechanism and Gender Predict Acute Stress Disorder Risk

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Background: Injury is the leading cause of death and functional disability in adolescent children. Little is known about quality of life and psychological outcomes after trauma in adolescents. The Trauma Recovery Project in Adolescents is a prospective epidemiologic study designed to examine multiple outcomes after major trauma in adolescents aged 12 to 19 years, including quality of life (QoL) and psychological sequelae such as acute stress disorder (ASD) and posttraumatic stress disorder (PTSD). The specific objectives of the present report are to examine ASD rates and the association of ASD with QoL outcomes in injured adolescents.

Methods: Between April 26, 1999, and November 13, 2002, 401 eligible trauma patients aged 12 to 19 years triaged to five participating trauma center hospitals in a regionalized trauma system

were enrolled in the study. The admission criteria for patients were as follows: (1) age 12 to 19 years and (2) injury diagnoses excluding severe traumatic brain injury (TBI) or spinal cord injury. QoL after trauma was measured using the Quality of Well-being (QWB) scale, a sensitive and well-validated functional index (range, 0 = death to 1.000 = optimum functioning). ASD (before discharge) was diagnosed with the Impact of Events Scale-Revised. Scores of 24+ were used to diagnose ASD. Patient outcomes were assessed at discharge and at 3, 6, 12, 18, and 24 months after discharge.

Results: ASD before discharge was diagnosed in 40% of adolescent trauma survivors. ASD status was associated with large QoL deficits during follow-up, as follows: 3-month, ASD-positive QWB score = 0.667 vs. ASD-negative QWB

score = 0.710, $p < 0.01$; 6-month, ASD-positive QWB score = 0.704 vs. ASD-negative QWB score = 0.742, $p < 0.001$; 12-month: ASD-positive QWB score = 0.718 vs. ASD-negative QWB score = 0.757, $p < 0.01$; 24-month, ASD-positive QWB score = 0.725 vs. ASD-negative QWB score = 0.769, $p < 0.01$. Female sex and violent mechanism predicted ASD risk (47% female vs. 36% male; odds ratio, 1.6; $p < 0.05$; violence 54% vs. 38%; odds ratio, 1.9; $p < 0.01$).

Conclusions: Adolescent trauma survivors have high rates of ASD. ASD severely impacts QoL outcomes and is associated with female sex and mechanism of injury in adolescents. Early recognition and treatment of ASD in seriously injured adolescents will improve QoL outcomes.

Key Words: Acute stress disorder, Adolescents, Quality-of-life outcomes, Posttraumatic stress disorder.

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Injury is not only the leading cause of death but notably the leading cause of preventable morbidity in individuals 19 years of age and younger.¹ The establishment of mature trauma systems in the United States has led to an evolution in trauma outcomes research, with studies directed toward short- and long-term quality of life (QoL) after injury, dis-

ability, return to work and usual activities, and psychological sequelae such as posttraumatic stress disorder (PTSD).^{2–12}

Recently, the importance of PTSD as an outcome in seriously injured trauma survivors has been demonstrated in several reports by our research team and by Michaels et al. and others.^{13–23} These studies have provided new and provocative evidence that PTSD is both common and extremely detrimental in adult trauma patients. Little is known about psychological outcomes after serious injury in adolescents. In adolescent children, the diagnostic symptomatology of acute stress disorder (ASD), an early precursor of PTSD, and PTSD, is similar to adults. The disorder is characterized by recurrent flashbacks, reexperiencing of the traumatic event, hyperarousal, and avoidance.²⁴ However, the severity of disease, onset timing, duration, and response to treatment have been postulated to be different than in adults.²⁵ The Trauma Recovery Project in Adolescents (TRP-A) is a prospective epidemiologic study designed to examine multiple outcomes after major trauma in adolescents aged 12 to 19 years, including quality of life (QoL) and psychological sequelae such

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as depression, ASD, and PTSD. The specific objectives of the present report are to examine ASD rates and the association of ASD with QoL outcomes in injured adolescents. A secondary objective was to investigate the association of injury event-related factors such as perceived threat to life and mechanism of injury with ASD onset.

PATIENTS AND METHODS

Source of Study Population

Between April 26, 1999, and November 13, 2002, 401 eligible trauma patients triaged to five participating trauma center hospitals in the San Diego Regionalized Trauma System were enrolled in the TRP-A study. The admission criteria for patients were as follows: (1) age 12 to 19 years and (2) injury diagnoses excluding severe traumatic brain injury or spinal cord injury. Enrollment criteria also included a current address in California, Arizona, Utah, or Oregon; corresponding telephone number(s) for follow-up contact; and English or Spanish as the primary language spoken.

Patient outcomes were assessed at discharge and at 3, 6, 12, 18, and 24 months after discharge by a trained interviewer. Institutional review board approval for the study was granted by all participating hospitals, and informed consent for the discharge and follow-up interviews was obtained from each enrolled patient. The questionnaire is designed to collect information on sociodemographic and injury-event characteristics and includes several standardized survey instruments designed to measure functional status before and after injury. Follow-up interviews are complete through the 12-month follow-up time point. Follow-up rates for each follow-up time point are as follows: 3-month, 96%; 6-month, 90%; 12-month, 90%; 18-month, 90%; and 24-month, 88%.

Injury Event-Related Questions

As part of the primary discharge interview, injury event-related questions were asked of each study participant. Perceived threat to life was assessed with the following question: "Did you feel during this event that your life was in danger?" Respondents answered either yes or no to this dichotomous question.

Acute Stress Disorder

Each patient was assessed at discharge for early symptoms of ASD using the Impact of Events Scale-Revised, a validated scale developed to assess psychological morbidity related to ASD onset.²⁴ A score of greater than 24 on the Impact of Events Scale-Revised was used as the cutoff value for clinically significant ASD.

Quality-of-Life Assessment

Functional outcome was measured using the Quality of Well-being (QWB) scale, an interview-based measure of well-being.²⁶⁻²⁹ The QWB scale combines preference-weighted measures of symptoms and functioning to provide a numerical point-in-time expression of well-being, which

ranges from 0 for death to 1.0 for asymptomatic full functioning. The QWB scale includes a symptom scale and three scales of function: mobility, physical activity, and social activity. Each symptom and step on these scales has its own associated preference weight. The overall QWB score is based on a preference-weighted average of functioning in the previous 6 days with respect to symptoms and the three function scales. Individual subscale and symptom scores are not routinely reported because of both the preference weighting and the greater utility and generalizability of a summary score. Typically, the QWB score is reported as a decimal with three significant digits. Normal healthy adolescent children usually score in the range of 0.900 to 0.950, with 1.000 representing asymptomatic full function. The mean QWB score in a population sample of healthy children in San Diego County was 0.910.

The validity of the measure is well established, and both the sensitivity and predictive value independent of the measure have been estimated to be at above 0.90.^{30,31} Earlier reports from the adult Trauma Recovery Project have documented the high sensitivity of the index to the well end of the functioning continuum.^{7,8} Thus, differences as small as 1% to 2% are clinically significant.

Statistical Analysis

QoL as measured by the QWB scale was considered as the primary outcome variable. For the functional outcome analysis, the Student's *t* test was used to examine the difference in QWB score by ASD status at each follow-up time point. Comparisons by ASD status were made using χ^2 analysis and the association of ASD with injury-event related factors and mechanism were quantified using the odds ratio.³² Statistical significance was attributed to $p < 0.05$.

RESULTS

The mean age of TRP-A adolescents was 15.0 ± 2.3 years, and 62% ($n = 246$) were male patients. In Table 1, the distribution of mechanism of injury in the TRP-A cohort is shown. The most common mechanism was motor vehicle crash (22%), followed by recreational (16% [all-terrain vehicle, skateboard, team sport]), bike (13%), intentional injuries (13% [assaults, gunshot wounds, stab wounds]), falls (12%), and pedestrian struck (10%), a distribution similar to that observed among all adolescent patients admitted to trauma centers in San Diego County. The category 'other' included many diverse mechanisms of injury, most notably wakeboard, in-line skates (Rollerblade), personal watercraft (Jet Ski), horse-related, dog attacks, and jumping from heights.

QoL outcomes (Fig. 1), based on the QWB score at follow-up, were significantly and markedly lower in injured adolescents with ASD compared with study subjects without ASD before discharge. This effect was significant beginning at 3-month follow-up and continued through the last long-term follow-up time point, 24 months.

Table 1 Distribution of Mechanism of Injury of TRP-A Participants: Trauma Recovery Project in Adolescents

Mechanism of Injury	Frequency	%
Motor vehicle crash	89	22.2
Motorcycle crash	25	6.2
Pedestrian struck	40	10.0
Intentional injuries	53	13.0
Assault	11	2.7
Gunshot wound	23	5.7
Stab wound	19	4.7
Fall	48	12.0
Bicycle	52	13.0
Recreational injuries	64	16
ATV	14	3.5
Skateboard	22	6.4
Team sport	28	7.0
Burn	1	0.2
Other	29	7.2

ATV, all-terrain vehicle.

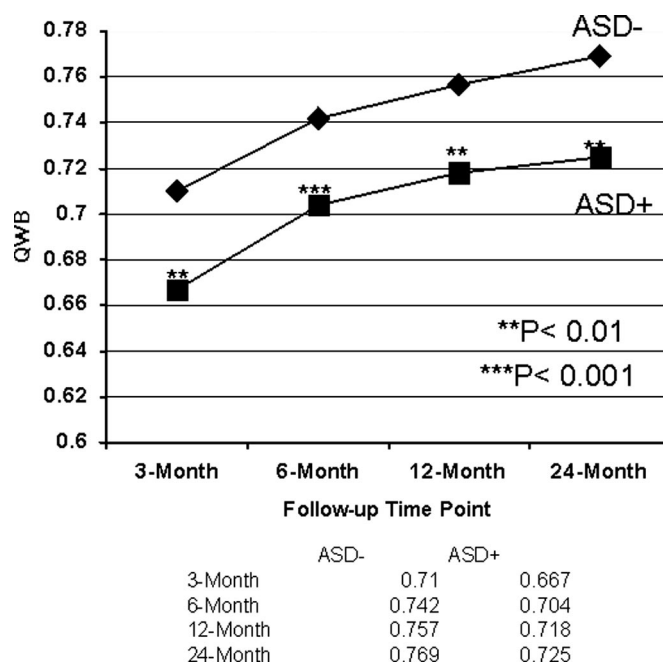
Table 2 shows the association of ASD status with selected injury event-related putative risk factors for ASD. Rates of ASD were higher in adolescent female patients versus male patients (47% vs. 36%; odds ratio [OR], 1.6; $p < 0.05$). Perceived threat to life was strongly associated with ASD risk (OR, 3.3; $p < 0.001$). Intentional or violence-related injury was also significantly associated with ASD onset (OR, 1.9; $p < 0.05$).

DISCUSSION

Our findings highlight the major impact of psychologic morbidity from ASD after serious injury in adolescents. In the TRP-A population, the overall rate of ASD was 40% among the 401 adolescent children enrolled in the study. If these rates are applied to the number of adolescent children discharged across the United States from trauma center hospitals for major injury in any recent year, they underscore an enormous and previously unrecognized problem in recovery from serious injury in this age group.

Very little research on ASD has been conducted in seriously injured child and adolescent populations; thus, rate comparisons are difficult. Rates of ASD were 28% among children injured by motor vehicle crashes.³³ Daviss and colleagues observed full and partial PTSD in 29% of a small sample of injured children.³⁴ The rate of 40% observed in the TRP-A is higher but similar to rates reported in our adult trauma study and to reported findings from other populations of injured adults.^{13–20}

In our study, ASD was strongly associated with significant reductions in short- and long-term QoL as measured by the QWB scale at 3-, 6-, 12-, and 24-month follow-up. To our knowledge, this association with reduced QoL in adolescent children has not been previously reported but strongly supports our findings in adult trauma patients.^{13–15} Other investigators have also documented the damaging effect of PTSD on general health status.^{35,36}

**Fig. 1.**

Our finding regarding the increased risk of ASD in adolescent female subjects compared with male subjects is both novel and important and is supported by several previous studies of ASD and PTSD in child and adolescent populations and in adults.^{13–15,17,37–40} However, it should be taken into account that most studies on risk factors for ASD and PTSD in children and adolescents are based on children exposed to disaster events or victimization but not necessarily physically injured.²⁵ Thus, the results of these studies are not directly comparable to our work in seriously injured adolescents. Nevertheless, the underlying reasons for the higher risk of adverse psychological outcomes in adult women and child and adolescent female subjects remain puzzling.

We also demonstrated that perceived threat to life is strongly associated with ASD onset in adolescents after major trauma. This finding is supported by our previous work in adult trauma patients and in several other injured populations.^{13–14,17,21} This observation is important because it may provide trauma surgeons and other health care providers in the acute postinjury period with a simple and reliable method for assessing ASD risk in the injured adolescent patient. Indeed, it is one of our major objectives to identify

Table 2 Rates and Odds Ratios for the Association of ASD Status with Injury Event Factors and Mechanism of Injury: Trauma Recovery Project in Adolescents

Injury Event and Mechanism	ASD-Positive (n = 158) (%)	ASD-Negative (n = 248) (%)	OR
Perceived threat to life	56	28	3.3*
Violence-related	54	38	1.9†

* $p < 0.05$.† $p < 0.001$.

early markers for ASD and PTSD in the adolescent trauma population.

Our study also confirms the association of intentional or violence-related injury events with ASD onset. This observation has been the focus of much of the research on PTSD in the civilian population and is well documented.^{37,41} In seriously injured adolescents, this finding has broad implications for the early detection of ASD. Considered together, perceived threat to life and violence-related mechanism of injury may provide a valuable and efficacious early screening tool with which to identify injured adolescents at risk for ASD onset.

Although the prospective epidemiologic cohort study design of the TRP-A has many advantages, this study has certain limitations with respect to the analysis of ASD. Because of the nature of the study design, it was not possible to obtain a preinjury baseline assessment of mental health problems or diagnoses in TRP-A-enrolled adolescents. It is well documented that preexisting psychiatric morbidity is an independent risk factor for PTSD in children and adults. Thus, the potential contribution of preexisting psychiatric morbidity to ASD risk after injury in the presence of other risk factors such as perceived threat to life cannot be evaluated from our data. Clearly, more research in injured adolescent populations is needed to address this issue.

Injury is not only the leading cause of death in adolescents younger than 19 years of age but, more importantly, leads all other conditions combined for years of productive life lost and loss in quality-adjusted life-years. In conclusion, ASD had a prolonged and profound negative impact on short- and long-term outcomes in the TRP-A population. Perceived threat to life and violence-related mechanism predicted acute ASD onset after major traumatic injury in adolescents. It is clear that psychological outcomes such as ASD take an enormous toll on short and long-term recovery and exert strong influences on postinjury QoL in injured adolescents. The return of adolescent trauma survivors to preinjury quality of life will depend not only on optimal clinical care but also on a commitment to long-range trauma care, quality of life, awareness of psychiatric pathology, and rehabilitative and support services. More research is needed to reduce psychological morbidity after trauma and to improve QoL outcomes in adolescents after major trauma.

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