Prevalence of Pain in Patients 1 Year After Major Trauma

Frederick P. Rivara, MD, MPH; Ellen J. MacKenzie, PhD; Gregory J. Jurkovich, MD; Avery B. Nathens, MD, PhD; Jin Wang, MS, PhD; Daniel O. Scharfstein, ScD

Objectives: To describe the prevalence of pain in a large cohort of trauma patients 1 year after injury and to examine personal, injury, and treatment factors that predict the presence of chronic pain in these patients.

Setting: Sixty-nine hospitals in 14 states in the United States.

Patients: There were 3047 patients (10,371 weighted) aged 18 to 84 years who were admitted to the hospital because of acute trauma and survived to 12 months after injury.

Main Outcome Measure: Pain 12 months after injury measured with the Chronic Pain Grade Scale.

Results: At 12 months after injury, 62.7% of patients reported injury-related pain. Most patients had pain in more than 1 body region, and the mean (SD) severity of pain in the last month was 5.5 (4.8) on a 10-point scale. The reported presence of pain varied with age and was more common in women and those who had untreated depression before injury. Pain at 3 months was predictive of both the presence and higher severity of pain at 12 months. Lower pain severity was reported by patients with a college education and those with no previous functional limitations.

Conclusions: Most trauma patients have moderately severe pain from their injuries 1 year later. Earlier and more intensive interventions to treat pain in trauma patients may be needed.

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PAIN IS A NATURAL ACCOMPANIMENT of acute injury to tissues and is expected in the setting of acute trauma. However, the persistence of pain after acute injury is less well studied. In a survey of 10 pain clinics in north Britain, previous trauma was ascribed as the cause of pain in 18.7% of patients seeking treatment.¹ Recent studies with long-term follow-up of trauma revealed that 5 to 7 years after injury, chronic pain was present in most patients who sustained pelvic fractures² and serious lower extremity injuries.³ Pain was an important contributor to disability in these patients²,³ and often interacted with other sequelae of trauma, such as post-traumatic stress disorder⁴,⁵ and depression,⁶,⁷ to affect functional recovery.

We describe the prevalence of pain in a large cohort of trauma patients 1 year after injury. We also examine personal, injury, and treatment factors that predict chronic pain in these patients.

Methods

This analysis is based on data collected as part of the National Study on Costs and Outcomes of Trauma (NSCOT), a prospective cohort study of patients treated in 18 trauma centers and 51 large nontrauma centers in 15 metropolitan statistical areas from 14 states in the United States.⁸ Institutional review boards at all 69 institutions approved the study. Patients were aged 18 to 84 years at the time of the injury and had at least 1 injury that had an Abbreviated Injury Scale score of 3 or higher. Patients were excluded if they had burns, first-listed diagnosis of hip fracture, were 65 years or older, delayed care for more than 24 hours, or spoke neither English nor Spanish.⁹ Patients who were alive 3 months after injury were contacted and enrolled in the study; 60.7% of eligible patients alive at 3 months were enrolled. Patients were sampled from discharge lists at study hospitals to obtain a prespecified number of patients in cells specified by type of hospital (trauma center vs nontrauma center), age (18-64 or 65-84 years), Injury Severity Score (9-15, 15-24, or >24), and principal body area injured (head, extremities, or other body regions). The

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sampling scheme has been described in detail elsewhere. Of those enrolled and alive at 12 months, 82.0% (3047) completed a follow-up interview at 12 months after injury in addition to the interview at 3 months after injury. Eighty-six patients (208 weighted patients) died between 3 and 12 months after injury.

ASSESSMENT OF PAIN

At the 12-month interview, patients were asked about pain in the previous 4 weeks using questions from the Chronic Pain Grade Scale in abst. This scale assessed the presence of pain in any of 7 body areas including the back, neck, head, abdomen, joints, chest, and face. We asked whether the patient thought the pain was related to the injury and, if so, to report the body area in which pain bothered him or her most in the previous 4 weeks. They were asked to rate the pain in this body area at the 12-month interview, the intensity of the worst pain, and the intensity of the average pain for this body area in the previous 4 weeks on a scale of 0 (none) to 10 (worst possible pain). We also assessed pain in the previous 4 weeks at 3 and 12 months using the 2-item subscale of the 36-Item Short-Form Health Survey, which assesses pain intensity and interference with activities.

POTENTIAL PREDICTORS OF PAIN

We examined preinjury and injury variables that, based on the literature, would be potential predictors of pain at 12 months after injury. These included demographic characteristics (age, sex, self-reported race/ethnicity, and educational achievement), preinjury health (global health self-assessment reported as excellent, very good, good, fair, or poor), and comorbid illness using questions from the Charlson Index, the Alcohol Use Disorder Identification Test for alcohol abuse, illicit drug use, self-reported depression, activities of daily living (ADL), and instrumental ADL. Injury characteristics included the maximum Abbreviated Injury Scale score, Injury Severity Score, New Injury Severity Score, body area injured, presence of multiple injuries, blunt vs penetrating trauma, and whether the patient required surgery, assisted mechanical ventilation, or admission to the intensive care unit (ICU).

DATA ANALYSIS

Data were weighted to account for the sampling scheme and nonresponse. All patients who died but only a percentage of patients discharged alive were sampled, as described in the “Methods” section. Not all patients who were sampled agreed to participate in the study. The sampling weights consisted of the inverse of the probability of being selected multiplied by the inverse of the probability of participating in the study. All analyses were conducted with weighted data.

We used Poisson regression to examine predictors of injury-related pain at 12 months after trauma, comparing patients who reported injury-related pain with those who reported no injury-related pain. Patients with no injury-related pain included those reporting no pain and those who reported pain that was not related to their injury. We conducted multiple linear regression analysis to examine predictors of injury-related pain severity at 12 months after injury, using the average severity score for the most bothersome pain in the previous 4 weeks.

PREVALENCE OF PAIN AFTER INJURY

Data were available for 3047 patients 12 months after injury, representing 10,371 weighted patients. At 12 months after injury, 1818 patients (62.7%) reported pain related to their injury (Table 1). The prevalence of pain was similar among men and women, and was most common among those 35 to 44 years of age and least common among those 75 to 84 years of age who survived to 12 months. The most common painful areas were joints and extremities (44.3%), back (26.2%), head (11.5%), neck (6.9%), abdomen (4.4%), chest (3.8%), and face (2.8%).

Only 37.3% of patients with injury-related pain had a single painful body area; 59.3% of those with pain had 3 painful areas or more. The mean number of painful body areas was 2.2 and varied little by sex. Patients 75 to 84 years of age reported the fewest number of injury-related sites of pain, and those 35 to 44 years of age reported the greatest number (Table 1).

The severity of the pain was similar across sex and age groups (Table 1). The average severity of pain was higher among patients with a greater number of painful body areas, increasing from a mean of 4.3 in those with 1 painful area to 8.5 in those with 6 painful areas.

PREDICTORS OF INJURY-RELATED PAIN AT 12 MONTHS

The prevalence of pain at 12 months after injury was related to several sociodemographic and preinjury cha-

Table 1. Prevalence, Severity, and Number of Body Areas of Injury-Related Pain 12 Months After Trauma

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of Patients (No. of Weighted Patients)</th>
<th>Pain Related to Injury Weighted, %</th>
<th>Mean No. of Body Areas With Pain</th>
<th>Severity of Worst Pain in Last 4 Weeks, Mean (SD)</th>
<th>Average Severity of Pain in Last 4 Weeks, Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Patients</td>
<td>3047 (10,371)</td>
<td>62.7</td>
<td>2.2</td>
<td>6.6 (4.9)</td>
<td>5.5 (4.8)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1981 (7093)</td>
<td>63.1</td>
<td>2.2</td>
<td>6.6 (4.9)</td>
<td>5.4 (5.0)</td>
</tr>
<tr>
<td>Female</td>
<td>1066 (3278)</td>
<td>61.7</td>
<td>2.2</td>
<td>6.7 (4.6)</td>
<td>5.6 (4.4)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-34</td>
<td>977 (4005)</td>
<td>64.1</td>
<td>2.2</td>
<td>6.7 (5.0)</td>
<td>5.5 (5.0)</td>
</tr>
<tr>
<td>35-44</td>
<td>490 (1825)</td>
<td>69.4</td>
<td>2.5</td>
<td>7.0 (5.1)</td>
<td>5.7 (5.2)</td>
</tr>
<tr>
<td>45-54</td>
<td>460 (1715)</td>
<td>66.9</td>
<td>2.4</td>
<td>6.7 (4.8)</td>
<td>5.6 (4.6)</td>
</tr>
<tr>
<td>55-64</td>
<td>367 (1242)</td>
<td>68.1</td>
<td>2.1</td>
<td>6.2 (5.0)</td>
<td>5.4 (5.0)</td>
</tr>
<tr>
<td>65-74</td>
<td>383 (781)</td>
<td>45.4</td>
<td>2.0</td>
<td>6.1 (3.8)</td>
<td>5.0 (3.5)</td>
</tr>
<tr>
<td>75-84</td>
<td>370 (804)</td>
<td>39.8</td>
<td>1.6</td>
<td>6.1 (3.6)</td>
<td>5.6 (3.5)</td>
</tr>
</tbody>
</table>
acteristics (Table 2). Pain was more common among those who were poor, although it did not vary significantly by race/ethnicity or preinjury educational attainment. Pain was somewhat more common among those who were smokers and those who were intravenous drug abusers before sustaining their injury but did not vary by preinjury alcoholic beverage drinking status. Pain was more common among those with depression at baseline, especially those who did not take medication.

The body part injured was related to the prevalence of pain at 12 months (Table 3). Three-fourths of the patients with moderate to severe injuries.
Injury Scale score ≥3) to their neck or spine had injury-related pain at 12 months. Pain was more common in those with lower extremity injuries than in those with upper extremity injuries; it was least common among those with head injuries. Patients with injuries in more than 1 body area were significantly more likely to have pain than those without multiple injuries. The mechanism of injury (blunt vs penetrating) did not significantly affect the presence of pain at 12 months. Patients with pain were more likely to have been treated at a trauma center, required ICU care, received assisted ventilation, and underwent surgery (Table 3). Pain scores at 3 months on the 36-Item Short-Form Health Survey were significantly lower (worse) in patients with pain at 12 months than in those reporting no injury-related pain at 12 months (mean [SD], 37.9 [20.1] vs 47.8 [19.4]).

In multivariate analyses, age was significantly related to the presence of injury-related pain at 12 months, although nonlinearly (Table 4). The risk of pain was higher among women but lower in those who were receiving medication to treat depression (relative to not being depressed). Admission to the ICU and undergoing surgery were associated with the prevalence of pain at 12 months, as was the presence of pain at 3 months after the injury.

### PREDICTORS OF MEAN SEVERITY OF INJURY-RELATED PAIN IN LAST MONTH

The mean severity of pain was similar in men and women and in patients of different ages but was higher in non-Hispanic nonwhite patients and lowest in non-Hispanic white patients (Table 2). Pain severity was lowest in those whose household family income was above the poverty level and those who were college educated. Patients who reported that their health was fair or poor before their injury reported more severe pain than those with good, very good, or excellent preinjury health status. Patients with 1 preinjury comorbidity or more, especially untreated depression, and those dependent in 1 ADL or more and 1 instrumental ADL or more reported more severe pain than those without such preinjury impairments. Reported pain severity was somewhat lower in those who drank alcoholic beverages but higher in those who were smokers or intravenous drug abusers.
The severity of pain varied little by body area injured but was somewhat higher in patients with multiple injuries, those with penetrating trauma, and those requiring ICU care (Table 3). Severity of pain also did not vary with whether patients received assisted mechanical ventilation, were treated in a trauma center vs a nontrauma center, or underwent surgery.

Multivariate analyses revealed that the severity of pain at 12 months was related to the pain score at 3 months, the number of painful body areas, and penetrating trauma (Table 5). Severity of pain was less in those with a college education. Severity of pain was worse in those with preinjury limitations in ADL and instrumental ADL and in those who smoke but was less in those who reported that before the injury they were hazardous alcohol drinkers. Severity of pain was worst for those treated in an ICU.

In this study of trauma patients admitted to hospitals across the United States, most had pain 1 year after their injury. The prevalence of pain found in this study was similar to that found in the few previous studies of trauma patients. For example, among patients with serious lower extremity injuries, 73% of patients reported pain 7 years after injury. In one study, 37.2% of patients reported moderate to severe pain 6 months after orthopedic trauma, and in another study, 45% to 80% of patients with extremity or pelvic fractures reported pain 5 years after injury. The prevalence of chronic pain found in our study is substantially higher than the 30% to 50% reported after amputation or thoracotomy. Conversely in patients with chronic pain, trauma is an important cause. For example, 36.6% of patients in 1 study of chronic facial pain had a history of injury. Trauma was the reported cause of pain in 18.7% of patients seeking care in 10 pain clinics in north Britain.

Risk factors found in this study for pain after trauma are similar to those found in the few other studies of trauma-related pain and similar to those found in nontrauma pain syndromes such as back pain. Patients with chronic spinal pain are more likely to be female, have lower educational attainment, and have a history of depression than are patients without such pain. In a study by Von Korff et al, the prevalence of chronic pain increased with age; in contrast, we found that pain was less common in the elderly than in younger patients. In studies of pain after inguinal herniorrhaphy, older patients have less postoperative pain. We also did not find, after adjustment for other risk factors, that previous hazardous drinking or intravenous drug use was a risk factor for pain after trauma. In unadjusted analyses, pain was less common among non-Hispanic whites compared with Hispanics and nonwhites. However, after adjustment for other risk factors, race/ethnicity was not a significant predictor of pain. As with other studies of pain in both trauma and nontrauma patients, presence of pain earlier in the course of recovery is a strong predictor of later pain. Many earlier studies have documented the higher risk of pain in patients with a history of depression. However, whereas untreated depression was associated with an increased risk of pain at 12 months, treated depression was associated with a lower risk.

The mean pain severity score of 5.5 on a 10-point pain scale reported by patients in this study is at a level where patients would likely have moderate to severe interference with activities because of pain. Patients with low back pain or osteoarthritis pain severity scores of 5 or higher report interference in activities. In patients with cancer, a score higher than 4 differentiates moderate from mild pain. Predictors of pain severity were somewhat different than those for the presence of pain in this study. In population-
based studies of pain, pain severity was lower in white subjects than in either black or Hispanic subjects,29 similar to our findings. There may be some genetic basis for this finding. For example, the MC1R (melanocortin-1 receptor gene) allele found in fair skinned, red-headed women seems to decrease severity of pain to a noxious stimulus.27

We were unable in this study to assess the adequacy of in-hospital pain control as a factor that might affect long-term prevalence or severity of pain. We were also unable to assess the use of pain control service consultants among our study patients.

Retrospective recall of pain intensity and persistence seems to be reliable and valid.30 Average or usual pain intensity correlates highly with diary-based estimates. The findings of this study suggest that interventions to decrease chronic pain in trauma patients are needed. The high prevalence of pain, its severity, and its effect on functioning warrant such interventions. This may consist of interventions during the acute phase of hospitalization to aggressively treat early pain29 and better manage neuropathic pain.50

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Correspondence: Frederick P. Rivara, MD, MPH, Department of Pediatrics and Epidemiology, Harborview Injury Prevention and Research Center, University of Washington School of Medicine, Box 359960, 325 Ninth Ave, Seattle, WA 98104 (e-mail: fpr@u.washington.edu).

Author Contributions: Dr Rivara had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Rivara, Mackenzie, Jurkovich, and Nathens. Acquisition of data: Rivara, Mackenzie, Jurkovich, and Nathens. Analysis and interpretation of data: Rivara, Mackenzie, Jurkovich, Nathens, Wang, and Scharfstein.

Drafting of the manuscript: Rivara, Jurkovich, and Nathens. Critical revision of the manuscript for important intellectual content: Rivara, Mackenzie, Jurkovich, Nathens, Wang, and Scharfstein. Statistical analysis: Mackenzie, Nathens, Wang, and Scharfstein. Obtained funding: Rivara, Mackenzie, and Jurkovich. Administrative, technical, and material support: Rivara, Mackenzie, and Jurkovich. Study supervision: Rivara and Nathens.

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