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Original Contributions

SUBWAY-RELATED TRAUMA: AN URBAN PUBLIC HEALTH ISSUE WITH A HIGH CASE-FATALITY RATE

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□ **Abstract—Background: Between 1990 and 2003, there were 668 subway-related fatalities in New York City. However, subway-related trauma remains an understudied area of injury-related morbidity and mortality. Objective: The objective of this study was to characterize the injuries and events leading up to the injuries of all patients admitted after subway-related trauma. Methods: We conducted a retrospective case series of subway-related trauma at a Level I trauma center from 2001 to 2016. Descriptive epidemiology of patient demographics, incident details, injuries, and outcomes were analyzed. Results: Over 15 years, 254 patients were admitted for subway-related trauma. The mean (standard error of the mean) age was 41 (1.0) years, 80% were male (95% confidence interval [CI] 74–84%) and median Injury Severity Score was 14 (interquartile range [IQR] 5–24). The overall case-fatality rate was 10% (95% CI 7–15%). The most common injuries were long-bone fractures, intracranial hemorrhage, and traumatic amputations. Median length of stay was 6 days (IQR 1–18 days). Thirty-seven percent of patients required surgical intervention. At the time of injury, 55% of patients (95% CI 49–61%) had a positive urine drug or alcohol screen, 16% (95% CI 12–21%) were attempting suicide, and 39% (95% CI 33–45%) had a history of psychiatric illness. Conclusions: Subway-related trauma is associated with a high case-fatality rate. Alcohol or drug intoxication and psychiatric illness can increase the risk of this type of injury.** © **2018 Elsevier Inc. All rights reserved.**

□ **Keywords—subway-related trauma; subway; public transportation; trauma; suicide**

INTRODUCTION

In 2004, subway collisions accounted for 24% of all public transit–related fatalities, and in New York City (NYC) alone, there were 668 subway-related fatalities between 1990 and 2003 (1). Victims of subway-related trauma often have severe injuries, including extremity fractures and amputations (2,3). Understanding the nature of subway injuries and the events leading up to them is an important part of treatment and control of these unique injuries. This issue is particularly pertinent to dense urban environments where residents rely heavily on public transportation (4).

Studies have highlighted several events leading up to subway-related injuries, with the rate of suicides exceeding unintentional injuries (such as slips and falls), which in turn exceed assaults (1,3–5). In a retrospective analysis of 16 cases of subway rail electrocutions, Rabban et al. found that the most common mechanisms

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included suicide attempts and unintentional falls (6). The types of injuries sustained in subway-related trauma have also been the subject of a small number of previous studies. Lin and Gill examined subway-related fatalities in NYC between the years 2003 and 2007 (3). They found rates of head injury, torso injury, and amputation of 88%, 76%, and 33%, respectively. This suggests that many subway-related fatalities involve polytrauma.

The objective of this study was to characterize the injuries and events leading up to the injuries of all patients admitted after subway-related trauma. This is the first step in developing an understanding of the epidemiology of subway-related trauma. This may allow for future developments in trauma patient care, and potentially prevention of subway-related injuries.

METHODS

This is a retrospective study of patients admitted after subway-related injury to Bellevue Hospital, a Level I trauma center in NYC, from January 1, 2001 to December 31, 2015. Patients were identified from the American College of Surgeons National Trauma Registry System using the e-codes outlined in the Appendix 1.

Abstracted data included demographics, incident-related variables, type and severity of injuries, surgical interventions, and clinical outcomes. Risk factors of interest included blood alcohol content (BAC), history of alcohol and drug dependence, and history of psychiatric illness among the study patients. Alcohol intoxication was defined as a BAC >80 mg/dL, based on the legal definition. The BAC of patients for whom no BAC was obtained was coded as unknown in alcohol intoxication analyses. Drug use (excluding alcohol) was detected via urine drug screen (UDS). Patients were considered "not intoxicated" when BAC was <80 mg/dL and no drugs were detected on UDS. Psychiatric history included evidence of past alcohol or drug abuse, depression, and schizophrenia, among other psychiatric diagnoses in the electronic medical record or by self-report. Incidents were considered suicidal in nature only if self-reported by the patient or if bystander accounts clearly documented such activity. Patients who died at the scene and whose injuries did not involve the subway tracks or train were excluded (e.g., patients who fell on the platform or on the station stairs). Surgical interventions included amputation, surgical fracture reduction, intracranial pressure monitoring, craniotomy/craniectomy, and laparotomy.

Descriptive statistics were calculated using mean (standard error of the mean [SEM]) for normally distributed variables and median (interquartile range [IQR]) for non-normally distributed variables. When making comparisons between groups of patients, the Student's *t*-test was utilized for continuous data. Mann-Whitney *U* test was used for non-normally distributed variables, such as Injury Severity Score (ISS). A χ^2 analysis was used for categorical data and, when appropriate, substituted with the Fisher's exact test or binomial test. A p value of <0.05 was considered significant. This study was approved by the Institutional Review Boards of NYU School of Medicine and Bellevue Hospital.

RESULTS

During the 15-year period, 254 patients were admitted for subway-related trauma. Demographic details can be found in Table 1. The mean (SEM) age of the cohort was 41.3 (1.0) years with only 5% of patients younger than 20 years old (95% confidence interval [CI] 3–8%). Eighty percent of patients were male (95% CI 74–84%). The time of injury was equally distributed throughout the day. There was significant seasonal variability, with more cases occurring in winter and spring relative to summer and fall ($p = 0.01$), as defined by astronomical seasons in the northern hemisphere.

Table 1. Demographic Characteristics and Mechanisms of Injury (n = 254)

Characteristic	Data
Age, y, median (IQR)	40.37 (27–54)
Male sex, % (95% CI)	80 (74–84)
Length of stay, d, median (IQR)	6 (1–18)
Injury time of day, % (95% CI)	
6 AM to 12 PM	13 (9–18)
12 PM to 6 PM	18 (14–23)
6 PM to midnight	19 (15–25)
Midnight to 6 AM	17 (12–22)
Unknown	33 (27–39)
Transfers	0.39 (0–2)
Injury season, %	
Winter	26
Spring	33
Summer	20
Fall	21
ISS, median (IQR)	14 (5–24)
Event type, % (95% CI)	
Unintentional	70 (64–75)
Suicide	17 (12–22)
Assault	3 (1–6)
Unknown	11 (8–15)
Injury mechanism, % (95% CI)	
Hit by train	49 (43–55)
Fall onto tracks	44 (38–50)
Pinned by train	3 (1–6)
Unknown	5 (3–8)
Intoxication, %	55
Alcohol (BAC >80 mg/dL), %	42
Positive UDS, %	20
Unknown (no BAC or toxicology), %	9
Suicide, %	17
Psychiatric history, %	39

BAC = blood alcohol content; CI = confidence interval; IQR = interquartile range; ISS = Injury Severity Score; UDS = urine drug screen.