



Gunshot wounds to the spine in post-Katrina New Orleans



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ABSTRACT

Background: Gunshot wounds (GSW) to the spine represent a major health concern within today's society. Our study assessed the epidemiologic characteristics of patients with GSW to the spine treated in New Orleans.

Patients and methods: A retrospective chart review was performed from January 2007 through November 2011 on all the patients who were seen in the emergency room and diagnosed with a gunshot wound to the spine. Epidemiologic factors, as well as the results of admission toxicology screening, were noted. Outcome analysis was performed on patients undergoing conservative versus operative management for their injuries. Clinical outcomes were assessed using the ASIA classification system. Complications related to initial injury, neurosurgical procedures, and hospital stay were noted.

Results: A total of 147 patients were enrolled. Of those diagnosed with a GSW to the spine, 88 (59.8%) received an admission toxicology screen. Seventy-three (83%) patients out of those tested had a positive screen, with the most common substances detected being cannabis, cocaine, and alcohol. In regards to management, 127 (87%) patients were treated conservatively and only one (0.7%) patient improved clinically from ASIA D to E. Of the 20 patients who underwent surgery, one (5%) patient had clinical improvement post-operatively from ASIA C to D.

Conclusions: This study evaluates the largest number of patients with GSW to the spine per year treated in a single centre, illustrating the violent nature of New Orleans. In this urban population, there was a clear correlation between drug use and suffering a GSW to the spine. Surgical intervention was seldom indicated in these patients and was predominately used for fixation of unstable fractures and decompression of compressive injuries, particularly below T11. Minimally invasive techniques were used successfully at our institution to minimize the risk of post-operative CSF leak.

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Introduction

Gunshot wounds (GSW) to the spine represent a major health concern within today's modern society. This form of penetrating injury accounts for approximately 1200 (11%) of the 11,000 new cases of spinal column injury each year [1]. Due to the high likelihood of suffering severe neurological damage secondary to these wounds, there is a significant socioeconomic impact imparted by this subset of patients [4,20].

While the main cause of GSW varies with geographical location [31], within the urban setting in the USA, gang and drug-related violence far exceeds all other etiologies [19,22]. Furthermore, there

is a direct association between drug-use and injury caused by interpersonal violence [7,10,11,24,25].

Previous studies conducted in New Orleans have described the association between substance use and traumatic injury within the urban population [24,25]. The goal of our study was to assess the epidemiologic characteristics of patients with GSW to the spine treated in New Orleans.

Materials and methods

A retrospective chart review was performed from January 2007 through November 2011. All patients who were evaluated in the emergency room and diagnosed with a new gunshot wound to the spinal axis were included in this study. A total of 147 patients met these criteria.

Within the selected patient population, epidemiologic factors including age, gender, race, and marital status, as well as the results of admission toxicology screening, were noted. Outcome

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analysis was performed in patients with a positive versus negative toxicology screening, and patients undergoing conservative versus operative management for their injuries. The clinical outcome was assessed using the ASIA classification system. Complications related to initial injury, neurosurgical procedures, and hospital stay, were noted.

Results

Of the 147 patients included in the study, 123 (84%) were African Americans and 13 (9%) Caucasians. Eleven (7%) patients were not identified by race during the admission. The age ranged between 14 and 66 years old (mean: 27), with the mean age for African Americans being 25, while the mean age for Caucasians was 36. Ninety-two percent of the patients were male. In regards to marital status, 97% of the patients were single versus 3% married.

Within the population included in the study, 88 (59.8%) patients received an admission toxicology screen. Seventy-three (83%) patients of those tested had positive results. Of those 73 patients that tested positive, 47 (64.3%) had multiple substances detected within their toxicology screen. Among the individual substances tested for, THC was by far the most common substance detected, with 58 (79.4%) patients having a positive result. Less common substances detected included cocaine (32.8%), ethanol (31.5%), benzodiazepine (30.1%), and opiates (27.3%) (Table 1).

When assessing the frequency of GSW to the spine by specific levels affected, the cervical spine was injured in 40 (27%) patients. Of these patients, 19 (48%) suffered complete cord injury. The thoracic spine was injured in 53 (36%) patients with 35 (66%) suffering complete injury. The lumbo-sacral spine was affected in 54 (36%) patients with only 7 (13%) patients suffering complete injury.

In regards to management, 127 (87%) patients were treated conservatively. Of those that were managed non-operatively, one (0.7%) patient improved clinically from ASIA D to E. Of the 20 patients who underwent surgery, 13 had procedures performed below T11 while 7 had procedures above T11. Of those patients who had surgery below T11, 9 patients underwent decompressive procedures with only 1 showing clinical improvement post-operatively from ASIA score C to D (Fig. 1). Six of these 9 patients had a minimally invasive approach, using sequential tubular

dilators to place the final tubular retractor through which the decompressive laminectomy and bullet removal was performed. The remaining patients underwent stabilization procedures for treatment of unstable fractures. There were 6 procedures performed on the cervical spine and 4 for the treatment of unstable fractures. Two underwent decompressive procedures, one for persistent radiculopathy (Fig. 2) and another to treat a developing cord infarction (Fig. 3). One patient underwent a thoracic stabilization procedure. None of the patients who underwent surgery for lesions above T11 showed improvement in ASIA scores post-operatively (Table 2).

There were 41 patients within the study population that experienced complications secondary to their underlying injury and subsequent hospitalization. There were 3 patients which experienced complications related directly to their neurosurgical procedure; 2 wound infections and 1 intra-operative durotomy. Within our patient population, mortality rate was 7% (10 patients) during the hospitalization (Table 3).

Discussion

This study evaluates the largest number of patients with GSW to the spine per year treated in a single centre, illustrating the violent nature of the city of New Orleans [3,6,17,18,32,36]. Moreover, to our knowledge, this is the first study to evaluate the epidemiologic variables associated with GSW to the spine and, specifically, the positive toxicology screening upon admission. As previously noted, 83% of those patients suffering GSW to the spine who were tested had positive toxicology. While THC was the most frequently abused substance, it is perplexing that cocaine was detected more frequently than alcohol in the blood of GSW trauma victims. Previous authors have assessed drug use in adolescent trauma patients prior to the onset of Hurricane Katrina. Their findings revealed that 64% of patients seen at Charity Hospital for traumatic injuries tested positive for either illicit drugs or alcohol and that there was a strong association between GSW to the body and a positive toxicology screening [24]. In a separate study, the same author found 80% of those patients admitted after suffering intentional trauma had positive toxicology screening compared to 63% of patients who suffered accidental trauma [25]. It is apparent that, despite the large population shifts associated with the city's complete evacuation and re-inhabiting after Hurricane Katrina, the association between substance abuse and intentional trauma has persisted.

In regards to other epidemiologic variables within our patient population, the overwhelming majority of patients were single minority males with an average age of 25. These findings are consistent with previously published reports describing the prevalence of interpersonal violence among young urban minority groups [8,14].

The kinetics of GSW to the spine has its most devastating impact on the segments of the spinal column that contain cord. Consistent with previous publications, the patients in our study experiencing GSW to the cervical and thoracic spine suffered complete injuries (ASIA A) in 48% and 66% of the cases, respectively [40]. Conversely, GSW to the lumbar spine caused only 12% of its victims to suffer a complete injury.

The energy of any moving object is determined according to the formula $E = 1/2 mv^2$, where E = kinetic energy, m = mass, and v = velocity. Therefore, the bullet energy impacted to tissues increases exponentially with the velocity. Most civilian firearms (typically pistols and handguns) have muzzle velocities of less than 2000 ft/s and are considered "low energy", whereas military assault rifles (like AK-47 and M-16) have muzzle velocities greater than 2000 ft/s and are considered "high energy". The closer the range of a gunshot, the less energy will be lost during transit and

Table 1
Patient demographics and toxicology results.

Patient demographics	Number (percent, %)
Race	
African-American	123 (84%)
Caucasian	13 (9%)
Other	11 (7%)
Sex	
Male	135 (92%)
Female	12 (8%)
Age (mean years old)	
African-Americans	25
Caucasians	36
Marital status	
Single	142 (97%)
Married	5 (3%)
Toxicology	
Total patients tested = 88	Total patients with (+) test = 73 (83%)
Drug	
THC	58 (79.4%)
Cocaine	24 (32.8%)
Ethanol	23 (31.5%)
Benzodiazepine	22 (30.1%)
Opiates	20 (27.3%)
Amphetamine	5 (6.8%)
Methadone	2 (2.7%)
Multiple substances	47 (64.3%)

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