


Brief Communication

National patterns of injury and outcomes of gunshot wounds to the penis: A Trauma Quality Programs retrospective cohort analysis

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Aim: Gunshot wounds (GSW) to the penis represent a rare type of traumatic injury in the civilian United States population. Although small, single-center studies have reported results of care for these types of injured patients, no national analyses have examined this group.

Methods: A cohort of patients with GSW to the penis was identified using the 2017 American College of Surgeons Trauma Quality Programs database, a comprehensive national database of 753 accredited trauma centers.

Results: Gunshot wounds to the penis occurred in 722 patients, which represents 1.7% of all GSW patients ($n = 41,017$). Gunshot wounds from altercations with law enforcement or accidental discharge of a firearm were rare; the vast majority ($n = 655$, 90.7%) occurred as a result of assault, intentional self-harm, attempted suicide, or attempted homicide. Patients with a major concomitant non-genitourinary injury comprised 119 (16.5%) patients of the cohort. Most patients ($n = 499$, 69.1%) underwent a genitourinary procedure during their trauma admission. Penile salvage was successful in most cases, with only 13 (1.8%) patients requiring completion penectomy. Most patients (87.8%) required admission with a median length of stay of 49.8 h. Most patients were treated at the initial trauma center without requiring transfer to another center, and complications during admission were rare.

Conclusions: This analysis, the first national examination of care of patients with GSW to the penis, reveals overall favorable outcomes. Admission and surgical intervention were required in most patients, but penectomy was rare and length of stay was generally short. These results will guide resource utilization and quality improvement efforts in this patient cohort.

Key words: ER, trauma

INTRODUCTION

GENITOURINARY (GU) INJURIES from trauma are relatively rare. Of these, the penis is the least frequently affected. Small, retrospective series have noted that these comprise 8–10% of all GU injuries.^{1,2}

When evaluating penetrating wounds to the penis, a distinction should be made between high- and low-velocity injuries. High-velocity injuries are usually seen in the course of military combat. The management of these is different than the low-velocity gunshot wound injuries that are

typically seen in civilian situations. The former often needs urinary diversion and staged repair whereas the latter can be observed or managed with primary exploration and repair.³

Due to the relative rarity of civilian gunshot wounds (GSW) to the penis, available published reports are limited to single-center, retrospective analyses. These reports generally describe a young population with a high prevalence of associated injuries to other organs.^{1,3} To our knowledge, no analysis of this type of trauma has been undertaken on a national scale. Our study sought to examine the demographics, associated non-urologic injuries, and interventions carried out in this patient group using the national Trauma Quality Programs (TQP).

METHODS

WE USED THE 2017 American College of Surgeons (ACS) Trauma Quality Programs (TQP)

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Participant Use File (PUF), which is a national database of level 1–3 trauma centers that conforms to the National Trauma Data Standard. The TQP included data on more than 1,000,000 trauma admissions in 2017 from 753 participating centers. We, as authors of this manuscript, are required to note that the content reproduced from the TQP PUF remains the full and exclusive copyrighted property of the ACS. The ACS is not responsible for any claims arising from works based on the original data, text, tables, or figures. This study was deemed exempt from Institutional Review Board review because it uses deidentified data.

We identified a cohort of patients with GSW to the penis using a combination of International Classification of Diseases, Tenth Revision (ICD-10) Clinical Modification diagnosis codes for penile–scrotal wounds (S31.2x and S31.3x) plus external cause of injuries codes for the non-military uses of firearms: accidental or unclassified discharge (W34.x, Y22.x, Y23.x, and Y24.x), discharge in the course of a legal intervention (Y35.0x), and assault, intentional self-harm, attempted suicide, or attempted homicide (X72.x, X73.x, X74.x, X93.x, X94.x, and X95.x). The firearm injury codes were also used to calculate the size of the cohort of all patients with a GSW.

Associated ICD-10-PCS procedure codes (0Hx, 0Jx, 0T1x, 0T2x, 0T5x, 0T7x-0T9x, 0TBx-0TDx, 0TFx, 0TJx, 0TLx-0TNx, 0TQx-0TVx, 0TWx, 0TYx, 0U2x, 0V2x, 0UWx, 0VWx, 0V1x, 0V5x, 0V7x, 0V9x, 0VBx, 0VCx, 0VLx-0VNx, 0VPx-0VUx, 0VXx, 0W3Mx-0W3Nx, 0W3Rx, 0W4Mx-0W4Nx, 0W8NXZZ, 0W9Mx-0W9Nx, 0WBMx-0WBNx, 0WCRx, 0WFRx, 0WMMx-0WMNx, 0WQMx-0WQNx, and 0WUMx-0WUNx) were used to identify the subset of penile GSW cohort patients who underwent a genitourinary procedure. Abbreviated Injury Scale (AIS) data were used to identify patients who had a major concomitant non-genitourinary injury, defined by AIS severity 3–6 (3, serious; 4, severe; 5, critical; and 6, currently untreatable) for AIS diagnoses exclusive of 5416xx, 5448xx, and 5450xx.

Outcome variables included data on complications during the hospital admission, which were defined by variable definitions in the National Trauma Data Standard for 2017. Descriptive variables are reported as median (interquartile range) and number (percentage) unless otherwise noted. Analyses were carried out using SAS 9.4 (SAS Institute, Cary, NC, USA).

RESULTS

A TOTAL OF 722 patients were identified; this represents 1.7% of all GSW patients ($n = 41,017$) in the

2017 TQP PUF. Demographic and baseline characteristics of the cohort are shown in Table 1.

Gunshot wounds resulting from the discharge of a firearm in the course of a law enforcement intervention accounted for eight (1.1%) penile GSW patients, and those from accidental or unclassified discharge of a firearm accounted for 59 (8.2%) patients. Gunshot wounds from assault, intentional self-harm, attempted suicide, or attempted homicide accounted for the majority ($n = 655$, 90.7%).

Patients with a major concomitant non-genitourinary injury comprised 119 (16.5%) of the cohort. The distribution of major non-genitourinary injuries was as follows: colon, rectum, or small bowel ($n = 61$, 51.3%), liver ($n = 32$, 26.9%), major vascular injury ($n = 28$, 23.5%), whole abdomen ($n = 12$, 10.1%), pancreas ($n = 7$, 5.9%), spinal cord ($n = 6$, 5.0%), and spleen ($n = 6$, 5.0%).

A total 499 patients (69.1%) underwent a genitourinary procedure during their trauma admission. The distribution of genitourinary procedures is shown in Table 2. Sixty-seven patients (9.3%) had a retrograde urethrogram carried out to evaluate for urethral injury, and 33 patients (4.6%) underwent urethral repair.

Major outcomes of the hospitalization are shown in Table 3. Most patients (87.8%) required admission with a median length of stay of 49.8 h. Complications during admission were rare. Venous thromboembolic events were identified in 1.8% and infectious complications were identified in 1.2%.

DISCUSSION

THIS ANALYSIS INDICATES that penile GSW trauma is a rare event, comprising a small percentage of all GSW trauma. To our knowledge, ours is the first study to analyze penile GSW at the national level.

The demographics of the cohort are similar to those reported in smaller series, with the majority of cases in young Black men (mean age of our national cohort was similar to that in prior smaller series, 27–30 years).^{1,3,4} The mechanism of shootings was almost all intentional with very few accidental shootings. Substance abuse was common in this cohort; cannabis was the most common drug detected on toxicology studies. The vast majority presented to a level 1 trauma center and required hospital admission. However, transfer to another institution was rare, likely due to the presence of urologic specialists at level 1 and 2 trauma centers, where most patients (96.8%) received care.

In general, penile GSW can result in a number of injuries, both superficial (i.e., skin and subcutaneous tissues) and deep (i.e., urethra and the paired corpus cavernosa). One must be aware of potential injury in one or more of these

Table 1. Baseline characteristics of the cohort of patients with gunshot wounds to the penis

	<i>n</i>	%	Denominator
Age (years)	27	(22–35)	
Race/ethnicity			
Black	461	66.1	697
Latino or Hispanic	120	17.2	
White, non-Hispanic	108	15.5	
Asian/Pacific Islander	4	0.6	
Native American	4	0.6	
Place of injury			
Street, highway, sidewalk, or parking lot	244	49.1	497
Interior of residence (house, apartment, or mobile home)	116	23.3	
Store, restaurant, gas station, religious institution, or other public building	49	9.9	
Park, recreation area, beach, athletic court, or other public outdoor space	44	8.9	
Exterior of residence (garden, yard, or driveway)	36	7.2	
Vehicle	8	1.6	
Mode of arrival to ED			
Transported by ambulance or police	543	76.9	706
Private vehicle or walk-in	163	23.1	
Tox screen carried out	514	71.2	
Tox screen was positive (for either drugs or EtOH)	309	60.1	514
EtOH	158	30.7	
Blood alcohol concentration (if positive; %)	0.12	(0.05–0.18)	
Drugs	211	41.1	
Cannabis	142	27.6	
Cocaine	57	11.1	
Meth	46	8.9	
Opioids	29	5.6	
Ecstasy, PCP, other	7	1.4	
Smoking status			
Current smoker	248	34.3	722
Trauma center type			
Level 1	399	80.3	497
Level 2	82	16.5	
Level 3	16	3.2	
Number of hospital beds			
<200	51	7.1	722
201–400	177	24.5	
401–600	202	28.0	
>600	292	40.4	

Table 1. (Continued)

	<i>n</i>	%	Denominator
GCS on arrival			
15	605	84.7	714
4–14	52	7.3	
3	57	8.0	
Intubated prior to ED arrival	41	5.7	

Values are number (percentage) or median (interquartile range) as appropriate. ED, emergency department; EtOH, ethyl alcohol; GCS, Glasgow Coma Scale; Meth, methamphetamine; PCP, phencyclidine; Tox, toxicology.

Table 2. Categorization of procedures carried out on patients with penile gunshot wounds

	<i>n</i>	(%)
Incision and drainage, debridement, skin grafting, or other isolated soft tissue procedure	312	(43.2)
Endoscopic evaluation of urethra, bladder, and/or ureters	156	(21.6)
Urinary drainage procedure	144	(19.9)
Urethral catheter	128	(17.7)
Suprapubic catheter	16	(2.2)
Major pelvic/abdominal GU surgical intervention (urethra/bladder/kidney)	72	(10.0)
Repair of urethra	33	(4.6)
Testicular and scrotal procedures (excision and/or repair, including orchiectomy)	462	(64.0)
Penile procedures (exploration, repair, control of hemorrhage)	130	(18.0)
Completion penectomy	13	(1.8)

Values are number of patients undergoing each procedure type, and percentages based on 722 total patients, with sum greater than 100% because of patients with multiple procedures. GU, genitourinary.

areas. Blood at the urethral meatus should prompt concern for urethral injury and a retrograde urethrogram should be carried out in patients who are not critically ill and able to undergo diagnostic testing. Our findings note that only a small percentage of patients underwent this imaging procedure ($n = 67$, 9.3%). This could be for a variety of reasons, including critically ill patients who were not stable enough to undergo this imaging, lack of expertise in carrying out this relatively rare diagnostic procedure, and/or successful

Table 3. Outcomes of patients treated for gunshot wounds to the penis

			Denominator
Received blood transfusion	130	(18.0)	722
Discharge disposition from ED			
Admitted (including observation)	628	(87.8)	715
Home directly from ED	45	(6.3)	
Transferred to another hospital	14	(2.0)	
Deceased	28	(3.9)	
Length of stay (h)	49.8	(35.2,	134.4)
713			
Complications during admission			
Acute kidney injury	4	(0.6)	722
Unplanned reoperation	5	(0.7)	
Deep vein thrombosis/pulmonary embolism	13	(1.8)	
Catheter-associated urinary tract infection	2	(0.3)	
Infectious complications [†]	9	(1.2)	

Values are number (percentage) or median (interquartile range) as appropriate. Denominators reflect records without missing data.

[†]Includes superficial surgical site infection, deep surgical site infection, organ space surgical site infection, or severe sepsis. ED, emergency department.

attempt at urethral catheter placement (with or without cystoscopic assistance). In addition, urethral injuries from penile GSW seemed to be minor or partial (i.e., not a complete transection) as a urethral catheter was placed in almost all of the urinary drainage procedures noted ($n = 128/144$, 88.9%). However, a suprapubic tube should always be considered in patients with urethral injury where a urethral catheter cannot be placed safely. Penile preservation was very successful, with only 1.8% of patients undergoing completion penectomy at the time of their acute trauma admission. Unfortunately, long-term follow-up is not available to assess penile preservation over a greater timespan or to assess functional outcomes.

Most patients (69.1%) required a GU procedure after penile GSW, with the most common being testicular/scrotal and soft tissue procedures ($n = 462$, 64%). Due to the anatomic proximity, the scrotum should also be examined for bullet entry/exit sites, signs of scrotal hematoma, and/or active bleeding. If there is concern for scrotal injury based on physical examination, there could be scrotal changes that make it difficult to assess the health and viability of the

testes. If the patient is stable, a scrotal ultrasound with Doppler should be obtained to evaluate blood flow to the testes, potential testicular rupture, and hematocoele. Scrotal exploration, testicular repair, and possibly orchiectomy should occur, if indicated.

A minority of penile GSWs were found to have a major concomitant non-GU injury (119/722, 16.5%), a finding that is consistent with prior small series.^{3,4} Approximately 10% of patients required a major abdominal or pelvic operative GU repair of the urethra or bladder within the acute trauma admission, in keeping with national guidelines in favor of prompt surgical repair.⁵ In addition, a substantial percentage of patients received a blood transfusion. This was most likely due to more extensive vascular injuries in other areas and/or baseline anemia, which was acutely worsened with blood loss from the penile trauma. Although not all associated injuries in the setting of a penile GSW are considered “major,” the trauma team and any urologists involved should remain vigilant about assessing the patient for any other non-GU injuries, especially colon, rectum, and/or small bowel injuries that were affected in more than 50% of the major non-GU concomitant injuries noted.

The majority of patients with penile GSWs required admission to the hospital (87.8%), but the incidence of complications identified during admission such as deep vein thrombosis/pulmonary embolism and infection was low.

This study has many of the limitations inherent in an observational analysis of a national database. First, granularity is limited. For instance, we are not able to discern how often urologists were consulted or evaluate outcomes of management by urologists versus general or trauma surgeons. Similarly, it is not possible to parse the procedural details of GU interventions (e.g., debridement at the bedside for more superficial wounds versus formal exploration in the operating room for more substantial injuries). Reconstruction of more complex injuries (beyond simple soft tissue debridement or urinary drainage procedures) typically requires a specialty-trained reconstructive urologist, but TQP does not allow us to determine how frequently that was the case in this cohort.

Compared to other observational studies, TQP does have advantages of large numbers and comprehensive, national inclusion of certified trauma centers. Missing data are less profound of a challenge because of TQP’s audited processes, high data quality, and the nature of trauma activation protocols, where all GSW patients are likely to be captured as trauma activations.

CONCLUSIONS

THIS ANALYSIS, THE first national examination of care of patients with GSW to the penis, reveals overall

favorable outcomes. Admission and surgical intervention were required in most patients, but penectomy was rare and length of stay was generally short. These results will guide resource utilization and quality improvement efforts in this cohort.

DISCLOSURE

Approval of the research protocol: The protocol for this research project was deemed exempt from full Legacy Health System Institutional Review Board review because it uses publicly available, deidentified data. It conforms to the provisions of the Declaration of Helsinki.

Informed consent: N/A.

Registry and the registration no. of the study/trial: N/A.

Animal studies: N/A.

Conflict of interest: None.

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