Evaluation of Gunshot Orthopaedic Fracture Patients with Concurrent Vascular Injury, Compartment Syndrome, and Transfusion

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Disclosures: All the authors have no relevant financial disclosures or conflicts to disclose.

INTRODUCTION: Gun violence in the United States continues to remain a public health crisis associated with mortality and long-lasting disability. The impact of gunshot wounds (GSWs) on orthopaedic fractures and concurrent vascular injury, compartment syndrome, and blood transfusions has not been readily explored. Therefore, the purpose of this study was to evaluate the management of patients presenting at two NYC level-1 trauma centers with orthopaedic fractures secondary to gunshot wounds (GSWs), with respect to (1) patient demographics, as well as predictors of (2) vascular injury, (3) compartment syndrome, and (4) blood transfusion.

METHODS: A retrospective chart review was performed to identify all GSW patients presenting to two NYC Level-1 trauma centers. Patient demographics, anatomic region, vascular injury, compartment syndrome, transfusion, length of stay, and mortality were collected. Univariate and/or multivariate logistic regression analyses as well as odds ratios (OR) were conducted for primary outcomes: 1) vascular injury 2) compartment syndrome 3) transfusion. Statistical significance was set at $p<0.05$.

RESULTS SECTION: Among 478 total GSW patients identified, 94 (19.7%) patients sustained 130 orthopaedic fractures. Of the 94 patients with orthopaedic fracture injury, 64 patients (68.1%) presented with a lower extremity fracture. Orthopaedic fracture patients had significantly higher rates of vascular injury, compartment syndrome, and blood transfusion compared to patients with non-orthopaedic injury from GSW. Univariate analysis showed fracture of the hip/femur (OR=5.31, $p<0.001$) and ankle (OR=47.50, $p<0.001$) as predictors of vascular injury. Univariate analysis showed lower extremity vascular injury (OR=30.14, p=0.007) as a predictor of compartment syndrome. Multivariate analysis showed anatomic fracture sites at the acetabulum/pelvis (OR=7.17, p=0.025), humerus (OR=15.17, p=0.008), and clavicle/scapula (OR=11.30, p=0.009), as well as lower extremity vascular injury (OR=54.69, p=0.006) as predictors of blood transfusion.

DISCUSSION: This study aimed to evaluate patient demographics and predictors of concurrent vascular injury, compartment syndrome, and blood transfusion in these patients with GSW-related orthopaedic fractures during the hospital course period. While patient demographics in this study are consistent with those reporting GSW-related traumatic injury in urban centers, we found that female sex, and fractures to the hip/femur and ankle were associated with higher odds of vascular injury; lower extremity vascular injury was associated with higher odds of compartment syndrome; and fractures to the acetabulum/pelvis, humerus, and clavicle/scapula, as well as lower extremity vascular injury, were associated with higher odds of blood transfusion. Though ours is the largest analysis of its kind, larger and higher-evidence studies are required to further explore this topic.

SIGNIFICANCE/CLINICAL RELEVANCE: These findings emphasize vigilance in the diagnosis and management of vascular injuries and compartment syndrome in patients presenting with GSW-related orthopaedic fractures while highlighting the need for targeted transfusion strategies in these clinical scenarios.

IMAGES AND TABLES:

Table 1. Demographic profile of non-orthopaedic fracture injury versus orthopaedic fracture injury GSW patients.

Demographic	Non-Orthopaedic Injury N (%)	Orthopaedic Injury N (%)	p-value
Patients	384 (100.0)	94 (100.0)	
Year			0.82
2019	31 (8.1)	7 (7.4)	
2020	231 (60.2)	54 (57.4)	
2021	122 (31.8)	33 (35.1)	
Mean Age (years) [IQR]	28.9 [21-35]	29.9 [21-34]	0.44
Insurance			
Uninsured	92 (24.0)	6 (6.4)	
Medicaid	260 (67.7)	77 (81.9)	**<0.001**
Private	21 (5.5)	4 (4.3)	
Medicare	11 (2.9)	7 (7.5)	
Age Group			**0.015**
≤21	98 (25.5)	20 (21.3)	
21-27	99 (25.8)	19 (20.2)	
27-35	106 (27.6)	20 (21.3)	
≥35	81 (21.1)	35 (37.2)	
Biological Sex			**<0.001**
Male	357 (93.0)	75 (80.2)	
Female	27 (7.0)	19 (19.8)	
Race			0.88
White	7 (1.8)	1 (1.1)	
Black/AA	270 (70.3)	68 (72.3)	
Hispanic	58 (15.1)	12 (12.8)	
Other	49 (12.8)	13 (13.8)	
Social Deprivation Index			**<0.001**
<38	0 (0)	15 (15.9)	
38- ≤ 58	7 (1.8)	4 (4.3)	
58- ≤ 78	33 (8.6)	6 (6.4)	
78- 100	344 (89.6)	69 (73.4)	
Number of Fractures			-
1	-	69 (73.4)	
2	-	19 (20.2)	
3	-	4 (4.3)	
4	-	0 (0.0)	
5	-	1 (1.1)	
6	-	1 (1.1)	
Anatomic Fracture Site*			-
Hand	-	2 (1.8)	
Forearm	-	5 (4.5)	
Humerus	-	10 (9.0)	
Clavicle/Scapula	-	12 (10.8)	
Foot	-	8 (7.2)	
Ankle	-	7 (6.3)	
Tibia/Fibula	-	13 (11.7)	
Hip/Femur	-	36 (32.4)	
Acetabulum/Pelvis		18 (16.2)	
LOS (days) [IQR]	2.69 [0-3]	7.65 [1-12]	**<0.001**
In Hospital Mortality	43 (11.2)	3 (3.2)	**0.007**
Vascular Injury Site			
Total	18 (4.7)	28 (29.8)	**<0.001**
Upper Extremity	0 (0)	19 (20.2)	**<0.001**
Lower Extremity	7 (1.8)	23 (24.5)	**<0.001**
Other	11 (2.9)	20 (21.3)	**<0.001**
Compartment Syndrome	1 (0.3)	3 (3.2)	**0.011**
Transfusion	49 (12.8)	26 (27.7)	**0.006**

IQR = Interquartile Range; AA = African American.
*Anatomic fracture site representing number of patients with a given fracture.
p-value <0.05 (bolded) signifies statistical significance.