Original Article

Gunshot Injuries in Lebanon: Does Intent Affect Characteristics, Injury Patterns, and Outcomes in Victims?

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Abstract

Introduction: Lebanon lacks a national database of gunshot injuries (GSIs), which limits injury prevention initiatives. **Objectives:** This study examines patient characteristics, injury patterns, and clinical outcomes in GSI victims and evaluates the impact of intent on clinical outcomes with the aim of improving awareness among emergency department (ED) physicians about the importance of inquiring about intent to predict prognosis. **Materials and Methods:** We conducted a retrospective cohort study of GSI victims presenting to the ED of a tertiary care center in Beirut, Lebanon. Descriptive and bivariate analyses were done to identify differences based on intent. **Results:** A total of 83 patients were included, 59% with intentional GSI, 22% with unintentional GSI, and 19% with unspecified intent. They were mostly males (89.2%), with a mean age of 31.7 years, and mostly presenting during summer seasons. Females were more commonly victims of unintentional GSI. All victims sustaining multiple GSIs were in the intentional group. When compared to unintentional GSI, intentional and unspecified GSIs were found to result in more ICU admissions (46.9%, 31.3%, and 16.7%, $P = 0.096$), significantly longer hospital stays (18.2, 26.3, and 5.6 days; $P = 0.001$) and higher mortality (11.6%, 18.2%, and 6.7%; $P = 0.747$). The rates of surgical procedures were similar between the three groups although more victims of intentional and unspecified GSI underwent multiple surgeries. **Conclusion:** GSIs have different features, resource utilization, and clinical outcomes depending on the intentionality of injuries. All GSI victims suffer from substantial morbidity and mortality, but intentionally harmed victims sustain more severe injuries with worse outcomes.

Keywords: Gunshot, injury prevention, intentional, Lebanon, penetrating injury, stray bullets

Introduction

Gunshot injuries (GSIs) cause significant mortality[1,2] and lead to high economic costs on societies globally.[3-6] Nonfatal GSI injuries can also inflict considerable morbidity related to major injuries such as pulmonary trauma, spinal cord injury, and vision loss,[1-3,7,8] in both the adult and pediatric populations.[9-11] Males of young age constitute the highest proportions of gunshot victims.[12,13]

In Lebanon, GSIs remain prevalent among civilians despite the absence of armed conflicts since the 2006 war. Multiple factors contribute to this and include the widespread availability of weapons and ammunition among civilians and the ease of access to weapon purchase. The presence of weapons in untrained hands increases both intentional and unintentional GSI.[13] Intentional GSIs occur with the frequent use of weapons during regular clashes or fights.[6] Unintentional GSIs, on the other hand, can occur due to mishandling of arms by untrained civilians and due to access of adolescents and children to unsecured arms.[9]

Another relatively common form of unintentional GSI in Lebanon is the "stray bullet" phenomenon. Random aerial shootings are a form of expression in Lebanon during emotional situations such as celebratory events, grieving events, charged political speeches, or to express anger at times of civil unrest. Studies have looked into stray bullets and found that it may reach values of 14.7% of total GSI and have mortality rates of up to 10%.[13,14] Lebanon also receives a large number of patients with GSI from neighboring countries

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affected by war (Syria and Iraq) and these patients frequently require advanced and complex care in tertiary care centers in Lebanon.

Intent in GSI (intentional vs. unintentional) was shown to affect patient presentation, pattern of injury, and clinical outcomes in affected victims.[13,15] In a study by Monuteaux *et al*. examining 9628 gunshot victims, self-inflicted injuries had the highest morbidity and mortality rates when compared to nonintentional and violent GSI.[15] Another study out of Pakistan reported higher mortality among victims of assaults referred to as civilian fighting injuries (7.7%) and among stray bullets victims (10%) when compared to general GSI (5.2%) and war injuries (4.4%).[13]

To date, a national database of injuries is missing in Lebanon and injury-related data out of Lebanon is not well described in the literature, which limits injury prevention initiatives and strategies. This study examines patient characteristics, injury patterns, and clinical outcomes in GSI victims treated at a tertiary care center in Beirut, Lebanon. It evaluates the impact of intent (intentional vs. unintentional) on different clinical outcomes with the aim of improving awareness among ED physicians about the importance of inquiring about intent in GSI victims to better predict prognosis and improve delivery of care.

Materials and Methods

Study design and setting

This is a retrospective chart review cohort study conducted at the XX Medical Center (XXMC), a tertiary care center in Lebanon with over 55,000 emergency department (ED) visits annually. The Institutional Review Board office at XX approved this study.

Study population

All patients of all ages who presented to XXMC with GSIs from missile or cased pellet bullets between January 1, 2012, and December 31, 2017, were included in the study. Patients were identified using ED discharge diagnoses reports. We excluded patients presenting for pellet-gun and rubber-bullet injuries as well as patients presenting with cardiac arrest.

Patients were further classified into three groups, victims of intentional or violent shootings, those of unintentional or accidental shootings, and those of unspecified mechanism of intent. We defined intentional and unintentional GSIs according to the tenth revision and clinical modification of the International Classification of Diseases (ICD-10-CM). Intentional shootings included assaults by firearm discharge, terrorism acts involving firearms and household shootings or homicides, and self-inflicted injuries by firearms. Unintentional shootings included those with mishandling of weapons and accidental discharge from firearms such as while performing gun maintenance or cleaning, either by the victims themselves or by other individuals, legal interventions involving firearm discharge, and GSIs due to stray bullets. Based on the ICD and on the literature, stray bullet victims were defined as those who sustained bullet injury while present in an open area without being involved in conflict and with no knowledge of bullet source or shooter.[13,14,16]

Data collection

Trained research fellows with Medical Doctor degrees collected data using a manually filled data collection sheet. Collected data included information about demographic characteristics, emergency severity index (ESI), laboratory tests, medical and surgical history, symptom description, physical examination findings, computed tomography scan findings, and other diagnostic tests done.

ESI consists of a five-level triage system maintained by the Agency for Healthcare Research and Quality used to triage patients based on the acuity of their health condition and the anticipated resources their care would require.

Statistical analysis

A descriptive analysis was carried out with continuous variables presented as means ± standard deviations and categorical variables presented as frequencies with percentages. This was followed by a bivariate analysis using Student's *t*-test and Pearson's Chi-square test to assess the significance of the statistical association between the independent variables in the different groups. Tests were interpreted at a predetermined significance level (alpha = 0.05).

Results

A total of 83 cases of GSI were identified and included in the study. Of these, 16 (19%) did not have a specified method of shooting and were grouped separately under unspecified GSI. The largest group of patients consisted of intentional GSI with 49 patients (59%), while unintentional GSI accounted for 18 patients (22%). Patients had a mean age of 31.7 (±12.2) years and mostly consisted of males (89.2%) with most GSIs occurring during summer seasons. Most injuries were from missile bullets (90.4%). Patients mostly had an ESI of 2 or 3 (80.5%) and were transferred from another hospital (60.5%) with internal injuries (77.1%). Mortality rate reached 11.6% and 18.4% of patients suffered from some form of disability.

Table 1 presents the characteristics of GSI patients after stratification by intent. Patients in the different groups were relatively young and had similar baseline characteristics with the exception of the following: females were more commonly victims of unintentional GSI. Patients in the intentional group had more commonly multiple GSI with missile being the most common bullet type. Patients transferred from other hospitals had more commonly intentional or unspecified GSI.

Hospitalization outcomes are listed in Table 2: intentional and unspecified GSI were found to result in more ICU admissions (46.9% and 31.3% vs. 16.7%, $P = 0.096$) and significantly longer hospital stays (18.2 days and 26.3 vs. 5.6 days, $P = 0.001$) as compared to unintentional GSIs. The rate of

Table 1: Characteristics of patients presenting to the emergency department with gunshot injuries stratified by intentionality

	Unintentional (n=18)	Intentional (n=49)	Unspecified (n=16)	P
Age (years)	30.0±12.4	31.2±10.6	34.9±16.4	0.478
Gender				
Male	11 (61.1)	48 (98.0)	15 (93.8)	<0.001
Female	7 (38.9)	1 (2.0)	1 (6.3)	
Season				
Summer	2 (11.1)	16 (32.7)	5 (31.3)	0.691
Fall	6 (33.3)	10 (20.4)	4 (25.0)	
Winter	5 (27.8)	10 (20.4)	3 (18.8)	
Spring	5 (27.8)	13 (26.5)	4 (25.0)	
Year				
2012	3 (16.7)	5 (10.2)	4 (25.0)	0.623
2013	2 (11.1)	5 (10.2)	3 (18.8)	
2014	1 (5.6)	12 (24.5)	2 (12.5)	
2015	4 (22.2)	11 (22.4)	3 (18.8)	
2016	3 (16.7)	10 (20.4)	2 (12.5)	
2017	5 (27.8)	6 (12.2)	2 (12.5)	
Insurance				
Self	8 (44.4)	34 (69.4)	10 (62.5)	0.174
Insured	10 (55.6)	15 (30.6)	6 (37.5)	
Residence				
Beirut	7 (50.0)	16 (35.6)	2 (13.3)	0.487
Mount Lebanon	4 (28.6)	7 (15.6)	6 (40.0)	
North	1 (7.1)	7 (15.6)	2 (13.3)	
Bekaa	1 (7.1)	5 (11.1)	2 (13.3)	
South	1 (7.1)	4 (8.9)	2 (13.3)	
Syria/Iraq	0 (0)	6 (13.3)	1 (6.7)	
Bullet type				
Missile	18 (100)	44 (89.8)	13 (81.3)	0.156
Cased pellet	0 (0)	5 (10.2)	3 (18.8)	
Multiple GSWs	0 (0)	12 (24.5)	0 (0)	0.005
Injury type				
Superficial	6 (33.3)	8 (16.3)	5 (31.3)	0.239
Internal	12 (66.7)	41 (83.7)	11 (68.8)	
Location				
Head	2 (11.1)	8 (16.3)	2 (12.5)	0.913
Neck	0 (0)	7 (14.3)	1 (6.3)	0.191
Chest	2 (11.1)	9 (18.4)	3 (18.8)	0.846
Abdomen/pelvis	2 (11.1)	11 (22.4)	2 (12.5)	0.571
Back	2 (11.1)	6 (12.2)	0 (0)	0.506
UE	4 (22.2)	6 (12.2)	0 (0)	0.142
LE	6 (33.3)	11 (22.4)	8 (50.0)	0.100
Transferred	6 (33.3)	32 (68.1)	11 (68.8)	0.028
ESI				
1	3 (17.6)	10 (20.4)	2 (12.5)	0.953
2-3	14 (82.4)	38 (77.6)	14 (87.5)	
4-5	0 (0)	1 (2.0)	0 (0)	

ESI: Emergency Severity Index, GSWs: Gunshot wounds, LE: Lower extremity, UE: Upper extremity

surgical procedures was however found to be similar among all groups although more victims of intentional and unspecified GSI had to undergo multiple surgeries compared to those of unintentional shootings.

Disabilities, including quadriplegia, blindness, limb amputation, and others, affected 20.5% of patients with intentional GSI, 33.3% of those with unspecified GSI versus 0% for the unintentional group (P = 0.051).

Stray bullets accounted for 50% of injuries in the unintentional group with 5 out of 9 patients having superficial injuries, while the others suffered from more serious injuries. Wound patterns resulting from stray bullets are described in Table 3.

Table 2: Outcomes of patients presenting to the emergency department with gunshot injuries stratified by intentionality

	Un-intentional (n=18)	Intentional (n=49)	Unspecified (n=16)	*P*
ED disposition				
Home	3 (16.7)	5 (10.2)	4 (25.0)	0.096
AMA	0 (0)	0 (0)	1 (6.3)	
Floor	12 (66.7)	20 (40.8)	6 (37.5)	
ICU	3 (16.7)	23 (46.9)	5 (31.3)	
Dead in ED	0 (0)	1 (2.0)	0 (0)	
Surgical procedure	11 (61.1)	28 (57.1)	10 (62.5)	0.912
Multiple surgical procedures	3 (27.3)	16 (57.1)	6 (60.0)	0.209
Hemoglobin (g/dl)	13.7±2.1	12.6±2.6	10.8±2.3	0.010
Hematocrit	40.8±6.2	37.5±7.8	31.7±7.2	0.007
Transfusion, yes				
RBC	2 (11.1)	12 (24.5)	4 (25.0)	0.466
FFP	0 (0)	6 (12.2)	2 (12.5)	0.352
Length of stay (days)*	5.6±5.4	18.2±20.2	26.3±35.8	0.001
Death in hospital	1 (6.7)	5 (11.6)	2 (18.2)	0.747
Disability†	0 (0)	9 (20.5)	5 (33.3)	0.024

*Kruskal-Wallis test was used since the length of stay was not found to be normally distributed, †Disability included quadriplegia, blindness, limb amputation, and others. AMA: Against medical advice, ED: Emergency department, ICU: Intensive care unit, FFP: Fresh-frozen plasma, RBC: Red blood cell

Table 3: Description of injuries due to stray bullets

Type of injury, n (%)	Location of bullet entry									
	Head (n=2)		Chest (n=1)		Back (n=2)		UE (n=1)		LE (n=3)	
Skin/soft tissue	1 (50)		0 (0)		2 (100)		1 (100)		1 (33.3)	
Organs	Brain	1 (50)	Lung	1 (100)	-	-	-	-	-	-
	Spinal cord	1 (50)								
Fractures	Cranial	1 (50)	Clavicle	1 (100)	-	-	-	-	Tibia	1 (33.3)
									Fibula	1 (33.3)
									Femur	1 (33.3)

LE: Lower extremity, UE: Upper extremity

Discussion

GSIs affect most commonly young males in Beirut Lebanon. Females are more commonly victims of unintentional GSIs. Different injury patterns were identified when comparing GSI victims by shooting intent. This study is the first to report on characteristics and outcomes of GSI victims and their relation with intent out of Beirut Lebanon.

GSIs, whether intentional or unintentional, mainly affect the younger age groups. This is in line with previous reports from other countries.[3,13] Young adults form the bulk of the Lebanese population and tend to be outgoing which puts them at higher risk of being injured unintentionally or hit by stray bullets. In addition, younger people are more prone to being involved in fights and conflicts with subsequent involvement in intentional shootings.

In terms of gender differences, males were more commonly affected similar to other large epidemiologic studies of firearm injuries in both adult[17] and pediatric samples.[18] Women were found to rarely suffer from intentional GSIs as only 2% of intentional shootings involved women, compared to 39% of unintentional shootings. This was expected as women are less likely to be involved in armed conflicts that result in intentional violent shootings. On the other hand, 39% of unintentional shootings involved women. This differs from other surrounding Arab countries such as Libya where only 17% of unintentional shootings involved women.[13] In those countries, women are usually kept away from situations involving firearms and males are exposed to more risk regardless of the mechanism of intent.[13]

During the past 6 years, there have been no major armed conflicts in Lebanon. GSIs have been however occurring without any significant rate changes and without any significant seasonal changes. This is also the case in the United States and worldwide where the incidence and severity of civilian public mass shootings continue to rise.[19] This sheds light on the fact that GSIs continue to constitute a clinical and public health concern in Lebanon regardless of the surrounding political situation due to the widespread and uncontrolled ownership of firearms.[20,21] Urban adult residents possessing a gun are at increased risk of intentional shootings.[6,22] The steady incidence of GSIs over the past years highlights a need for better laws pertaining to firearm access as well as targeted educational policies and safety measures.

It is important to note that half of the unintentional shooting victims (9 patients) suffered injuries due to stray bullets. In our study, injuries due to stray bullets mostly occurred in the lower extremities, head, and back. In a previous Centers for Disease Control and Prevention report about New Year's Eve injuries in Puerto Ricco, the head was found to be the most commonly injured body part,[23,24] whereas extremities were identified as most commonly injured in previous reviews of stray bullet events in the US,[16] Libya,[25] and Lebanon.[17,26]

Random aerial shootings occur in certain areas of South America and South Asia but are more endemic to some regions in the Middle East.[27,28] In those regions, some citizens even tend to remain indoors to minimize their exposure and avoid any risk.[29-34] Throughout the years, this phenomenon has resulted in injuries and deaths during marriage ceremonies in Saudi Arabia or high school results announcements in Jordan and after football team victory in Iraq and election of a new parliament speaker in Lebanon.[21,35] In Libya, 23 victims of stray bullet injuries were reported between 2011 and 2012,[25] and 165 similar cases were reported in the Sind province of Pakistan between 2006 and 2010.[17] The stray bullet phenomenon thus imposes serious risks on communities in developing countries and needs to be addressed with better preventive and educational measures. This phenomenon mirrors rates of firearm violence. As such, initiatives that include retaliation-interruption campaigns,[36] wide initiatives implicating police and social agencies,[37] strict implementation of firearms laws,[38,39] and prohibition of illegal firearm acquisitions[40,41] are needed as they have all been shown to be beneficial prevention methods, at least provisionally, both for the people behind violent endeavors and for innocent citizens.

While other studies previously demonstrated poor prognosis and elevated costs associated with GSI,[18,42-45] our study further highlighted significant differences in clinical outcomes and health-care utilization among GSI victims in terms of intent. As expected, our study showed that intentional shooting victims had more lethal mechanisms of injury, which could be attributed to the violent determination of the shooters to fatally injure their target. They suffered from deeper wounds, many had multiple GSIs as well as worse outcomes in terms of length of hospital stay, doing multiple surgeries, getting admitted to ICUs, and potentially having higher mortality rates. The rates of performed surgical procedures were, however, similar across both groups with around 60% of patients requiring surgery. As such, all GSI victims suffer from substantial morbidity and mortality and require a substantial amount of hospital resources, even more so for intentionally harmed victims.

As was shown in previous studies, mortality rates varied among the different groups by intent, but this was not statistically significant. Victims of shootings of unspecified mechanism of intent had the highest mortality rates (18.2%), followed by intentional (11.6%) and unintentional (6.7%) mechanisms. These findings are in line with those of the previous studies that also reported higher mortality rates among violent injuries compared to unintentional injuries.[13,15] These mortality rates are however higher than those of the previous studies.[12-15,46] This can be related to transfers with higher acuity (ESI levels). These require more advanced care in tertiary care centers such as XXMC and could have led to the observed increased mortality rates in our study.

The findings of this study are important despite limitations related to its small sample size and to its retrospective nature and the associated resource constraints. Patients were recruited from a single urban center with most catchment areas from in and around Beirut district. Estimates presented are likely to underrepresent the true incidence of GSI-related events since victims might have received medical care in outpatient settings or other health-care facilities with some deaths occurring before arrival or transfer to our institution. Aerial shootings are also very common in Lebanon and the actual stray bullet burden is expected to be larger, especially with shootings tending to occur more commonly in rural areas or in city peripheries with strict geographic distinction between conflicted political groups. Victims of these shootings might end up in peripheral community hospitals. Moreover, the current study used the ESI for stratification of patients on the basis of acuity and resource needs, as this is the current protocol adopted in our institution. The internationally recognized injury severity score generally used for trauma patients correlates mortality, morbidity, and other measures of severity and could have been more appropriate as a scoring system for GSI victims. Furthermore, a large proportion of GSI victims included in our study had unspecified intent. While many of these unspecified GSIs could be intentional injuries that were not disclosed for fear from legal implications, many patients from this group also exhibited similarities with the unintentional injuries. This group represents 19% of our population and could have potentially affected the significance and accuracy of our results. This however highlights a lack of directed history taking regarding the GSI mechanism itself.

This study serves as an initial look at the problem of GSIs in Lebanon. Conducting a national study and implementing surveillance mechanisms from hospitals in multiple centers across Lebanon would provide a better understanding of the impact of intent on the outcomes of GSIs. Considering our study findings, ED physicians should be encouraged to inquire about details related to the mechanism of injury to better predict outcomes.

Conclusion

GSIs have different features, clinical outcomes, and health-care utilization depending on the intentionality of injury. All GSI victims suffer from substantial morbidity and mortality, but intentionally harmed victims tend to sustain more severe injuries with worse outcomes compared to unintentional GSI victims. ED physicians should be aware of these differences and could benefit from a more specialized triage system with classification of GSI victims into intentional and unintentional injuries to better predict prognosis and improve delivery of care.

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Conflicts of interest

There are no conflicts of interest.

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