

Evaluation of Clinician Accuracy in Describing Gunshot Wound Injuries*

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ABSTRACT: A large series of gunshot wounds is analyzed to determine, first, whether the wounds were described with enough detail to estimate the distance and direction of fire; and second, to utilize the autopsy description to determine accuracy.

All of the University of Miami-Jackson Medical Center (UM-JMC) records coded as gunshot wounds and treated during calendar year 1995 were included in this study. The analysis is of 566 shootings from bullets in which 1259 wounds were described in the hospital records.

Of the 1259 bullet wounds, the size and/or shape was described in only 63 (5%) and only four wounds (0.3%) had any indication of distance of fire. The location of the wound could be determined to within 3 cm in 655 (52%) and only 39 (3%) of the wounds were measured from some landmark. Directionality was neither indicated nor determinable in 897 (71%) of the wounds examined.

Fifty-five (9%) cases resulted in death and were compared with medical examiner autopsies. Clinical information was inadequate for comparison in three (6%) of these cases. In 22 cases that were said to have one wound, only 14 (64%) of these were correctly documented. Of 16 cases with 2 wounds, 9 (56%) were correctly identified by the clinicians. When greater than 2 wounds were present (14), the clinicians were wrong 93% of the time.

This study demonstrates that clinicians responsible for treating gunshot-wounded persons do not adequately document or interpret these wounds.

KEYWORDS: forensic science, forensic pathology, gunshot wounds, physical examination

Gunshot wounds are a significant cause of morbidity and mortality in the United States. It is estimated that 1.4 billion dollars are expended in direct care and treatment annually (1). The ratio of nonfatal to fatal gunshot wounds has been estimated to occur at a rate of 2.6:1—suggesting that 56 325 to 141 725 gunshot-wound victims are treated and survive annually in the United States (2).

Persons dying from gunshot wounds are routinely subjected to autopsy examination, where forensically trained or experienced pathologists examine the wounds. Forensic pathologists rarely examine those who survive.

As a consequence of the activities occurring about the time of the shooting, both civil and criminal litigation often ensues. The location of the firearm in relation to the victim and the posture of the victim at the time of the shooting are important factual evidence that can be determined from an understanding of wound ballistics

(3–5). Despite the importance of accurate documentation of gunshot wounds prior to surgical intervention and/or healing, the anecdotal experience of forensic pathologists has been that medical specialists responsible for treating such wounded persons do not adequately document or interpret gunshot wounds. Only two prior studies have addressed and confirmed these suspicions (6,7).

The primary concern when treating victims of firearms is the acute care of the patient. However, preservation and collection of evidence during the initial evaluation should be standard practice in the emergency setting to ensure accurate documentation for imminent medicolegal investigations.

We have reviewed the charts of 576 gunshot-wound admissions to assess the adequacy and accuracy of clinical descriptions of gunshot wounds in patients treated in a tertiary care, university medical center with a level I trauma center.

Methods

This study combines the designs of prior reports by Collins and Lantz (6) and Fackler and Riddick (7). It is a retrospective analysis of all cases coded as gunshot wounds treated at Jackson Memorial Hospital in Miami, Florida, during the 1995 calendar year. The study was approved by the Institutional Review Board of the University of Miami and included an examination of all records coded as E922x, E955x, E965x, E985x, and E991x (8). Demographic data were obtained from the hospital information system database. The authors reviewed the records and the number of wounds (bullet holes) and proposed number of shots was recorded. Each wound was assessed for the following: entrance versus exit determination, indication of size, shape, distance and direction of fire, and location. Single gunshot wounds were considered entrance wounds even if not explicitly stated in the record. The accuracy of the location was stratified into “region”—location not determinable to within 3 cm, “area”—location determinable to within 3 cm, “measurement”—location measured from a fixed point, and “diagram”—location was diagrammed. The record was reviewed through the first day of admission, including any operative procedures. Discrepancies within a patient’s chart were noted and more similar wound descriptions or descriptions by more senior persons were used in the study. The direction of fire was described as not indicated, explicitly indicated, or could be inferred from the description of the wounds. The Dade County Medical Examiner autopsy was reviewed for all patients who expired. The gunshot-wound descriptions in the medical record were compared with those in the autopsy report in these cases. The comparison of the medical record with the autopsy report was stratified by the number of wounds stated in the medical record. The autopsy report was considered the “gold standard” and each expiration was compared with the medical record with respect to the number of wounds, location of wounds and determination of entrance and exit. Each

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medical record interpretation was determined to be: equal to the ME, equal to the ME with discrepancies within the clinical record, wrong number of wounds, wrong entrance/exit designation, wrong number of wounds and entrance/exit, or not enough information for comparison. Shotgun wounds were evaluated separately.

A total of 614 records with E-codes indicating gunshot wounds in the calendar year 1995 treated at Jackson Memorial Hospital were reviewed. Ten of these records were discarded because the E-codes were erroneously entered for patient transfers. Nine patients' records were excluded as follows: 2 pistol whipped, 2 injured by a CO₂ or pellet gun, 1 laceration that was not a gunshot wound, 1 spear gun (bang stick) injury, and 3 who were admitted for treatment of complications more than 24 h after the gunshot wound. Nineteen cases were excluded, because the charts were not available in a timely manner. The remaining 576 charts were reviewed of 574 patients. Two persons were treated for gunshot wounds from two separate shootings during the year. These were separate events and thus the data are calculated based on 576 gunshot wound admissions. The charts were evaluated as stated above.

Results

The age of patients ranged from 6 to 91 years with an average age of 30.8 years. Sixty-three percent were black and the male to female ratio was 9:1. The ethnicity and race distribution is shown in Table 1 and the distribution of patients by E-codes is shown in Table 2.

TABLE 1—Demographic data.

Ethnicity	Black	White	Total (%)
American	306	92	398 (69.1)
Bahamian	12	0	12 (2.1)
Cuban	12	57	69 (12.0)
Haitian	23	2	25 (4.3)
Nicaraguan	0	9	9 (1.6)
Puerto Rican	2	11	13 (2.3)
Other Hispanic	7	41	48 (8.3)
Not Specified	2	0	2 (0.35)

TABLE 2—Patient distribution by ICD-9 injury codes.

E Code	Number of Patients
922x - Accident Caused by Firearm Missile	
0 - Handgun	50
8 - Other specified firearm missile	16
9 - Unspecified firearm missile	63
955x - Suicide and Self-Inflicted Injury by Firearms and Explosives	
0 - Handgun	17
1 - Shotgun	1
4 - Other and unspecified	13
9 - Unspecified	4
965x - Assault by Firearms and Explosives	
0 - Handgun	81
1 - Shotgun	8
4 - Other and unspecified	188
9 - Unspecified	2
985x - Injury by Firearms and Explosives, Undetermined Whether Accidental or Purposely Inflicted	
0 - Handgun	5
1 - Shotgun	2
4 - Other and unspecified	126

Of the 576 gunshot wound admissions, there were ten shotgun wounds that are evaluated separately. The remaining 566 gunshot wound admissions had a total of 1259 wounds described. The number of wounds was not indicated in eight cases.

Table 3 summarizes the documentation of the gunshot wounds by trauma specialists. Overall, the most frequently documented datum was the indication of entrance vs. exit (68%) and the location of wound by region (91%) and by diagram (77%). Location was documented to within 3 cm in only approximately one-half of the cases (52%). Documentation of the wound's size or shape (5%), the distance of fire (0.3%), and location by measurement from a fixed point (3%) was rarely included in the description. An explicit determination of the direction of fire was seen in only 5.5% of the cases, though it could be inferred in another 23%.

The number of wounds documented in the hospital record into one wound, two wounds, or more than two wounds further stratifies the data. There were 219 cases with a single gunshot wound, 186 with two gunshot wounds, and 153 with more than two gunshot wounds. Cases with one wound were deemed to be entrance wounds whether or not it was explicitly stated in the record. The designation of entrance versus exit wound was greater when there were two wounds (82%) than when more than two wounds were present (52%). The indication of direction of fire was thus more often stated or could be inferred when only two wounds existed than when more than two were present. Direction of fire was rarely stated explicitly, though it was could often be inferred from information available in the record. Direction of fire of single gunshot wounds was inferred in 21% of cases where a palpable bullet was documented or the bullet location was well documented radiographically. The documentation of location of the wounds was also related to the number of wounds. Single wounds were more often documented by region and area, whereas more than two wounds were usually documented by diagram. The wound's location was rarely measured; however, a single wound was more likely to be measured than when two or more wounds were present.

There were discrepancies between physicians' descriptions within the clinical record in 44 (8.6%) of the 511 nonfatal gunshot wound cases. The discrepancies included: different number of wounds described than diagrammed, conflicting entrance and exit wound designations, and wounds described differently in separate notes.

Fifty-five (9.7%) patients in the study expired and all were autopsied by the Dade County Medical Examiner. The autopsy for each of these cases was reviewed and the autopsy wound description compared with the wounds documented in the medical record. In three of these cases, the hospital documentation was not sufficient to compare with the autopsy report—the wound(s) were located by region, but no other information was documented. The remaining 52 cases were segregated based on the number of wounds stated in the medical record into one wound, two wounds, and greater than two wounds. There were 22 cases with one wound, 16 cases with two wounds, and 14 cases with greater than two wounds. The results of these comparisons are summarized in Table 4.

Fourteen (64%) of the cases with only one wound were correctly identified by the trauma specialists. There were two (9%) cases in which some of the trauma specialists were correct, but there were inconsistencies in the medical record. In another two cases (9%) there was insufficient description to compare with the medical examiner's autopsy—only the region of the wound was given, but no other information. The number of wounds was incorrect in four

TABLE 3—*Gunshot-wound documentation.*

	All Cases (%)	One Wound (%)	Two Wounds (%)	>Two Wounds (%)
Total No. of Wounds	1259	219	370	670
Entrance exit indicated	858 (68)	219 (100)*	303 (82)	348 (52)
Size/shape indicated	63 (5)	14 (6)	22 (6)	27 (4)
Indication of distance of fire	4 (0.3)	2 (1)	2 (0.5)	0
Location by region	1150 (91)	216 (99)	360 (97)	574 (86)
Location by area	655 (52)	174 (79)	245 (66)	236 (35)
Location measured	39 (3)	18 (8)	15 (4)	6 (1)
Location diagrammed	975 (77)	155 (70)	262 (70)	558 (83)
Indication of direction	explicit 67 (5.5) inferred 295 (23)	explicit 9 (4) inferred 46 (21)	explicit 34 (10) inferred 152 (41)	explicit 24 (4) inferred 97 (14)

* By definition, all single gunshot wounds were entrance wounds.

TABLE 4—*Comparison of trauma specialist wound description with the Dade County Medical Examiner's autopsy.*

	One Wound (%)	Two Wounds (%)	More Than Two Wounds (%)
Number of cases	22	16	14
Cases correctly identified	14 (64%)	9 (56%)	1 (7%)
Cases correctly identified by at least one physician	2 (9%)	1 (6%)	0
Incorrect number of wounds	4 (18%)	2 (12.5%)	12 (86%)
Incorrect entrance/exit designation	N/A*	2 (12.5%)	1 (7%)
Insufficient information	2 (9%)	0	0

* N/A = not applicable.

cases (18%), two of which exit wounds were missed and another two in which separate wounds were overlooked.

When the trauma specialists determined there to be two wounds, they were correct in the location, number of wounds, and number of shots in nine cases (56%). In addition, in one case (6%) at least one physician correctly identified the wounds, but others did not. The documented number of wounds was incorrect in two cases (12.5%); in one case exit wounds were overlooked and the other case a laceration was incorrectly designated as a separate gunshot wound. Two cases (12.5%) had correct locations of the wounds, but the entrance/exit determinations were opposite of what was concluded by the medical examiner's autopsy. In the remaining two cases, the location of the wounds was correct, but there was no entrance or exit determination.

In the 14 cases with more than two gunshot wounds, the trauma specialists were correct in only one case (7%). Twelve (86%) of these had the wrong number of wounds, eleven had missed wounds and one case had added wounds that were not present. In addition, four of these 12 cases had inconsistent documentation of the wounds. One case (7%) had the correct number of wounds, but had concluded that there were two gunshots when it was actually a single shot through the arm into the head.

Shotgun injuries comprised ten cases. Three of these patients expired and were autopsied by the Dade County Medical Examiner. The locations of the wounds were diagrammed in all but one case. In this case only the region of the body that was injured was documented. The size of the wounds was described in only one case and the distance of fire was not indicated in any of the cases. In the three cases autopsied, one case was accurately described by the trauma specialists, one case had the wrong number of wounds,

and one case had the location of the wound correctly identified, but it was not described as a shotgun wound. The extent of spread of the pellet wounds was not documented in any of the cases.

Discussion

Gunshot wounds are a significant cause of mortality and morbidity in the United States. The circumstances of the shooting often form the basis of civil and/or criminal litigation. The direction and distance of fire, which can be determined with knowledge of wound ballistics, is important factual evidence in these cases. Utilizing wound ballistics, however, requires accurate documentation of the gunshot wounds. Since more than twice as many gunshot wounds are nonfatal as compared to fatal wounds, it is imperative that those who are in the front line of therapeutic intervention devise a system to accurately document these wounds before surgical intervention and/or healing occurs.

Our study demonstrates that the description of gunshot wounds by trauma specialists lacks the detail required to determine the distance of fire in essentially all cases. Further, the records lack sufficient detail to determine the direction of fire in 49% when two wounds are present and in 82% when there are more than two wounds. In cases where there is only one wound, it is still difficult to determine directionality due to lack of detail. Indication of the size or shape of the wound, information that is important in determining entrance versus exit, is absent in 95% of the reviewed cases. A prior study by Fackler and Riddick (7) yielded nearly identical results. In their study of 258 gunshot wounds, only 37.6% could be located to within 3 cm, and the size and shape of the wounds were documented in only 4.3% and 2.7%, respectively.

In those cases where a "gold standard" forensic autopsy examination was done, the correct interpretation by the trauma specialists was slightly better for single (64%) than for double gunshot wounds (56%). In cases with more than two wounds the accuracy dropped to 7%. These data are similar to those seen by Collins and Lantz (6). In their study, 52% of fatal single exiting and multiple gunshot wounds were misinterpreted. Seventy-four percent of the multiple gunshot wounds were misinterpreted and 37% of the single exiting wounds were misinterpreted.

The number of shotgun wounds evaluated during the year of this study was small. In general, the location and designation of a shotgun injury were well documented. The diameter of the pellet spray was not documented. Only one of the three cases autopsied was entirely correct and one that was well documented was not recognized to be a shotgun wound by the trauma specialists.

The present study confirms what has been "known" by forensic

pathologists for many years. Trauma specialists do not adequately document and often misinterpret gunshot wounds.

The importance of wound ballistics in the emergency setting has been recognized in the past (9,10). Relatively minimal education of trauma specialists would improve the gunshot wound descriptions and provide for more accurate guidance to the courts in subsequent civil and criminal proceedings. We agree with Fackler and Lantz (7) that better descriptions of the wounds rather than interpretations should be emphasized in trauma specialists' reports. Accurate diagrams of wound locations along with indication of size, shape and presence of soot or stippling would provide all the necessary information needed to determine direction and distance of fire in future reviews of the medical record by wound ballistic experts. At least a cursory knowledge of wound ballistics is necessary for these physicians to record adequate descriptions. We have proposed a yearly mini-course in wound ballistics to train our trauma specialists in an attempt to improve upon the currently inadequate documentation.

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