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Thoracoabdominal shotgun wounds: an evaluation of factors associated with the need for surgical intervention

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Abstract

BACKGROUND: Shotgun wound classification systems attempt to predict the need for surgical intervention based on the size of wounds, pellet spread, or distance from the weapon rather than clinical findings.

METHODS: A 5-year retrospective review of patients sustaining a thoracoabdominal shotgun wound was performed. Factors believed to be associated with the need for surgical intervention were examined using the Fisher exact test or an independent sample *t* test.

RESULTS: Sixty-four patients suffered a thoracoabdominal shotgun wound. Fifty-nine percent required surgical intervention. Factors significantly associated with the need for surgical intervention were a low revised trauma score and systolic and diastolic blood pressure ($P < .05$). Distance from attacker, wound patterns, pellet size, and pellet spread were not found to have an association.

CONCLUSIONS: Clinical indicators of hemorrhage and shock are associated with the need for surgical intervention, whereas pellet spread, pellet size, and distance from the attacker are not. This is a significant departure from traditional classification systems.

For well over a century, surgeons have struggled to establish a standard treatment protocol for shotgun injuries.[1–3] Today, shotgun wounds continue to be a problem of urban warfare, sporting accidents, and self-inflicted injuries. The magnitude of this problem is difficult to estimate because shotgun injuries often are lumped together with injuries from rifles and other large firearms. However, to the surgeon, these injuries are unique and some of the most challenging of penetrating trauma because of their extreme variability. Shotguns are associated with a wide spectrum of injuries ranging from minor soft-tissue damage to deep injuries affecting multiple organ systems.

Throughout the literature, a variety of firearm characteristics have been used in the description and evaluation of shotgun injuries. Previous studies have attempted to develop treatment protocols based on range, pellet spread, radiographic findings, and number of body regions involved in the injury (Table 1).[1,4–6] These classification schemes alone have not been proven to determine reliably which patients require exploration. More recently, deep peritoneal lavage, number of pellets entering the thorax and abdomen, and physical examination findings have been recommended for the evaluation of shotgun wounds.[7–9] The need for traditional classification systems has been challenged, and a more clinically based approach has been advocated.[8] The

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Table 1 Wound classification systems

Type	Distance from shotgun to patient	Ordog et al[2] modification[6,10]	Pellet spread[11]	Body region involved[8]
0		<12 m with penetration of skin only		
I	<7 yd	<12 m with penetration of subcutaneous tissue and deep fascia	<25 cm	Multiple regions
II	3–7 yd	5–12 m	10–25 cm	Two adjacent regions
III	<3 yd	<5 m	<10 cm	Only 1 region

purpose of this study was to examine factors associated with the need for surgical intervention in patients with shotgun injuries to the chest and abdomen and to examine whether traditional classification schemes are clinically useful in a modern, urban trauma setting.

Materials and Methods

We reviewed the hospital records of all patients with shotgun wounds who arrived at our institution (a level I trauma center in Houston, TX) over a 5.5-year period from January 2000 to September 2005. Specific data gathered included demographic information (age, sex, and date of injury), distance from the attacker, pellet size and spread, as well as presenting vital signs, laboratory results, and pertinent physical examination findings. Outcomes including mortality, specific organ injuries, and need for surgery also were recorded.

Statistical analysis was performed using SPSS software (SPSS, Inc., Chicago, IL, USA). Chi-square or Fisher exact tests were used as appropriate for categoric variables, and the Student *t* test was used for the analysis of continuous variables. A *P* value of less than .05 was considered significant.

Approval for this study was obtained from our institution's local review board.

Results

A total of 64 patients with shotgun injuries were identified. Demographics and baseline characteristics are shown in Table 2. Thirty-seven patients (58%) required surgical intervention. Five patients required a resuscitative thoracotomy in the Emergency Center shock room and all 5 died. These 5 patients were included in the analysis and were counted as requiring surgical intervention because their injuries obviously were severe and necessitated immediate surgical management, albeit outside of the operating room. All 17 patients who presented with shock underwent immediate surgical intervention. Twenty patients without hypotension (systolic blood pressure > 90 mm Hg) underwent surgery as well. In these cases, the decision to perform surgery was based on initial physical examination findings suggestive of peritonitis (n = 17) or worsening serial abdominal examinations (n = 3). In the absence of shock, these physical examination findings—not traditional scoring systems—were the strongest influence on the decision to go to the operating room.

Statistically significant factors associated with the need for surgical intervention were a low revised trauma score (RTS) ($P = .034$), low systolic blood pressure ($P = .009$), and low diastolic blood pressure ($P = .016$) (Table 3). Traditional scoring systems were evaluated for their ability to predict the need for surgical intervention. Previously described factors such as the distance from the attacker, wound classification systems, pellet size, and pellet spread were not statistically associated with the need for surgical intervention.

Although the primary focus of this study was to identify which patients need surgical intervention, we did note that 16 patients (25%) did not survive their injury. Statistically significant factors associated with mortality were injuries to the abdominal and thoracic solid organs, hollow viscus, abdominal vasculature, thoracic vasculature, multiple cavity injuries, and the need for a resuscitative thoracotomy ($P <$ .05 for each factor). Glasgow coma score (14.7 ± .8 vs 7.0 ± 1.1), RTS (11.8 ± .7 vs 5.9 ± 4.6), surgical blood loss (1.2 ± 1.8 L vs 6.6 ± 5.4 L), pH level (7.3 ± .1 vs 7.1 ±

Table 2 Patient characteristics and outcomes

Continuous variables, mean (SD)	
Age, y	25.3 (±8.9)
Distance from attacker, ft	12.4 (±6.4)
Pellet spread, cm	29.5 (±11.1)
Pellet size, mm	3.7 (±.9)
Categoric variables, n (%)	
Self-inflicted	1.0 (1.6%)
Male	60.0 (93.8%)
Location of injury	
Abdomen only	19.0 (29.7%)
Chest only	26.0 (40.6%)
Chest and abdomen	14.0 (21.8%)
Missing/unknown	5.0 (7.8%)
Surgical intervention required	37.0 (57.8%)
1 surgery	23.0 (35.9%)
>1 surgery	14.0 (21.8%)
Died	16.0 (25.0%)
In the emergency room	5.0 (7.8%)
In the operating room	6.0 (9.3%)
In the Surgical Intensive Care Unit	5.0 (7.8%)