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# Injuries and outcome after laparotomy in gunshot wound patients who have minimal bleeding[1]

by

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**Abstract**

During 1990-1, 970 patients with gunshot wounds (GSW) were admitted to Los Angeles County - USC Medical Center. Of the 686 patients with trunk GSW, 433 had wounds of the abdomen or of the chest and abdomen. No blood transfusions were required in 323 of these patients, 5 of whom died (four of the deceased are omitted, being moribund on arrival). Up to four units of packed cells were transfused in 37 patients, 7 of whom died; 5-10 units were transfused in 30 patients, 8 of whom died. The remaining 43 patients received over 10 units of packed cells. The type of surgery was related to the injury severity score. Organ injuries were classified as chest, colon, gut, urological, liver and spleen and vascular. SPSS multivariate analysis showed 19 single or combined injuries of 64 to be significantly ($P < 0.05$) associated with bleeding and to be located in the thoracoabdominal region. Of 318 survivors not transfused 1,2,3 and 4 organs were injured in 75, 59, 16 and 3 patients respectively; and 110 had only an injury of the abdominal wall. Stable patients not requiring blood transfusion with abdominal GSW are at significant risk of organ injury and require laparotomy.

**Introduction**

It is well recognised that in modern military warfare, extremity wounds occur with more than double the prevalence of wounds of the head and trunk.[1.2.3.4] Landmines are mostly responsible for this problem, the massive wounds they produce result in traumatic amputations, multiple fractures, degloving and other tissue loss; these wounds often involve the buttocks, perineum, genitals and lower abdomen which are injured by blast and shrapnel.[4.5] When the lower abdomen is involved the wound could be classified as a trunk wound.[6]

Abdominal wounds (and wounds of the trunk), on the other hand, are most prevalent in civil and urban warfare in almost double the prevalence of wounds of the other two main regions.[6.7] In most situations including the military, abdominal wounds are caused by penetration by missiles or shrapnel. Abdominal wounds are associated with haemorrhage that is difficult to control by tourniquet or pressure. Gut contamination requires more extensive, time-consuming therapy which may overwhelm resources when there are large numbers of casualties. They, therefore, cause the most anxiety to those who might be responsible for triage in mass casualty situations.[8.9]

This study was performed to analyse data from a consecutive series of patients who had abdominal gunshot wounds (GSW) in order to determine probabilities of injury and outcome in relation to blood transfusion and surgical therapy. Emphasis would be given to the group of patients who were not transfused, as this group would be very likely to reach hospital in any crisis.

**Method**

The methods of this study have been described in two previous reports.[6.10] The reports are analyses of data recorded by trauma nurses on Trauma and Emergency Medicine Information Systems (TEMIS) about a consecutive series of patients admitted to the Los Angeles County-USC Medical Center between 1 September 1990 and 31 August 1991. Patients were classified as having abdominal GSW when their injury severity was recorded with an abdominal component, except when a head injury score was also present. This meant that patients with abdominal GSW (those who might require laparotomy) could also have had chest and extremity wounds caused either by a wound from one missile or by multiple wounds of chest, abdomen and extremities from more than one missile. The TEMIS data did not specify the number or type of missile wounds. This approach, however, is consistent with surface anatomy, the lower chest and upper abdomen overlapping each other. Patients who had chest surgery would include those who had either thoracotomy or placement of one or more chest tubes.

In order to simplify analyses, internal organs would be grouped together. Chest organs would include pleura, lung, heart and great vessels. The colon includes the rectum. Gastrointestinal tract (GIT) covers the stomach, duodenum and small bowel. Liver, spleen and pancreas are combined. Renal includes kidneys, ureters and bladder. Vascular covers aorta and iliac arteries, vena cava and iliac veins. Patients with spinal cord injuries were included, however, a reference to the injury has been omitted.

Blood transfusion volumes include packed cells and fresh frozen plasma together. A 3000 ml volume cut off was selected because this could be taken as the packed cell volume of an average male, and greater volumes could be defined as massive. A 1200 ml volume (representing 4 units) was the median volume transfused in patients whose injury severity was 15 or below in the previous publication and who might, therefore, be expected to have minimal bleeding.[10] Because bleeding can occur from wounding and during surgery, patients with replacement of up to 10 units are included in some analyses. Statistics were computed with the SPSS advanced package Version[6.1.]

**Results**

In the previous publication, 645 patients had GSW of the trunk in TEMIS records; 41 other survivors with trunk wounds were excluded from this study because their blood transfusion records were not available.[6] Abdominal and thoraco-abdominal wounds were present in 433 patients whose blood transfusion volumes and outcome are given in Table 1. Table 2 shows the type of surgery according to injury severity in the whole group. The 43 patients who received massive transfusions were excluded from further analyses. Of the 67 patients receiving up to 10 units of blood, 37 received up to 4 units; and the mortality was evenly divided between the 4 unit and 10-unit groups. The median volumes of blood transfused and the outcome of "minimally transfused" patients are given in Table 3.

**Table 1. Transfusions and outcome**

| Volume (ml) | Number Alive | Number Dead |
|---|---|---|
| >3000 | 17 | 26 |
| ≤ 3000 | 52 | 15 |
| Nil | 318 | 5 |

**Table 2. Surgery and injury severity**

| | ISS:5 15 | ISS > 15 |
|---|---|---|
| Dead | 4 | 42 |
| No Surgery | 108 | 2. |
| Chest Surgery | 8 | 2 |
| Laparotomy | 64 | 87 |
| Laparotomy + Chest | 16 | 36 |
| Negative Laparotomy | 62 | 2 |
| TOTAL | 262 | 171 |

*Extremities also

**Table 3. Transfusion data (excludes massive transfusion)**

| | Number | Median (ml) | Mode (units) | Total Units |
|---|---|---|---|---|
| ALIVE | 52 | 1200 | 2 | 222 |
| DEAD | 15 | 1926 | 9 | 84 |
| TOTAL | 67 | 1200 | 2 | 306 |

**Table 4. Patarities organs involved**

| Transfusion/ Organ Groups | Vascular | Liver-Spleen | GIT | Chest | Renal | Colon |
|---|---|---|---|---|---|---|
| ≤ 1200 ml | | | | | | |
| 1 | X | | | | | |
| 2 | | X | X | X | | |
| 3 | | X | | X | | |
| 4 | X | X | | X | X | |
| 4 | X | X | | X | X | |
| 4 | X | X | | X | X | |
| 6 | X | X | X | X | X | X |
| 1201 – 3000 ml | | | | | | |
| 1 | | X | | | | |
| 2 | X | | | | X | |
| 2 | | X | X | | | |
| 3 | X | | X | | | X |
| 3 | X | | X | | | X |
| 3 | X | | X | | | X |
| 3 | X | X | X | | | |
| 4 | | X | X | X | | X |

*Organ groups injured

Multivariate analysis (MANOVA) was used to rank organ groups according to blood transfused. Spinal injury patients were excluded because of the intrusion of spinal shock in volume requirements, leaving 359 patients at risk. Highly significant associations ($P<0.002$) with volume in descending order were found when there were multiple injuries of kidney with vascular and chest, liver/ spleen and foregut (GIT) and chest; and also with individual vascular and GIT wounds. The organs involved in the 15 fatalities are given in Table 4. It is important to note that in every chest injury in Table 4 the specific organ involved was the heart.

No blood transfusions were given to 318 survivors. The number of organs injured included abdominal (and/ or chest) wall only in 110 patients. A negative laparotomy in 64 patients occurred after no organs were found to be injured. These patients obviously had an abdominal or trunk wall injury. The number and percentage of grouped organ involvement in the 153 not transfused patients with internal injuries are given in Table 5.

For information, a comparison of internal organ involvement between our previous study and data from Vietnam is given in Table 6.[6, 11] Table 7 compares our data with Vietnam and the Persian Gulf.[10, 12, 13]

**Discussion**

Los Angeles County - USC Medical Center can be seen to devote immense and costly resources to the care of the victims of urban warfare.6 These patients have injuries which are likely to be similar to those received in most civil wars, during which time outside military forces may participate in an humanitarian role. In both cases there are obligations to go all out in saving the lives of the injured[11]. During any warfare, however, problems in evacuation and supply may hinder optimal care.[14.15] Mass casualties may overwhelm resources; in the Gulf War casualty rates were manageable, however, and military surgical facilities were prepared to treat immediately any uncontaminated patient who presented with a penetrating wound.[13] Triage is therefore a flexible process.

**Table 5. Not transfused**

| Organ Groups (No.) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Chest | 20% | 51% | 69% | 100% |
| Colon | 25% | 42% | 56% | 67% |
| GIT | 41% | 48% | 88% | 67% |
| Liver/spleen | 5% | 46% | 63% | 100% |
| Renal | 5% | 10% | 19% | 67% |
| Vascular | 3% | 3% | 6% | 0% |
| Total (153 Patients) | 75 | 59 | 16 | 3 |

The numbers in each column are percentages of the total number of patients in the bottom row. No organ or group was significantly associated with the absence of blood transfusion (MANOVA).

**Table 6. Percent organ injury at laparotomy – comparison with Vietnam**

| Organ | LAC + USC[6] | LAIKHE[11] |
|---|---|---|
| Small Bowel Colon | 24 | 33 |
| & Rectum Liver & | 21 | 23 |
| Gall Bladder Stomach | 18 | 21 |
| Kidney | 10 | 8 |
| Spleen | 7 | 8 |
| Bladder | 5 | 5 |
| Pancreas | 6 | 4 |
| Vascular | 4 | 3 |
| | 5 | 0 |

Table 7. Transfusion comparisons

| Hospital | Number | Volume (litres) | Units (mean) |
|---|---|---|---|
| Da Nang[12] | 478 RA* | 2,676.8 | 5.6 |
| | 38 sn ** | 452.2 | 11.9 |

| | | | |
|---|---|---|---|
| Khanjar[12]<br>LAC + USC[10] | 40<br>64***<br>194**** | 170<br>277<br>2373 | 4<br>4<br>12 |

* RA Released Alive

** SD Salvageable Death

*** < 3 litres

**** All Cases

It is probably appropriate to assume that patients who are unstable in a war zone would be much less likely to reach an appropriate surgical facility or field hospital. This is the main reason patients who required massive transfusion were excluded from analyses in this study. Support for the inference that unstable patients are less likely to reach hospital in war situations comes from Table 6 where no vascular injuries were recorded at laparotomy in the Byerly and Pendse report.[11] By comparison, a small proportion of patients in Los Angeles transfused 10 units or less had vascular injuries and vascular injuries were significantly associated with (the need for) blood transfusion. Transfusions were administered to six of the seven patients who died of GSW of the heart it is presumed that those who received nothing or less than 1200 ml were moribund. (Another patient, who was not in this study, survived a GSW of the heart). Furthermore, mortality in the massively transfused was 60 percent compared with 22 percent in the "minimally" transfused (P=0.00002). Table 3 shows the larger volume requirements of fatalities. The transfused group obviously presents difficulties when there are resource limitations for although their number is small, their injuries are multiple, complex and difficult to control. Blood transfusion volume has been found to correlate in soldiers with vital sign measurements, which are being considered for inclusion in US military triage policy.[13]

Patients who did not require transfusion and who were stable, on the other hand, only occasionally (5 percent) had three or four organ injuries. The not transfused group was 75 percent of all patients with civilian thoracoabdominal and abdominal wounds and 90 percent of the "minimal" (requiring less than 10 units of blood). It is probable that 65 percent of these stable patients had bullet wounds because it was hospital policy to explore all patients who had (tangential) bullet wounds which were proximate to the abdominal cavity. The 64 patients who had a negative laparotomy were therefore about 27 percent of patients who had "bullet" wounds.

Conversely, patients with shotgun wounds were only operated upon if there was evidence that the gun had been discharged at close range. The 110 patients who had trunk wall injuries were likely to have had pellet or shrapnel wounds from a distance.

The vital message from these data is that the majority of stable patients with bullet wounds have internal injuries which require laparotomy. The presence or absence of internal injuries in these patients, even in the absence of positive clinical signs, is unpredictable. I most battlefield conditions, expectant therapy would not be appropriate in stable patients with abdominal GSW. If faced with even limited numbers of such casualties where facilities permitted observation, triage could be practised on clinical grounds.

It would appear that the wounding and the injuries of patients in this report were comparable with those from military combat. It should follow that appropriate training for management of combat casualties could be found in a civilian environment similar to that seen in Los Angeles.

**References**


1. Maughan JS. An inquiry into the nature of wounds resulting in killed in action in Vietnam. *Mil Med* 1970. 135:8-13
2. Carey ME. Learning from traditional combat mortality and morbidity data used in the evaluation of combat medical care. *Mil Med* 1987; 152:6-13.
3. Leedham CS, Newland C, Blood CG. A descriptive analysis of wounds among US Marines treated at second-echelon facilities in the Kuwaiti theater of operations. *Mil Med* 1993; 158:508-12.
4. Burkle FM, Newland C, Meister SJ, Blood CG. Emergency medicine in the Persian Gulf War- Part 3: Battlefield casualties. *Ann Emerg Med* 1994; 23:755-9.
5. Traverso LW, Johnson DE, Fleming C, Wongrukmitr B. Combat casualties in Northern Thailand: Emphasis on land mine injuries and levels of amputation. *Mil Med* 1981; 146:682-5
6. Payne JE, Berne TV, Kaufinan RL, Dubrowskij R. Outcome oftreatrnent of686 gunshot wounds of the trunk at Los Angeles County-USC Medical Center: Implications for the community. *J Trauma* 1993; 34:276-281.
7. Radonic V, Pavie A, Aras N. Organisation and functioning of the front-line surgical station at Rama in Bosnia and Herzegovina. *Mil Med* 1993; 158:763-6.
8. Chipman M, Hackley BE, Spencer TS. Triage of mass casualties: Concepts of coping with mixed battlefield injuries. *Mil Med* 1980; 145:99-100.
9. Llewellyn. Triage: In austere environments and echeloned medical systems. *World J Surg* 1992; 16:904-9.
10. Payne JE, Meyer HJ, Berne TV. Transfusion requirements in 970 patients with gunshot wounds. *Aust Mil Med* 1996; 5(3)
11. Byerly WG, Pendse PD. War surgery in a forward surgical hospital in Vietnam: A continuing report. *Mil Med* 1971; 136:221-6.
12. McCaughey BG, Carey LC, Garrick J, Kelley JB. Naval Support Activity Hospital Da Nang combat casualty deaths January to June 1968. *Mil Med* 1987; 152:284-9.
13. Burkle FM, Newland C, Orebaugh S, Blood CG. Emergency medicine in the Persian Gulf War- Part 2: Triage methodology and lessons learned. *Ann Emerg Med* 1994; 23:748-54.
14. Dole E. Early evacuation of patients from the battlefield after laparotomy: Experiences in Vietnam, Israel and the Falklands. *Mil Med* 1987; 152:57-9.
15. Smith AM. What makes war surgery different? *Mil Med* 1991; 156:33-35