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# Not all intestinal traumatic injuries are the same: A comparison of surgically treated blunt vs. penetrating injuries

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ABSTRACT

*Purpose:* Traumatic intestinal injuries are less common with blunt compared to penetrating mechanisms of trauma and blunt injuries are often associated with diagnostic delays. The purpose of this study is to evaluate differences in the characteristics and outcomes between blunt and penetrating intestinal injuries to facilitate insight into optimal recognition and management.

*Methods:* A retrospective analysis of trauma admissions from January 2009 to June 2011 was performed. Patient demographics, ISS, early shock, injury type, timing to OR, blood loss and transfusions, surgical management, infections, EC fistulas, enteric leaks, LOS and mortality were compared.

*Results: Demographics* – There was 3866 blunt admissions and 966 penetrating admissions to our level II trauma centre (Total $n = 4832$) during this interval. The final study group comprised $n = 131$ patients treated for intestinal injuries. Blunt $n = 54$ (BI) vs. penetrating (PI) $n = 77$. Age was similar between the groups: (BI 34 SD 12 vs. PI 30 SD 12). Comorbid conditions were similar as were ED hypotension and blood transfusions. Blunt mechanisms had higher ISS; BI (20 SD 14) vs. PI (16 SD 12), $p = 0.08$ and organ specific injury scales were higher in blunt injuries.

*Operative Management* – Time to operation was higher in BI: (500 SD 676 min vs. PI 110 SD 153 min, $p = 0.01$). The use of an open abdomen technique was higher for BI: $n = 19$ (35%) vs. PI: $n = 5$ (6%), $p = <0.001$, as well as delayed intestinal repair in damage control cases.

*Outcomes* – Anastomotic leaks were more prevalent in BI: $n = 4$ (7%) vs. PI: $n = 2$ (3%), $p = 0.38$. Enteric fistulas were: (BI $n = 8$ (15%), vs. PI $n = 2$ (3%), $p = 0.02$). Surgical site infections and other nosocomial infections were: (BI $n = 11$ (20%) vs. PI $n = 4$ (5%), $p = 0.02$), (BI $n = 11$ (20%) vs. PI $n = 2$ (3%), $p = 0.002$), respectively. Hospital and ICU LOS was: (BI = 20 SD 14 vs. PI = 11 SD 11, $p = 0.001$), (BI = 10 SD 10 vs. PI = 5 SD 5, $p = 0.01$) respectively. These differences were reflected in higher hospital charges in BI.

*Conclusions:* Blunt and penetrating intestinal injury patterns have high injury severity. Significant operative delays occurred in the blunt injury group as well as, anastomotic failures, enteric fistulas, nosocomial infections, and higher cost. These features underscore the complexity of blunt injury patterns and warrant vigilant injury recognition to improve outcomes.



## Introduction

Primary repair of penetrating colon injuries has evolved as the standard of care in the majority of penetrating injuries excluding rectal trauma over the last three decades [1–3]. Algorithms based on the extent of injury, i.e., blood loss, the location of injury (right vs. left) and the degree of colonic wall destruction have also impacted decisions regarding primary repair vs. diversion for penetrating trauma [3,4]. In comparison, there are limited data on the management of blunt intestinal trauma, which is likely due to the rarity of these injuries. What we do know is that blunt trauma is associated with massive tissue injury based on early clinical and animal data that documents an exaggerated inflammatory response and high injury severity that impacts immune function and possible tissue healing [4–6]. These known inflammatory effects may impact outcomes related to decisions regarding primary intestinal repair vs. diversion in blunt injuries. Thus the purpose of this study is to evaluate outcomes comparing penetrating intestinal injuries that are associated with a large body of clinical data regarding surgical management, vs. blunt

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injuries that have limited clinical data. Our study hypothesis is that outcomes related to anastomotic failures, surgical site occurrences and morbidity are higher in blunt vs. penetrating intestinal injuries.

## Materials and methods

Institutional review board approval was obtained for a retrospective analysis of trauma admissions from January 2009 to January 2011. During this time interval there were 3866 blunt admissions and 966 penetrating admissions to our Level II trauma center. Our trauma registry provided the database, and patients who required surgical intervention for both blunt and penetrating intestinal injuries (stomach, small and large intestine) were identified for our final study group, $n = 131$.

There were 54 patients with blunt intestinal injuries and 77 patients with penetrating intestinal injuries. All of the inpatient admissions related to the traumatic injuries were reviewed and outpatient clinic records were also reviewed. Data analysis compared the two groups based on patient demographics, including pre-existing co-morbid conditions, emergency room vital signs, injury severity scores (ISS), intestinal injury grading scales (IIGS) based on the American Association for the Surgery of Trauma, intestinal injury type, associated neurologic injuries, timing to operative intervention, surgical management (intestinal primary repairs vs. diversion, open abdomens, delayed intestinal repairs), operative blood loss and transfusion requirements, surgical outcomes (anastomotic leaks, enteric fistulas, surgical site infections), hospital length of stay, hospital charges and mortality. Statistical analysis was performed using a graph pad software program. Fisher's exact test was used for categorical data and the Student's *t*-test was used for continuous data. All *p* values were two tailed and a *p* value of $\leq 0.05$ was considered statistically significant.

## Results

### *Demographics/injury severity/early shock*

Patient age was similar between the two groups. The presence of co-morbid conditions related to diabetes mellitus (DM), coronary artery disease (CAD) and obesity were similar as well. Early shock in the ED defined as a systolic blood pressure of <90 was similar between the two groups. Injury severity (ISS) was higher in the blunt intestinal injury group but did not reach statistical significance. Organ specific intestinal injury scales were recognised in 95% of our series. In the blunt group there was a significantly larger percentage of grades IV and V injuries compared to the penetrating group (Table 1).

**Table 1**
Demographics/early shock/ISS/intestinal injury grades.

| | Penetrating injuries | Blunt injuries | *p*-Value |
|---|---|---|---|
| *N* | 77 | 54 | |
| Age | 30 SD 12 | 34 SD 12 | 0.06 |
| DM | 1 (1%) | 3 (6%) | 0.4 |
| CAD | 2 (3%) | 1 (2%) | 1.0 |
| Obesity | 10 (13%) | 8 (15%) | 0.96 |
| ED shock | 9 (11%) | 14 (25%) | 0.06 |
| ISS | 16 SD 12 | 20 SD 1 | 0.08 |
| IIGS (I–III) | 71 (92%) | 13 (24%) | <0.001 |
| IIGS (IV–V) | 5 (6%) | 36 (67%) | |

### *Injuries*

Stomach injuries comprise $n = 25$ (32%) of penetrating and $n = 2$ (3%) of blunt injuries. Small intestinal injuries comprised $n = 51$ (66%) in penetrating injuries and $n = 42$ (77%) in blunt injuries. Large intestinal injuries comprised $n = 44$ (57%) of penetrating injuries and $n = 18$ (33%) of blunt injuries. Combined small and large intestinal were (PI $n = 27$ (35%) and BI $n = 26$ (48%), $p = 0.1$). The presence of associated neurologic injuries (traumatic brain and spine) was higher in the blunt group (BI = 12 and PI = 3, $p = 0.001$).

### *Operative management*

Overall the blunt injury cases were more complex as evidenced by longer times from admission to operative intervention and higher uses of open abdomen techniques. Delayed definitive repair of injuries occurred more frequently in the blunt injuries as well. Despite these differences, injuries that required intestinal diversion were similar (Table 2).

### *Outcomes*

Anastomotic leaks were uncommon but more prevalent in blunt injuries. Enteric fistulas were also more prevalent in the blunt group. Similarly surgical site infections (SSI) and other nosocomial infections were higher with blunt injuries. These significant differences in iatrogenic complications were also associated with higher hospital and ICU lengths of stay (LOS). Hospital charges were higher in blunt vs. penetrating injuries. Mortality rates were overall low: PI $n = 5$ (7%) vs. BI $n = 3$ (5%) (Table 3).

## Discussion

Traumatic intestinal injuries contribute to significant morbidity and may impact mortality in trauma patients. A major source for such morbidity is sepsis related consequences of intestinal leak and associated wound complications [7–10]. Anastomotic failures are a well-established source of morbidity in intestinal injuries;

**Table 2**
Operative transfusions/management.

| | Penetrating | Blunt | *p*-Value |
|---|---|---|---|
| *N* | 77 | 54 | |
| Time to operation (min) | 110 SD 153 | 500 SD 676 | 0.01 |
| Operative blood loss (l) | 1.8 SD 2.5 | 1.5 SD 1.7 | 0.5 |
| Operative Transfusions (units) | 4.3 SD 7 | 3.0 SD 5 | 0.3 |
| Open abdomen | 5 (6%) | 19 (35%) | <0.001 |
| Delayed intestine repair | 8 (10%) | 16 (30%) | 0.01 |
| Intestinal diversion | 2 (3%) | 3 (6%) | 0.7 |

**Table 3**
Outcomes.

| | Penetrating | Blunt | *p*-Value |
|---|---|---|---|
| *N* | 77 | 54 | |
| Anastomotic leaks | 2 (3%) | 4 (7%) | 0.38 |
| Enteric fistula | 2 (3%) | 8 (15%) | 0.02 |
| SSI | 4 (5%) | 11 (20%) | 0.02 |
| Nosocomial infections | 2 (3%) | 11 (20%) | 0.002 |
| HLOS | 11 SD 11 | 20 SD 14 | 0.001 |
| ICU LOS | 5 SD 5 | 10 SD 10 | 0.01 |
| Hospital charges (mean) | $127,128 SD 120,993 | $248,435 SD 255,354 | 0.007 |
| Mortality | 5 (7%) | 3 (5%) | 1.0 |