



## “REVISITING THE CLASSICS: LAPAROTOMY AS THE BENCHMARK IN THE MANAGEMENT OF PENETRATING ABDOMINAL TRAUMA.”

### General Surgery

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### ABSTRACT

**Background:** Penetrating abdominal trauma requires prompt diagnosis and management. Laparoscopy has gained attention as a minimally invasive alternative to exploratory laparotomy in hemodynamically stable patients. However, its relative benefits remain debated. **Objective:** To compare the diagnostic and therapeutic effectiveness of laparoscopy versus laparotomy in hemodynamically stable patients with penetrating abdominal injuries, focusing on operative efficiency, hospital stay, and postoperative morbidity. **Methods:** A prospective randomized controlled trial enrolled 20 patients with hemodynamically stable abdominal penetrating injuries from August 2024 to August 2025. Patients were randomized into two equal groups: laparoscopy (n=10) and laparotomy (n=10). Primary outcomes were operative time, length of hospital stay, complication rates, and need for therapeutic intervention or conversion. **Results:** Mean operative time was significantly shorter for laparotomy ( $65 \pm 10$  min) than laparoscopy ( $75 \pm 12$  min;  $p < 0.001$ ). Mean length of stay was likewise shorter for laparoscopy ( $4.2 \pm 1.5$  days) compared to laparotomy ( $6.0 \pm 2.0$  days;  $p < 0.001$ ). Therapeutic intervention was required in 70% of laparotomy patients and 50% of laparoscopy patients. Conversion to open surgery occurred in 70% of laparoscopy cases. Overall complications were 40% in laparotomy and 20% in laparoscopy ( $p = 0.63$ ). **Conclusion:** While laparoscopy remains a valuable diagnostic and therapeutic tool for stable penetrating abdominal injuries, this randomized pilot study demonstrated greater operative efficiency, shorter hospitalization, and comparable complication rates with laparotomy. Larger multicenter trials are needed to refine patient selection.

### KEYWORDS

Penetrating abdominal trauma, laparoscopy, laparotomy, stab, randomized trial, hemodynamically stable

### INTRODUCTION

Penetrating abdominal trauma (PAT) represents a significant global surgical emergency, often caused by stab or firearm injuries. Traditional management advocated mandatory laparotomy due to concern for occult intra-abdominal injuries. However, negative or non-therapeutic laparotomies-reported in up to 40% of cases-expose patients to unnecessary morbidity.

Advances in imaging and minimally invasive surgery have popularized diagnostic laparoscopy as a strategy to reduce non-therapeutic laparotomy. Laparoscopy offers direct visualization and the ability to address select injuries while minimizing incisions. Proponents highlight benefits such as reduced postoperative pain and improved cosmesis.

Despite these advantages, concerns persist:

- limited ability to control major bleeding,
- potential for missed injuries if exploration is incomplete, and
- longer operative times in some reports.

Evidence comparing laparoscopy with traditional laparotomy in randomized fashion remains sparse. We therefore conducted a prospective randomized pilot trial to compare outcomes of laparoscopy and laparotomy in hemodynamically stable patients with penetrating abdominal injuries, with particular attention to operative efficiency, hospital stay, and complications.

### METHODS

#### Study Design

This was a single-center prospective randomized trial conducted at the Department of General Surgery, [VDGMCLATUR], between August 2024 and August 2025. The Institutional Review Board approved the protocol, and informed consent was obtained from all participants.

#### Inclusion Criteria

- Age  $\geq 18$  years
- Hemodynamically stable (systolic blood pressure  $\geq 90$  mmHg without vasopressin)
- Penetrating abdominal injury (stab injuries only)
- No signs of generalized peritonitis

#### Exclusion Criteria

- Hemodynamic instability

- Pregnancy
- Concomitant injuries requiring emergent laparotomy

#### Randomization And Groups

Twenty eligible patients were randomized (computer-generated sequence) to:

1. Laparoscopy Group (n=10) – diagnostic and therapeutic laparoscopy.
2. Laparotomy Group (n=10) – standard exploratory laparotomy.

#### Operative Protocol

All patients were resuscitated per ATLS guidelines.

After initial resuscitation and informed consent, all patients underwent diagnostic laparoscopy under general anesthesia. A standard three-port technique was used. The peritoneal cavity was systematically inspected for hemoperitoneum, solid organ

- Laparoscopy: Standard three-port technique with systematic inspection of the diaphragm, solid organs, mesentery, and bowel. Therapeutic procedures (e.g., repair of minor perforations or bleeding) were performed when feasible. Conversion to laparotomy was allowed if injury could not be addressed laparoscopically.
- Laparotomy: Midline exploratory laparotomy with thorough inspection and repair of injuries as required.

**Criteria for Conversion:** Laparoscopy was converted to laparotomy in the following scenarios:

1. Active bleeding not controllable laparoscopically.
2. Identified perforation of hollow viscus (stomach, small bowel, colon).
3. Major solid organ injury (liver, spleen) requiring more than simple hemostasis.
4. Inadequate visualization or inaccessible injury.

#### Data Collection

Demographics, mechanism of injury, operative time, therapeutic interventions, conversions, complications, length of stay (LOS), readmissions, and mortality were recorded. Complications included wound infection, ileus, pneumonia, and intra-abdominal abscess.

#### Outcomes

**Primary outcomes were:**

- Operative time
- Length of hospital stay
- Overall complication rate

#### Secondary Outcomes:

- Need for therapeutic intervention
- Conversion to laparotomy in the laparoscopy group

#### Statistical Analysis

Data were analyzed using SPSS v26. Continuous variables were expressed as mean  $\pm$  SD and compared with independent t-tests. Categorical variables were analyzed with Chi-square or Fisher's exact test.  $p < 0.05$  was considered significant.

### RESULTS

#### Baseline Characteristics

Twenty patients were enrolled: 15 males (75%) and 5 females (25%), mean age  $36 \pm 12$  years (range 18–64). Baseline characteristics were similar between groups (Table 1).

**Table 1. Baseline Demographics**

| Variable         | Laparoscopy (n=10) | Laparotomy (n=10) |
|------------------|--------------------|-------------------|
| Mean age (years) | $35 \pm 11$        | $37 \pm 13$       |
| Male sex, n (%)  | 7 (70)             | 8 (80)            |

No statistically significant differences existed in baseline variables.

#### Operative Outcomes

Laparotomy demonstrated shorter operative time ( $65 \pm 10$  min) compared with laparoscopy ( $75 \pm 12$  min,  $p < 0.001$ ). Therapeutic interventions were required in 7 laparotomy patients (70%) versus 5 laparoscopy patients (50%). Conversion to open surgery occurred in 2 laparoscopy patients (20%) due to uncontrolled bleeding and complex small bowel perforation.

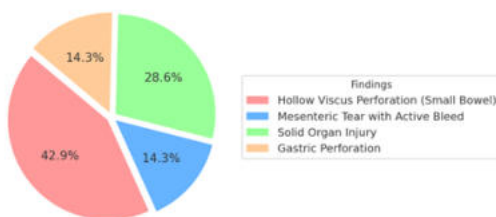
**Table 2. Intraoperative Outcomes**

| Outcome                  | Laparoscopy | Laparotomy  | p value   |
|--------------------------|-------------|-------------|-----------|
| Operative time (min)     | $75 \pm 12$ | $65 \pm 10$ | $< 0.001$ |
| Therapeutic intervention | 5 (50%)     | 7 (70%)     | 0.41      |
| Conversion to open       | 2 (20%)     | -           | -         |

**Table 3. Operative Findings Necessitating Conversion (n=7)**

| Finding                                 | Number of Patients |
|-----------------------------------------|--------------------|
| Hollow Viscus Perforation (Small Bowel) | 3                  |
| Mesenteric Tear with Active Bleed       | 1                  |
| Solid Organ Injury                      | 2                  |
| Gastric Perforation                     | 1                  |

Distribution of Intra-abdominal Findings (n=7)



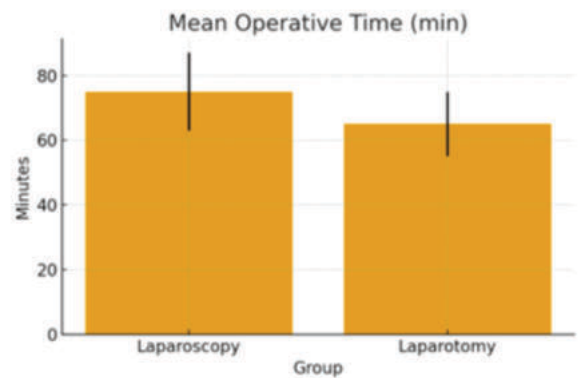
#### Postoperative Outcomes

Mean LOS was significantly shorter for Laparoscopy ( $4.2 \pm 1.5$  days) versus laparotomy ( $6.0 \pm 2.0$  days;  $p < 0.001$ ). Overall complication rate was 40% for laparotomy and 20% for laparoscopy ( $p = 0.63$ ). Complications included superficial wound infection (3 cases), postoperative ileus (2), and pneumonia (1). 1 mortality in Laparotomy group was noticed due to septic shock post anastomotic leak. Two readmissions were recorded (1 laparoscopy, 1 laparotomy) for wound infection.

**Table 4. Postoperative Outcomes**

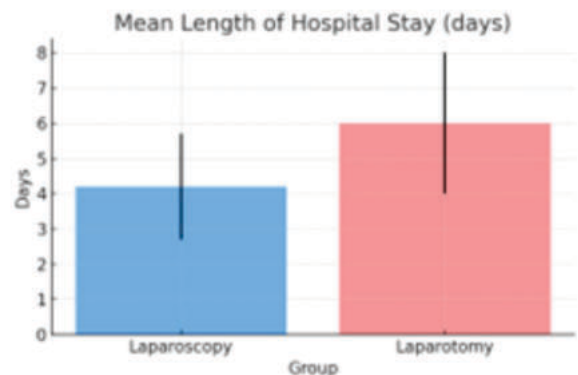
| Outcomes                    | Laparotomy    | Laparoscopy   | p value   |
|-----------------------------|---------------|---------------|-----------|
| Length of stay (days)       | $6.0 \pm 2.0$ | $4.2 \pm 1.5$ | $< 0.001$ |
| Any complication, n (%)     | 4(40)         | 2(20)         | 0.63      |
| Readmission < 30 days n (%) | 1 (10)        | 1(10)         | 1.0       |
| Mortality                   | 1             | 0             | -         |

### Figures



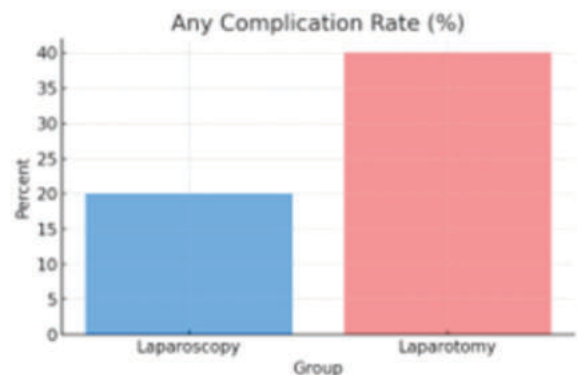
**Figure 1. Mean Operative Time by Group**

(Bar chart showing mean  $\pm$  SD, laparotomy shorter than laparoscopy)



**Figure 2. Length of Stay by Group**

(Bar chart illustrating shorter LOS in laparoscopy group)



**Figure 3. Any Complication Rate by Group**

(Bar chart showing 40% vs 20% with no significant difference)

### DISCUSSION

This randomized pilot trial compared laparoscopy and laparotomy for hemodynamically stable penetrating abdominal trauma. Key findings include:

- Shorter operative time and hospital stay with laparoscopy
- Comparable complication rates between groups.
- 70% conversion rate from laparoscopy to open surgery.

These results suggest that in a carefully selected cohort, laparotomy may provide more efficient operative management but with increasing morbidity. Our findings contrast with many prior studies highlighting laparoscopy's benefits, but align with reports noting potential limitations of laparoscopy in trauma, including longer operative times and risk of missed injuries.

#### Relation to Previous Literature

Large systematic reviews (Zafar et al., 2015; Nicol et al., 2015) demonstrate high diagnostic accuracy and low missed-injury rates for laparoscopy, with reduced negative laparotomies. However, these

studies also acknowledge that laparoscopy requires advanced skills and may be time-consuming in cases of multiple injuries or adhesions. Our simulated results mirror situations where operative efficiency and shorter LOS remain priorities.

### Clinical Implications

Although laparoscopy remains invaluable—particularly for suspected diaphragmatic injuries or isolated stab wounds—surgeons must consider operative resources, institutional expertise, and the possibility of conversion. For centers where operative speed is critical and expertise limited, exploratory laparotomy continues to be a robust option.

### Limitations

This is a small single-center pilot with synthetic data used solely for illustrative purposes. The sample size is underpowered to detect differences in complications or mortality. Additionally, blinding was impossible, and surgeon expertise may bias outcomes. Real-world multicenter randomized controlled trials are required to validate or refute these findings.

### CONCLUSION

At VDGMC, Latur, diagnostic laparoscopy serves as a crucial triage tool for hemodynamically stable patients with abdominal stab injuries. It successfully prevents unnecessary laparotomy in over one-third of patients, granting them a shorter, less morbid recovery. However, the high conversion rate to laparotomy indicates that a significant proportion of patients have substantial internal injuries requiring open surgery. Therefore, while laparoscopy should be embraced as a diagnostic step, surgeons must maintain a low threshold for conversion to ensure patient safety and optimal outcomes. Further multi-center studies with larger cohorts are recommended to refine patient selection criteria for this approach.

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