



RESEARCH ARTICLE

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EARLY OUTCOMES OF LAPAROSCOPIC SURGERY FOR SMALL BOWEL INJURIES FOLLOWING BLUNT ABDOMINAL TRAUMA AT MILITARY HOSPITAL 103

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ABSTRACT

Objective: To evaluate early outcomes and explore factors associated with early outcomes after laparoscopic surgery for small bowel injuries following blunt abdominal trauma at Military Hospital 103. **Subjects and methods:** A descriptive case-series study using retrospective and prospective data was conducted in 40 patients who underwent laparoscopic surgery for small bowel injuries after blunt abdominal trauma at the Digestive Surgery Centre, Military Hospital 103, from January 2019 to July 2026. **Results:** The mean age was 48.87 ± 13.80 years, and 85.0% of patients were male. Road traffic accidents accounted for 75.0% of injuries. CT showed free intraperitoneal air in 80.0% and free fluid in 67.5% of patients. Jejunal injuries accounted for 87.5% of cases. Primary repair was performed in 75.0%, while bowel resection and anastomosis was performed in 25.0%. The median operative time was 90 minutes. Median time to first flatus was 3 days and median hospital stay was 9.5 days. Surgical site infection occurred in 10.0%, and one patient (2.5%) developed cardiac arrest with multiple organ failure. Early outcomes were classified as good in 87.5%, fair in 10.0%, and poor in 2.5%. Patients with unfavourable outcomes had longer intervals from injury to hospital admission and from injury to surgery, as well as greater intraperitoneal fluid volume, than those with good outcomes ($p < 0.05$). **Conclusion:** Laparoscopic surgery achieved favourable early outcomes in most appropriately selected patients with small bowel injuries following blunt abdominal trauma in this study.

Key words: blunt abdominal trauma, small bowel injury, laparoscopic surgery.

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1. Introduction

Bowel and mesenteric injuries are relatively uncommon in blunt abdominal trauma. However,

diagnosis can sometimes be challenging, and delayed recognition may increase the risk of complications. The World Society of Emergency

Surgery (WSES) guidelines emphasise the role of clinical assessment, computed tomography, and close observation in the diagnosis of bowel injury. Laparoscopic surgery may also be considered in appropriately selected patients [1].

Abdominal computed tomography is the primary imaging modality in haemodynamically stable patients with blunt abdominal trauma. However, its sensitivity for bowel and mesenteric injuries remains limited, and imaging findings should therefore be interpreted in conjunction with the clinical course [2]. The development of minimally invasive surgery has expanded the role of laparoscopy from diagnostic exploration to definitive treatment of intra-abdominal injuries in selected trauma patients. Recent studies have shown that laparoscopic surgery is feasible and may reduce complications and length of hospital stay compared with open surgery in appropriately selected patient groups [3], [4].

At Military Hospital 103, laparoscopic surgery has been used in the management of small bowel injuries following blunt abdominal trauma. However, data on early outcomes and associated factors remain limited. Therefore, this study was conducted to evaluate the early outcomes and investigate several factors associated with the early outcomes of laparoscopic surgery for small bowel injuries following blunt abdominal trauma at Military Hospital 103.

2. Subjects and Methods

2.1. Subjects

The study included 40 patients diagnosed with peritonitis due to small bowel injury following blunt abdominal trauma who underwent laparoscopic surgery at the Digestive Surgery Centre, Military Hospital 103, from January 2019 to July 2026.

Inclusion criteria

- Patients diagnosed with small bowel injury following blunt abdominal trauma.
- Underwent exploratory laparoscopy and surgical management of the injury. Laparoscopic surgery was selected for patients requiring emergency surgery whose haemodynamic status permitted a laparoscopic approach and who had no associated injuries requiring immediate laparotomy. Patients with complex injuries requiring primary open surgery were not included in the study.
- Medical records contained complete clinical, paraclinical, operative, and early postoperative follow-up data.
- For the prospective group, the patient or legal

representative provided consent to participate in the study.

Exclusion criteria

- Small bowel injury caused by penetrating trauma or by causes other than blunt abdominal trauma.
- Blunt abdominal trauma with complex injuries requiring open surgery.
- Patients who could not be contacted or had no follow-up information after hospital discharge.
- Medical records with insufficient data for the study.
- Refusal to participate in the study or refusal to attend follow-up examination.

Study setting and period

The study was conducted at the Digestive Surgery Centre, Military Hospital 103, from January 2019 to July 2026.

2.2. Methods

Study design

A descriptive case-series study with a combined retrospective and prospective design.

Sample size

The sample size was calculated using the formula for estimating a single proportion:

$$n = \frac{Z_{1-\alpha/2}^2 p(1-p)}{d^2}$$

In which:

- n: required sample size
- $Z_{1-\alpha/2} = 1.96$, corresponding to a 95% confidence level.
- p: estimated proportion of patients with successful laparoscopic surgery during postoperative follow-up. According to the study by Lin H. et al. (2018), which evaluated laparoscopic surgery in 112 patients with blunt abdominal trauma, the success rate was 92% [5]. Therefore, $p = 0.92$.
- d: allowable margin of error, set at 0.09.

Substitution into the formula yielded a minimum required sample size of 35 patients. In practice, 40 patients were included in the study.

Sampling method

For the retrospective data, medical records containing all required information from January 2019 to December 2025 were selected. For the prospective phase, non-probability consecutive sampling was used to enrol eligible patients from January 2026 to July 2026. During the study period, 40 patients and corresponding medical records met the inclusion criteria and were included in the study.

Study procedure

- Step 1: Trocar placement
- Step 2: Inspection and exploration of the abdominal cavity: After entering the abdominal cavity, the surgeon assessed the presence of fluid and blood and the degree of contamination, and systematically examined the intra-abdominal organs for associated injuries. The small bowel was inspected sequentially from the ligament of Treitz to the ileocaecal valve, with careful examination of the entire bowel circumference and mesentery to determine the site, number, and severity of injuries before selecting the appropriate surgical management.
- Step 3: Management of the injury: After systematic exploration of the entire abdominal cavity and small bowel, the injury was managed according to the extent of damage and the condition of the involved tissue. Primary repair was performed when bowel preservation was feasible and tissue perfusion was adequate. Bowel resection and anastomosis were performed when the injury was extensive or when the affected segment was unsuitable for primary repair.
- Step 4: Abdominal closure.

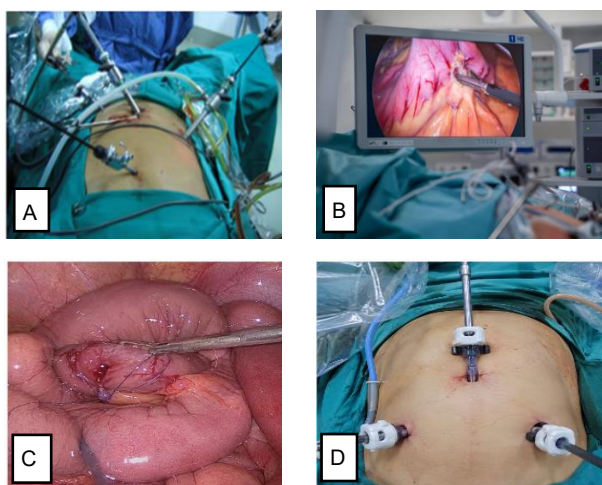


Figure 1. Intraoperative images showing the steps of laparoscopic surgery for small bowel injury
(A. Four-trocar placement; B. Abdominal exploration; C. Management of the injury; D. Abdominal closure)

Study variables

- Data collected included age, sex, mechanism of injury, time from injury to hospital admission, symptoms and abdominal examination findings, associated injuries, and ultrasonographic and computed tomography findings.

- Intraoperative variables included time from injury to surgery, operative time, location of small bowel injury, characteristics and volume of intraperitoneal

fluid, method of injury management, drain placement, and blood transfusion.

- Early outcomes were assessed during the postoperative period until completion of the treatment episode based on the clinical course, recovery of gastrointestinal function, and postoperative complications. The severity of postoperative complications was classified according to the Clavien–Dindo classification [6]. In this study, early outcomes were categorised into four levels: good, when no postoperative complication was recorded; fair, when mild complications corresponding to Clavien–Dindo grades I–II occurred and were controlled with conservative treatment; moderate, when complications required surgical, endoscopic, or radiological intervention, corresponding to Clavien–Dindo grade III; and poor, when life-threatening complications, single- or multiple-organ failure, or death occurred, corresponding to Clavien–Dindo grades IV–V. For analysis of associated factors, the fair, moderate, and poor categories were combined into the unfavourable outcome group. This categorisation was used only to facilitate descriptive analysis of early postoperative outcomes and was not intended as a new outcome classification system.

2.3. Statistic

Data were analysed using SPSS version 26.0. Categorical variables were presented as frequencies and percentages. Normally distributed continuous variables were presented as mean $\pm$ standard deviation, while non-normally distributed variables were presented as median and interquartile range (IQR). Comparisons between two groups were performed using the independent-samples t-test or Mann–Whitney U test for continuous variables, and Fisher's exact test for categorical variables, as appropriate. Statistical significance was defined as $p < 0.05$.

2.4. Research Ethics

The study was conducted after approval by the Scientific Research Council and the leadership of Military Hospital 103. For the retrospective phase, data were collected from medical records, coded, and patient information was kept confidential in accordance with regulations. For the prospective phase, patients or their legal representatives were provided with full information and gave consent to participate in the study. Study data were used solely for scientific purposes. The authors declare that there were no financial or personal conflicts of interest that

could have influenced the conduct, analysis, or reporting of this study.

3. Results

Table 1. Clinical and diagnostic characteristics of the study population (n=40)

Characteristic	Value
Age (years), mean $\pm$ SD	48.87 $\pm$ 13.80
Male sex, n (%)	34 (85.0)
Mechanism of injury, n (%)	
Road traffic accident	30 (75.0)
Occupational accident	5 (12.5)
Domestic accident	4 (10.0)
Assault	1 (2.5)
Time from injury to hospital admission (hours), median (IQR)	9.0 (3.0–16.5)
Abdominal guarding, n (%)	39 (97.5)
Peritoneal irritation signs, n (%)	34 (85.0)
Abdominal distension, n (%)	31 (77.5)
≥ 1 associated injury, n (%)	16 (40.0)
Free intraperitoneal air on CT, n (%)	32 (80.0)
Free intraperitoneal fluid on CT, n (%)	27 (67.5)
Preoperative definitive diagnosis of hollow viscus rupture, n (%)	33 (82.5)

* Note: SD - standard deviation; IQR - interquartile range; CT - computed tomography.

The results in Table 1 showed that road traffic accidents accounted for 75.0% of cases, and the median time from injury to hospital admission was 9 hours. Abdominal guarding and peritoneal irritation signs were observed in 97.5% and 85.0% of patients, respectively. On CT, free intraperitoneal air and free fluid were detected in 80.0% and 67.5% of patients, respectively.

Table 2. Injury and operative characteristics (n=40)

Characteristic	Value
Time from injury to surgery (hours), median (IQR)	15.5 (9.25-23.75)
Time from hospital admission to surgery (hours), median (IQR)	5.0 (4.0-7.0)
Operative time (minutes), median (IQR)	90 (75-120)
Injury location, n (%)	
Jejunum	35 (87.5)
Ileum	5 (12.5)
Intraperitoneal fluid >1,000 mL, n (%)	36 (90.0)
Intraperitoneal fluid volume (mL), median (IQR)	1,200 (1,100-1,350)
Method of injury management, n (%)	
Primary repair	30 (75.0)
Bowel resection and anastomosis	10 (25.0)
Intraoperative blood transfusion, n (%)	14 (35.0)
Time from injury to surgery (hours), median (IQR)	15.5 (9.25-23.75)
Time from hospital admission to surgery (hours), median (IQR)	5.0 (4.0-7.0)

Analysis of Table 2 showed that the median time from injury to surgery was 15.5 hours, while the median operative time was 90 minutes. The jejunum was the most commonly injured segment, accounting for 87.5% of cases. Primary repair was performed in 75.0% of patients, whereas bowel resection and anastomosis was performed in 25.0%.

Table 3. Selected postoperative recovery parameters and early complications (n=40)

Characteristic	Value
Time to first flatus after surgery (days), median (IQR)	3.0 (3.0-4.0)
Time to removal of all drains (days), median (IQR)	6.0 (5.0-7.0)
Duration of antibiotic therapy (days), median (IQR)	9.0 (7.0-11.0)
Length of hospital stay (days), median (IQR)	9.5 (7.0-11.0)
Surgical site infection, n (%)	4 (10.0)
Cardiac arrest and multiple organ failure, n (%)	1 (2.5)

The results in Table 3 showed that, after surgery, the median time to first flatus was 3 days, the median time to removal of all drains was 6 days, and the median length of hospital stay was 9.5 days. Surgical site infection occurred in four patients (10.0%), while one patient (2.5%) developed cardiac arrest accompanied by multiple organ failure.

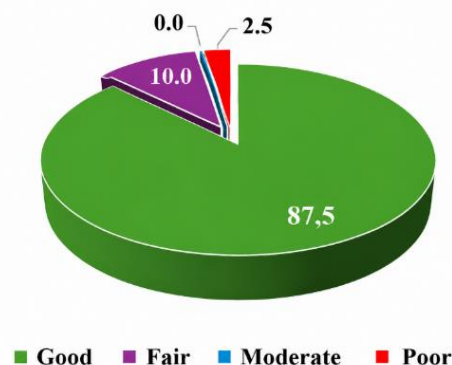


Figure 2. Classification of early surgical outcomes after surgery (n = 40)

Figure 2 shows that early surgical outcomes were classified as good in 87.5% of patients and fair in 10.0%. One patient (2.5%) had a poor outcome, while no moderate outcomes were recorded.

Table 4. Selected factors associated with early postoperative outcomes (n=40)

Factor	Good outcome (n=35)	Unfavourable outcome (n=5)	p
Age (years)	47.83 ± 12.99	56.20 ± 18.61	0.209
Time from injury to hospital admission (hours)	6.0 (3.0-15.0)	14.0 (12.0-54.0)	0.034
Time from injury to surgery (hours)	14.0 (9.0-21.0)	24.0 (16.5-58.5)	0.043
Operative time (minutes)	90.0 (75.0-120.0)	90.0 (72.5-120.0)	0.853
Intraperitoneal fluid volume (mL)	1.150 (1.100-1.350)	1.450 (1.350-1.450)	0.007
Associated injury. n (%)			0.631
Yes	15 (93.8)	1 (6.3)	
No	20 (83.3)	4 (16.7)	
Injured bowel segment			1.000
Jejunum	30 (85.7)	5 (14.3)	
Ileum	5 (100.0)	0 (0.0)	
Method of injury management			0.306
Primary repair	25 (83.3)	5 (16.7)	
Bowel resection and anastomosis	10 (100.0)	0 (0.0)	
Intraoperative blood transfusion			0.043
Yes	10 (71.4)	4 (28.6)	
No	25 (96.2)	1 (3.8)	

* Note: Percentages for categorical variables were calculated by row.

The results in Table 4 showed that the unfavourable outcome group had a longer time from injury to hospital admission (14.0 vs. 6.0 hours; $p=0.034$), a longer time from injury to surgery (24.0 vs. 14.0 hours; $p=0.043$), and a greater intraperitoneal fluid volume (1,450 vs. 1,150 mL; $p=0.007$). The proportion of unfavourable outcomes was 28.6% among patients who required blood transfusion, compared with 3.8% among those who did not receive blood transfusion ($p=0.043$).

4. Discussion

4.1. Patient Characteristics and Diagnosis

The mean age of the patients in this study was 48.87 ± 13.80 years, and males accounted for 85.0% of the study population. Road traffic accidents were the predominant mechanism of injury, accounting for 75.0% of cases. This pattern is consistent with the characteristics of blunt abdominal trauma, in which high-energy mechanisms, particularly road traffic accidents, play an important role in bowel and mesenteric injuries. Reviews of traumatic bowel injury have similarly reported that blunt bowel injuries are commonly associated with road traffic accidents and may be difficult to diagnose in the early stage [1], [7].

Abdominal guarding and signs of peritoneal irritation were observed at high rates, in 97.5% and 85.0% of patients, respectively. This indicates that the study population mainly consisted of patients with bowel injuries who had already developed clear signs of peritoneal irritation at the time surgery was indicated. Therefore, the findings should be interpreted in the context of a selected group of patients undergoing laparoscopic surgery and should not be considered representative of all patients with blunt abdominal trauma.

CT detected free intraperitoneal air in 80.0% of patients and free fluid in 67.5%, while 82.5% of cases were diagnosed with hollow viscus rupture before surgery. These detection rates were relatively high. However, CT cannot completely exclude bowel injury. A 2023 review showed that CT has high specificity but only moderate sensitivity for bowel and mesenteric injuries requiring intervention. Therefore, imaging findings should be interpreted together with clinical examination and serial assessment of the patient's condition [2].

4.2. Operative Characteristics

The jejunum was the most commonly injured segment, accounting for 87.5% of cases, whereas ileal injuries accounted for 12.5%. Primary repair was performed in 75.0% of patients, while bowel resection and anastomosis was required in 25.0%. These findings indicate that, in most patients, the injured bowel segment could be preserved by direct repair. The WSES recommends that the method of bowel repair should be determined according to the extent of injury, tissue perfusion, degree of contamination, and the patient's physiological condition. Primary repair should be preferred when the characteristics of the injury permit [1].

The median operative time was 90 minutes.

Notably, in our study, patients with ileal injuries had a longer median operative time than those with jejunal injuries, 150 versus 90 minutes ($p=0.003$). Similarly, the bowel resection and anastomosis group had a longer operative time than the primary repair group, 120 versus 90 minutes ($p=0.029$). These differences may reflect the nature and complexity of the injuries rather than an independent effect of the injured bowel segment or the surgical technique itself.

Recent evidence supports the feasibility of laparoscopy for abdominal trauma in selected patients. Kim D.H. et al. (2024) reported that, after propensity score matching, the laparoscopic group had a lower rate of major complications and a shorter operative time than the open surgery group, with no missed injuries reported. The conversion rate to open surgery was approximately 16% [3]. However, appropriate patient selection remains crucial, and the results of laparoscopic surgery should not be extrapolated to patients with haemodynamic instability or those requiring urgent damage-control surgery.

4.3. Early Treatment Outcomes

In this study, recovery of gastrointestinal function occurred relatively early, with a median time to first flatus of 3 days. The median length of hospital stay was 9.5 days. Surgical site infection occurred in 10.0% of patients, while one patient developed cardiac arrest and multiple organ failure. Overall outcomes were classified as good in 87.5% of patients, fair in 10.0%, and poor in 2.5%.

These findings suggest that laparoscopic surgery can provide a favourable postoperative course in most appropriately selected patients. This is consistent with the trend reported in recent studies. Analyses of haemodynamically stable patients with abdominal trauma have shown that laparoscopy may reduce major complications and length of hospital stay compared with open surgery in suitable patients [3], [4]. Abdulla Muhanna et al. (2026) synthesised data from 15 studies involving 22,242 patients also found that laparoscopy was associated with a shorter hospital stay and fewer postoperative complications. However, the authors highlighted the potential for selection bias, and the pooled conversion rate to open surgery was 18.6% [8]. As the present study did not include an open surgery control group, no conclusion can be drawn regarding the superiority of laparoscopy over open surgery. The findings only support that laparoscopy achieved favourable early outcomes in the selected patient population treated at our institution. The case of cardiac arrest and multiple organ failure was considered a severe postoperative adverse event. Given the descriptive design of the

present study, a direct causal relationship between this event and the laparoscopic approach cannot be established. Therefore, postoperative complications in this study were interpreted as clinical events occurring during the postoperative course rather than complications attributable specifically to laparoscopy.

4.4. Factors Associated with Early Outcomes

A notable finding was that the time from injury to hospital admission was longer in the unfavourable outcome group than in the good outcome group (14.0 vs. 6.0 hours; $p=0.034$). Similarly, the time from injury to surgery was 24.0 versus 14.0 hours, respectively ($p=0.043$). These findings are clinically plausible, as delays in diagnosis and source control may increase the severity of peritonitis and systemic disturbance. Current guidelines and reviews consistently emphasise the adverse consequences of delayed diagnosis and treatment in traumatic bowel injury [1], [2], [7].

The intraperitoneal fluid volume was also significantly greater in the unfavourable outcome group (1,450 vs. 1,150 mL; $p=0.007$). However, this finding should be interpreted with caution. A larger volume of intraperitoneal fluid may represent a marker of injury severity or the extent of contamination, whereas the present data do not establish it as an independent factor associated with unfavourable outcomes.

Likewise, patients who required blood transfusion had a higher rate of unfavourable outcomes than those who did not (28.6% vs. 3.8%; $p=0.043$). This should not be interpreted as indicating that transfusion itself caused poorer outcomes. The need for transfusion more likely reflects greater injury severity, blood loss, or a more compromised physiological condition. In particular, because the unfavourable outcome group included only five patients, statistically significant p values should be regarded as exploratory findings. The current sample size was insufficient to identify factors associated with unfavourable outcomes using multivariable analysis.

Despite the findings obtained, this study has several limitations. It was conducted at a single centre, involved a small sample size, and did not include an open surgery control group. Therefore, the generalisability of the findings and the ability to compare the effectiveness of different surgical approaches are limited. The small number of patients with unfavourable outcomes did not permit reliable multivariable analysis, and selection bias cannot be excluded because laparoscopic surgery was performed only in patients considered suitable for this approach.

5. Conclusion

Laparoscopic surgery for small bowel injuries following blunt abdominal trauma achieved good early outcomes in 87.5% of patients in this study, with a median time to first flatus of 3 days and a median length of hospital stay of 9.5 days. Surgical site infection occurred in 10.0% of patients. Longer intervals from injury to hospital admission and surgery, greater intraperitoneal fluid volume, and intraoperative blood transfusion were associated with unfavourable early outcomes in exploratory analyses. These findings should be confirmed in larger studies.

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Declaration of Competing Interest

We declare that all authors have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Generative AI and AI-Assisted Technologies

We declare that no artificial intelligence (AI) was used during the research process or in the writing of this manuscript.

Author Contributions

Minh Tuan Nguyen contributed to the study conception and design, data collection, interpretation of the results, and drafting of the manuscript. Thanh Binh Nguyen contributed to the study conception and design, data collection, data analysis, and revision and review of the manuscript. Van Tiep Nguyen contributed to the study conception and design, data collection, interpretation of the results, and revision and review of the manuscript. All authors read and approved the final manuscript.

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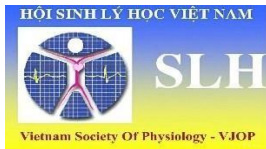
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KẾT QUẢ SỚM PHẪU THUẬT NỘI SOI ĐIỀU TRỊ TỔN THƯƠNG RUỘT NON DO CHẤN THƯƠNG BỤNG KÍN TẠI BỆNH VIỆN QUÂN Y 103

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TÓM TẮT

Mục tiêu: Đánh giá kết quả sớm và khảo sát một số yếu tố liên quan đến kết quả sớm sau phẫu thuật nội soi điều trị tổn thương ruột non do chấn thương bụng kín tại Bệnh viện Quân y 103. **Đối tượng và phương pháp:** Nghiên cứu mô tả loạt ca bệnh, sử dụng số liệu hồi cứu kết hợp tiền cứu trên 40 bệnh nhân được phẫu thuật nội soi điều trị tổn thương ruột non do chấn thương bụng kín tại Trung tâm Phẫu thuật Tiêu hóa, Bệnh viện Quân y 103, từ tháng 01/2019 đến tháng 07/2026. **Kết quả:** Tuổi trung bình là $48,87 \pm 13,80$ tuổi, nam giới chiếm 85,0%. Tai nạn giao thông chiếm 75,0%. CLVT phát hiện khí tự do ổ bụng ở 80,0% và dịch tự do ở 67,5% bệnh nhân. Tổn thương hồng tràng chiếm 87,5%. Khẩu trực tiếp được thực hiện ở 75,0%, cắt đoạn nối ruột ở 25,0%. Thời gian phẫu thuật trung vị là 90 phút. Thời gian trung tiện sau mổ trung vị là 3 ngày và thời gian nằm viện 9,5 ngày. Nhiễm trùng vết mổ gặp ở 10,0%; một trường hợp (2,5%) ngừng tim kèm suy đa tạng. Kết quả sớm được phân loại tốt ở 87,5%, khá ở 10,0% và kém ở 2,5%. Nhóm kết quả chưa tốt có thời gian từ tai nạn đến nhập viện và đến phẫu thuật dài hơn, đồng thời thể tích dịch ổ bụng lớn hơn nhóm kết quả tốt ($p < 0,05$). **Kết luận:** Phẫu thuật nội soi cho kết quả sớm thuận lợi ở phần lớn bệnh nhân tổn thương ruột non do chấn thương bụng kín được lựa chọn phù hợp trong nghiên cứu này.

Từ khóa: Chấn thương bụng kín, tổn thương ruột non, phẫu thuật nội soi.