Outcome of laparoscopic splenectomy in blunt abdominal trauma: A multicenter study

Original Article

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ABSTRACT

Background: One of the most frequent injuries from forceful abdominal trauma is splenic damage. Although laparoscopic splenectomy (LS) has significant benefits over open surgery, doctors are still reluctant to adopt this technique. This study evaluated the application of LS in cases of isolated splenic injuries following blunt abdominal trauma and compared the results for patients who underwent open splenectomy (OS).

Patients and Methods: A total of 30 trauma patients with isolated traumatic splenic injuries (grade II or III) criteria were included in the study. LS was done for 30 patients and compared with another 30 patients who underwent OS. The operating time, intraoperative blood loss, transfusions, length of hospital stay, and complications were reported and compared between both groups.

Results: For LS and OS, the mean age was 35.2±4.6 and 32.4±6.1 years, respectively. A total of 35 out of 60 patients were men. The majority of splenectomies were carried out following nonoperative management failure. In contrast to their much quicker bowel movements and return to normal activities, LS patients experienced significantly longer surgical waiting periods and longer operative time. Mortality, length of stay in critical care or hospital, and complications were comparable.

Conclusion: LS for isolated splenic injuries in cases with blunt trauma appears beneficial compared with OS, especially in patients with a low injury grade.

Key Words: Laparoscopic surgery, open splenectomy, trauma.

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INTRODUCTION

For many elective surgical procedures, laparoscopic surgery is the gold standard of care. yet its application in the trauma context has not reached its full potential. One of the most often injured organs in abdominal trauma, particularly blunt trauma, is the spleen. In trauma instances, exploratory laparotomy has been the norm, with laparoscopy saved for special circumstances. The first therapeutic laparoscopic treatment was described in 1995[1]. Over the last 10 years, the trauma setting has seen a rise in the application of laparoscopic procedures for both therapeutic and diagnostic purposes[2–5].

For trauma patients, the immediate goal is frequently the quickest path to diagnosis and treatment with a laparotomy. However, trauma patients are frequently stable enough to have a laparoscopy rather than a laparotomy. In an elective context, laparoscopic splenectomy (LS), which was initially described in 1991, is frequently the recommended procedure[6]. The best practice for treating splenic injuries in hemodynamically stable patients is splenic conservation with nonoperative management (NOM), which has the advantage of preventing needless laparotomy and the associated complications[7].

Angioembolization is an effective and less invasive method for addressing the splenic source of bleeding. While there are benefits of angioembolization, there are also significant hazards. Despite its high success rate, the NOM still needs to be continuously monitored, and any delayed complications like late splenic rupture or recurrent bleeding must be closely monitored and treated with immediate attention[8]. NOM is not appropriate when patients are hesitant or recalcitrant and cannot adhere to the short-and long-term care plan for NOM, or when there are additional abdominal injuries present[9].

An allergy to the contrast material used or decreased kidney function are contraindications for angioembolization. A 10–38% of people have been reported to fail the NOM for blunt splenic injuries[10,11]. A greater role for laparoscopy

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in the treatment of patients with acute injuries is warranted as it is an essential component of general surgery training. It is regarded as the typical procedure for the majority of elective or nontraumatic splenectomies. LS has significant benefits over open surgery, including decreased blood loss, wound-related problems, less pain following surgery, enhanced pulmonary function, faster healing, and an earlier hospital discharge with minimal risk of distant incisional hernias[12–16].

LS was described in trauma situations in a few studies and is still controversial. In this study, we highlight the outcome of (LS) performed in two tertiary hospitals and compare it to open splenectomy (OS).

PATIENTS AND METHODS:

Study design

The current retrospective analytical study was conducted at the Surgery Department, Ain-Shams University Hospitals, and Benha University Hospital following the ethical perspectives of the Helsinki Declaration. Approval to conduct the study was obtained from the ethical and research committees in the corresponding universities. After receiving written consent and having a thorough discussion with the patient and his family, the patient was enrolled in the study.

Among 100 of trauma cases presented to the emergency departments in the corresponding hospitals between January 2021 and January 2024, the study included only 60 patients with strict inclusion criteria. Patients were included if they were at least 16 years old, with isolated blunt splenic injuries that were grade II or III according to the American Association for the Surgery of Trauma (AAST) and had failed NOM and/or not amenable for angioembolization. Computed tomography was used for the proper grading of the splenic injuries.

Exclusion criteria included generally unstable patients and associated other abdominal organ injuries and that must be approved by radiological investigations preoperatively. Patients with known pathological splenic conditions like hemolytic anemias or congestive splenomegaly due to cirrhosis were also excluded.

Splenectomies were performed after failed NOM as seen by the continual reduction in hemoglobin and the requirement for constant fluid infusions or blood transfusions (BT) to maintain patients' vital signs.

Procedure

Group A: Laparoscopic splenectomy (LS)

In this group, the patient lay in the anterior approach in the right decubitus position with an angle of 60º between the body and the operating table. The patient will be restrained to the table by two belts, one at the mid-thigh and the other at the mid-chest. A 11 mm camera port will be placed at the umbilicus in a tiny body or four fingers superolateral to the umbilicus in patients with a large abdomen. The abdomen will first be insufflated, and then three more 5 mm ports will be positioned along the same line, two fingers below the costal margin, from the left anterior axillary line to the epigastrium. With the anesthesia staff's approval, the intra-abdominal pressure was temporarily increased up to 15–17 mmHg till control of bleeding but not for a long period to avoid vascular compromise to the viscera.

Following the suctioning of any collected blood, the lower pool of the spleen was dissected from the left colon by dissection of the splenocolic ligament and mobilization of the splenic flexure (Fig. 1). The short gastric vessels were secured using ligasure (Fig. 2). The spleen was prevented from falling by hanging it by a grasper by the assistant. Attacking the pedicle and careful dissection was applied with control of the blood vessels either by clipping (Fig. 3) or mass control using Stapler if applicable (Fig. 4). Posterior dissection (Fig. 5) of the lienorenal ligament was carried on and finally, extraction of the spleen was done through Pfannenstiel incision (Fig. 6). Insertion of a tube drain in the splenic bed was done.

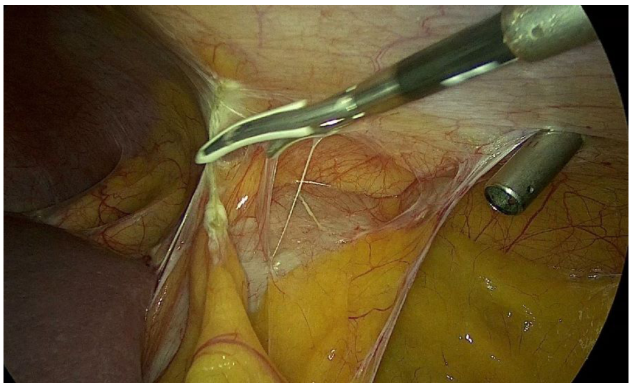

Fig. 1: Mobilization of the splenic Flexure. Figure 1: dissecting the lower pool of the spleen from the left colon (the splenocolic ligament division).

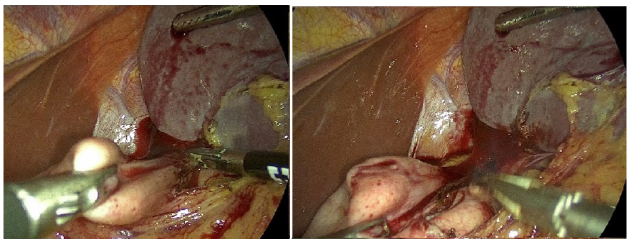

Fig. 2: Securing the Short gastric vessels.

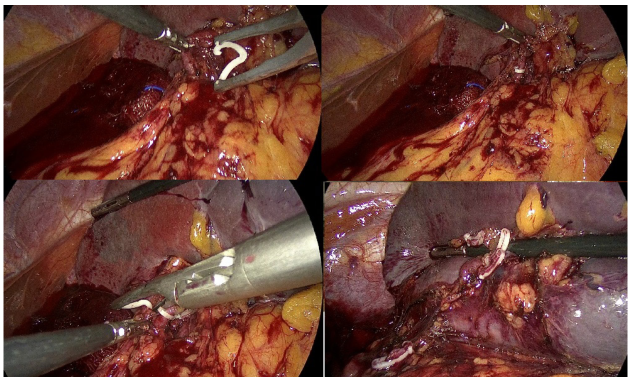

Fig. 3: Vascular control by clipping.

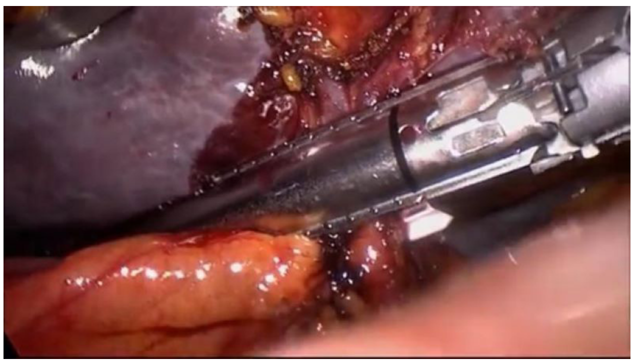

Fig. 4: Vascular control by Stapler.

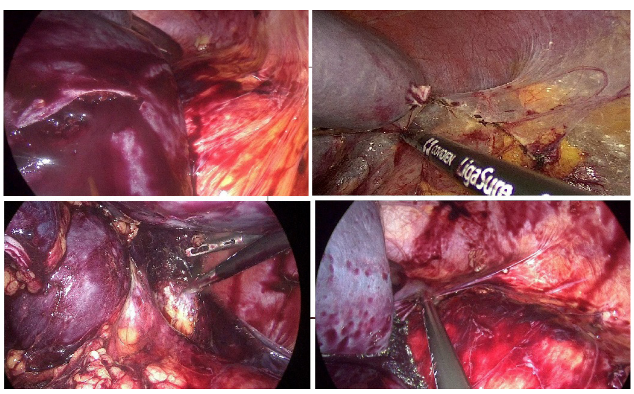

Fig. 5: Dissection of the lienorenal ligament.

Fig. 6: Pfannenstiel incision closure and extraction of the specimen.

Open splenectomy (OS) in group B

A midline incision was used. Posterior dissection of the lienorenal ligament was done then Vicryl 0 was used for vascular control. Insertion of a tube drain in the splenic bed was done.

Outcomes and follow-up

The primary research objective was successful LS with minimal postoperative complications in comparison with the conventional OS.

The secondary outcome was to enhance recovery and decrease postoperative stay.

For all included patients complete monitoring was done for intraoperative blood loss (BL) in milliliters (ml), BT in total units transfused, length of operation in minutes (min), the intensive care unit (ICU) length of stay, time to resume normal bowel Movement (BM) referred as patient passed flatus with tolerate oral fluids, length of hospital stay(LOS), time to return to normal activities (NA), 30 days postoperative complications related to splenectomy and 30 days mortality were compared, and analyzed.

Statistical analysis

The sample size required to achieve a power of 1-β=0.80 (80%) for the spearman's correlation at level α=0.05 (5%), under these assumptions, amounts to 30 in each group (G*power, version 3.1).

SPSS, version 25 (IBM Corp., Armonk, New York, USA) was used for statistical analysis. Student t-test was used for quantitative parameters that were described using mean and SD. The χ^2 test was used for qualitative parameters that were described as the frequency with percent. Categorical and binary variables were tested by χ^2 test with or Fisher exact test. The Mann–Whitney test was used for other non-parametric quantitative data. *P values* of less than 0.05 were considered significant.

RESULTS:

The current study included 60 patients with a mean age of 35.2±4.6 and 32.4±6.1 years in Group A and B respectively. No significant difference was present regarding sociodemographic data or the preoperative presentation. No surgeries in the laparoscopy group were converted to open procedures and/or reoperation (Table 1).

Patients who underwent LS had a longer time from hospital arrival to surgery (mean 2.4 days) versus those who had open surgery (mean 1.9 days) but was not statistically significant with a *P value* of 0.062 (Table 2).

During surgery, the OS group had significantly less BL (*P<0.001*) and significantly shorter operating times

(*P<0.001*). There was no significant difference regarding ICU and LOS; (mean 2.1 days for LS group, vs. 3.6 days for OS group) for ICU admission and regarding LOS (mean 11.7 days for the LS group, vs. 13.54 days for OS group). Conversely, LS has significant finding regarding Return to normal activity (18 days for LS vs. 32 days for OS with *P value* of *<0.001*) (Table 2).

Regarding complications, the overall complication rate was 6.15% (4/60), however, no statistically significant difference was observed between both groups (10%, n=3 of open, 3.33%, n=1 of laparoscopic; *P=0.273*) There was no statistically significant difference between both groups regarding wound complications. Two patients one in each group developed sub-phrenic collection which was managed by ultrasound-guided aspiration and antibiotic course. In the open group one patient developed prolonged ileus which was resolved and the other developed pneumonia ARDS (Acute respiratory distress syndrome) and RF (Renal Failure) and passed away. There was a single case of mortality in the OS group (3.33%, n=1 of open, 0%, n=0 of laparoscopic; *P=0.172*) due to postsplenectomy pneumonia and acute respiratory distress syndrome and the patient died of multiple organ failure (Table 2).

Table 1: Patients demographics, characteristics and clinical presentation

	LS *n*=30	OS *n*=30	*P* value
Age (year, M±SD)	35.2±4.6	32.4±6.1	*P*=0.532
Sex (*n*) (%)			
Male	20 (66.6)	15 (50)	*P*=0.245
Female	10 (33.3)	15 (50)	
Mode of injury (*n*) (%)			
RTA	15 (50)	12 (40)	*P*=0.364
Fall from height	9 (30)	6 (20)	
Other	6 (20)	12 (40)	
SBP (mmHg) (M±SD)	118.7±11.3	115.4±9.8	*P*=0.347
HR (bpm) (M±SD)	90.5±23	94.8±19.2	*P*=0.423
BE (mmol/l) (M±SD)	–2.67±0.9	-2.47±1.1	*P*=0.217
ASA Median (range)	1 (1–3)	1 (1–3)	*P*=0.661
GCS	15	15	*P*=0.253
AAST grade (M±SD)	1.44±0.2	1.89±0.15	*P*=0.485

AAST, American Association for the Surgery of Trauma; ASA, American Society of Anesthesiologists physical status classification system; BE, base excess; GCS, Glasgow coma scale; HR, heart rate; bpm beat per minute; LS, laparoscopic splenectomy; M±SD, mean±standard deviation; n, number; RTA, road traffic accidents; SBP, systolic blood pressure; SO, open splenectomy; yr, year.

Table 2: Comparison of outcomes between LS and OS techniques

	LS *n*=30	OS *n*=30	*P* value
SWT (days) (Median/range)	2.4 (1.5–3)	1.9 (1.2–1.4)	0.062
BL (ml) (M±SD)	1100±125	325±95.5	*P<0.001*
BT (units) (M±SD)	2.6±1.1	1.2±0.9	*P*=0.154
OT (min) (M±SD)	139.8±44	98.3±21	*P<0.001*
ICU stay (days) (M±SD)	2.1±0.5	3.6±1.1	*P*=0.157
BM (days) (M±SD)	1.6±0.5	3.5±0.6	*P<0.001*
LOS (days) (M±SD)	11.7±0.2	13.54±0.9	*P*=0.622
NA (days) (M±SD)	18±6	32±12	*P<0.001*
30 days Complications (*n*) (%)	1 (3.33)	3 (10)	*P*=0.273
Bleeding	0	0	1.00
Pulmonary complications	0	1 (3.33)	0.086
Sub-phrenic collection	1 (3.33)	1 (3.33)	1.00
Prolonged ileus	0	1 (3.33)	0.086
Thrombocytosis	0	0	1.00
Wound infection	0	1 (3.33)	0.086

Wound dehiscence	0	0	1.00
Wound seroma	1 (3.33)	1 (3.33)	1.00
Wound hematoma	0	0	1.00
Mortality (*n*) (%)	0	1 (3.33)	*P*=0.172

BL, blood loss; BM, bowel movement; BT, blood transfusion; ICU, intensive care unit; LOS, length of hospital stays; LS, laparoscopic splenectomy; NA, return to normal activity; OT, operative time; SO, open splenectomy; SWT, surgery waiting time.

DISCUSSION

Minimally invasive surgery, such as the laparoscopic method, has a definite advantage in most modern surgeries. Compared with open procedures, it provides a number of well-established benefits, such as reduced postoperative pain, LOS after surgery, quicker food resumes, and return to normal function[15]. Additionally, laparoscopy provides improved exposure, particularly for organs in the foregut such the liver, spleen, and diaphragm. It also facilitates exploration of the pelvic organs, which may be difficult to examine through open surgery or require a lengthy exploratory incision to reach. With surgeons moving slowly, its application in trauma situations has not lived up to expectations[13].

In the past, there have been reports on the use of laparoscopy for trauma related to overlooked injuries, probably because all areas of the abdomen could not be fully seen. Nonetheless, statistics have demonstrated that laparoscopic intervention, performed by a qualified hand, is extremely sensitive, specific, and accurate because to advances in laparoscopic technology and imaging. Laparoscopic abdominal exploration has become increasingly accepted in trauma since, in concordance with current statistics, the incidence of missing injury is less than 1%[16,17].

In 1995 and 2003, the first case reports of laparoscopic partial and complete splenectomies in trauma patients were published[18]. This study demonstrates the viability of LS with clear advantages over OS and very acceptable safety as seen by lower mortality and comorbidities. Numerous articles support the findings of this study in the same way where authors[5,6,19] reported the feasibility of LS in trauma. As the most frequent isolated injury with the study selection criteria, the study group consisted of AAST grades I and II. Many researches have demonstrated the value of LS in treating individuals with high-grade IV or V splenic lesions[20,21].

In this study, LS and OS were contrasted in cases of isolated blunt abdominal trauma-related splenic damage. Between the two methods, there is an obvious and notable difference. Because the primary indication for LS is failed NOM cases, surgery waiting times for LS were longer (ranging from 1.5–3 days in LS group in comparison with 1.2–1.4 days in OS group) but this difference was not statistically significant *P=0.062*. This is because semi-emergency lists allow time to find a surgeon who is experienced in laparoscopic surgery and has experience with LS.

On the other hand, OS group procedures can be performed whenever it is convenient because most surgeons are highly trained in performing an OS. A different study also produced results comparable to ours, with a delay of 3.18 days for LS and 0.27 days for OS. Birindelli *et al*.[22] showed contrasting findings, with an average delay of 6 days in the OS group and 2 days for LS.

The study's intraoperative results revealed that OS required less BT (mean 1.2 units for OS vs. 2.6 units for LS, *P=0.154*) and lost less blood (median 325 ml for LS vs 1100 ml for LS, *P<0.001*). These findings may be related to the fact that failed NOM is the primary indicator of LP and that it takes longer and causes greater BL during conservation which necessitates replacement. Additionally, a longer operating time (mean 139.8 min for LS vs. 98.3 min for OS) was needed for LS. This could have been caused by intra-abdominal blood obstructing spleen visualization or difficulties with the laparoscopic equipment and technique.

In comparison to our findings in the literature. This result has previously been reported elsewhere. Huang *et al*.[23] showed that LP patients required longer operating times. However, they also showed that OS patients experienced greater blood loss, which led to more BT. Ermolov *et al*.[24] corroborated these findings. Conversely, Trejo *et al*.[25] observed a reduced operative time utilizing LS in a different operating time result.

Significant clinical outcomes in the LS group included the onset of a bowel movement (mean, 1.6 days for LS vs. 3.5 days for OS, *P0.001*) and return to regular activity (mean, 18 days for LS vs. 32 days for OS, *P0.001*). Other results included a shorter length of stay in the intensive care unit (*P=0.157*) and LOS (*P=0.622*), both of which are clinically significant but did not reach statistical significance.

LS was found to be statistically significant for both LOS and resuming bowel habits (*P=0.039* and *P=0.042*, respectively) in one publication[26], which also showed statistical significance for LS in the case of an ICU stay (*P=0.152* and *P=0.662*), which is clinically but not statistically significant. Another published trial (n=26) revealed better results for LS in terms of bowel function (*P=0.0001*), ICU stay (*P=0.042*), and clinical relevance in terms of LOS (0.455)[22].

The fact that the surgeons performing the laparoscopic procedures on the group were proficient and experienced laparoscopic surgeons may have contributed to the research's 0% conversion rate and absence of reoperation. Unlike Birindelli *et al*.[22] who reported a 19% conversion rate[22,23].

Clinically significant differences were observed in the complication between the LS group (*P=0.273* and *P=0.172*, respectively). Similar results were obtained by other investigations[22–25] the LS group experienced a clinically meaningful outcome, suggesting that LS might be a less risky procedure than open laparotomy.

The fatality rate found in the other trials is representative of the patient's overall damage burden and is unrelated to the surgical intervention, in contrast to our single mortality event, which is related to a postoperative medical issue. Heuer *et al*.'s study[26] of 13 000 trauma patients, of which 46.5% had LS, provides compelling evidence of this. The higher injury score explained the overall in-hospital mortality of their splenectomy patients, which was 24.8%.

This study's limited sample size is the main limitation, which will probably have an impact on the study's results.

CONCLUSION

LS seems to be a better option than OS-especially for patients with lower injury grades. It appears safe and doable to perform laparoscopic surgery on hemodynamically stable patients whose initial nonoperative therapy fails, provided there are qualified surgeons available.

CONFLICT OF INTEREST

There are no conflicts of interest.

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