Myth And Facts About The Evolving Role of Laparoscopic Splenectomy In Isolated High Grades Splenic Injuries In Hemodynamically Stable Patients With Blunt Abdominal Trauma. Randomized Controlled Trial.

Tamer A. A.M. Habeeb (*tamerlnaimy@hotmail.com*)
Zagazig University, faculty of medicine Zagazig University

Gamal Osman
Zagazig University, faculty of medicine Zagazig University

Amr Ibrahim
Zagazig University, faculty of medicine Zagazig University

Mohamed Riad
Zagazig University, faculty of medicine Zagazig University

Abd-Elrahman M. Metwalli
Zagazig University, faculty of medicine Zagazig University

Mohamed . I. Mansour
Zagazig University, faculty of medicine Zagazig University

Ahmed S. mohamed
Zagazig University, faculty of medicine Zagazig University

Said . M. negm
Zagazig University, faculty of medicine Zagazig University

Tamer Wasefy
Zagazig University, faculty of medicine Zagazig University

Muhammad . A. Baghdadi
Zagazig University, faculty of medicine Zagazig University

Bassem Sieda
Zagazig University, faculty of medicine Zagazig University

Ashraf . a. elsayed
Zagazig University, faculty of medicine Zagazig University

Mohamed . F. Amin
Zagazig University, faculty of medicine Zagazig University

Wael M Abdalla
Zagazig University, faculty of medicine Zagazig University
Research Article

Keywords: laparoscopy, non-penetrating, splenectomy

DOI: https://doi.org/10.21203/rs.3.rs-558748/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License
Abstract

Background: Spleen is the most common intra-abdominal organ injury in blunt abdominal trauma. Splenectomy (open or laparoscopic) is the role in treatment of severe injuries of spleen or after failure of conservative treatment.

Aim of the work: Compare the outcomes between open versus laparoscopic in high grade splenic injuries.

Methods: This study includes 70 patients with various grades of splenic injuries in abdominal trauma. The patients were 15 years and older. They were categorized into two groups: open splenectomy group (35 patients) and laparoscopic splenectomy group (35 patients). The study was performed from January, 2012 to July 2017. Variables included demographics data, splenic injury graded by computerized tomography, duration of operation (in minutes), intra-operative blood loss (in ml), and intraoperative blood transfusion, length of hospital stay (in days), complications and mortality.

Results: There was no significant difference or association between groups as regard age, sex and causes of splenic injury (p=0.374, 0.41, 0.38). Most cases were under 35 years old male patients exposed to motor car accidents. As regard intraoperative data, no statistically significant difference between both groups except for blood loss and transfusion that were statistically significant to the open group (p=0.039*). In the laparoscopic group, operational time was longer than open but no statistically significant (p=0.11). As regard conversion, we found that 14% of laparoscopic group (5 cases) had conversion. Most cases operated by laparoscopic approach were in grade III, IV with no cases tried in grade V (p=0.06). No statistically significant difference between both groups as regard postoperative variables except Pain (p=0.0003), and hospital stay (p=0.00) that were significantly longer among open group. The immediate postoperative complications showed that Wound infection, Missed injuries, pancreatic fistula and ileus were significantly higher among open group (p=0.00, 0.006, 0.02, 0.0004). The delayed postoperative complications where Incisional hernia (p=0.001) and Adhesive intestinal obstruction (p=0.00) were significantly associated with open group.

Conclusion: In high-grade splenic injuries patients, this study found that laparoscopic splenectomy is safe.

Highlights

- Blood loss and blood transfusion that were statistically significant to the open group.
- Postoperative Pain and hospital stay those were significantly longer among open group.
- The immediate postoperative complications showed that Wound infection, Missed injuries, pancreatic fistula and ileus were significantly higher among open group.
- The delayed postoperative complications where Incisional hernia and Adhesive intestinal obstruction were significantly associated with open group.
Introduction

Rupture spleen is the commonest incidence in trauma to the abdomen especially to the left hypochondrium. The commonest cause is road traffic accident [1-2]. Spleen may be injuries either individually or with other nearby organ injuries as kidney, bowel and ribs. Ruptured spleen is suspected in poly-traumatized patient and usually associated with decreased blood pressure and increased heart rate [3-5].

Different methods are evolved aimed at grading of splenic trauma and this classification helped in different methods of treatment of splenic injuries. CT(Computerized Tomography) grading is important and the splenic injuries are classified into five grades according to the severity of splenic injuries [6-10].

Laparoscopic total splenectomy for splenic injuries was performed in 1995 and it was performed in hemodynamically stable patients [11]. Laparoscopic splenectomy in avoided in hemodynamically unstable patients or severe cases of splenic injuries with continuous severe bleeding as delay in time to intervention may endanger the patient life [12].

Laparoscopy put the open approach a side because of small operative wound and hence better cosmesis and less postoperative pain and infection. Laparoscopy also gives a panoramic view to the whole abdomen and this help not to miss associated injuries [13].

The number of studies handling laparoscopic splenectomy in high grade injuries is not numerous.

The aim of the work, strength of the study:

High grade splenic injuries necessitate urgent splenectomy and usually conducted by open approach due to rapid approach, no experienced laparoscopic splenectomy surgeons for trauma. Few studies conducted on splenic injuries treatment by laparoscopic approach but we conducted a randomized controlled clinical study on this types of injuries including high grade injuries. The role of laparoscopy is evolving in the last decades but its role in dealing with traumatic spleen is of a matter of debate. The main aim: was to compare between open and laparoscopic splenectomy in high grade splenic injuries (III-V) in hemodynamically stable patients as regard safety of the patient intraoperatively (mortality) and the second aim was to determine the role of laparoscopy in splenic trauma as having actual role (fact) or it is not supposed to be used (myth).

Patients And Methods

The design of the study: Prospective randomized clinical study conducted in our University Hospitals emergency surgery unit between Jan 2012 and July 2017 for 70 Patients admitted to high grade splenic injuries (III-V). The patients were randomly allocated into two groups: Group (A): includes 35 patients: underwent open splenectomy and Group (B): includes 35 patients: laparoscopic splenectomy. The method for calculating sample size was based on mortality rates from previous paper with study power
of 80 and confidence 95 samples in each group will be 35. Patients were randomly allocated using a random sequence computer. Patients were randomly numbered in closed envelopes, which were opened just before the operation. Patients were unaware to the any group until after the study. It is the role of registration office.

**Patient selection criteria:** patients enrolled in the study are male and non-pregnant female, age 15 years and more, Preoperative sonar and CT evidence of isolated splenic injuries and Blood pressure > 90/60 mmhgf, and heart rate < 120 beat. While patients excluded from the study were patients with associated other systems or abdominal injuries, successful non-operative management, or successful embolization and penetrating splenic injuries.

**Types of outcome and measurement (study endpoints):**

Primary outcome was intraoperative mortality. Secondary outcomes are the long and short term postoperative morbidities (early and delayed complications).

**Method:**

Preoperative workup was done by focused assessed sonography for trauma (FAST) and CT of the abdomen. All patients of the present study subjected to immediate initial resuscitation and primary survey, followed by secondary survey and routine laboratory investigations. After resuscitation and stabilization of the vital signs, abdominal ultrasonography and computed tomography scans were carried out for all cases. (Pic 1). Preoperative consultant anesthetist’s assessment. Nasogastric tube and urinary bladder catheter. With induction of anesthesia, metronidazole 500 mg and ceftriaxone 1gm. given intravenously. General anesthesia with cuffed endotracheal intubation. All surgeries were done in mono-center in trauma surgery unit for duration of 5years by 3 surgeons qualified in laparoscopic splenectomy surgery following the principles of laparoscopic surgery. Each surgeon had an experience of previous 100 laparoscopic splenectomies for elective cases. At least one of three senior surgeons was always present to ensure inclusion criteria.

A laparoscope of 30° was inserted following induction of pneumoperitoneum (12 mm Hg) with a Veress needle, and a massive hemoperitoneum was visualized and aspired by suction irrigation device. Three additional trocars, left side to umbilical port for the surgeon, and third left side for the assistant were laid in the epigastrium. Careful abdominal cavity inspection confirmed the spleen was the sole source of bleeding (pic 2). The spleno-colic ligament was broken downwards. By harmonic scalpel, the shorts of the gastric vessels and the attachments in the lower polar were divided. The splenic artery was prepared and ligated then cut. It is assured that the pancreatic tail was not damaged (pic 3,4). The lateral attachments were divided that allowed splenic mobilizations. With a 3-cm incision and through endobag, the spleen was removed (pic 7). Extensive uncontrolled bleeding is an indication for laparotomy. (pic 5,6).

Postoperatively, fluid was allowed as tolerated when the patients had open bowel. Antibiotics were continued for 5 days. A drain removed when contains less than 50 C.C for 3 days. Vaccination occurred
after 2 weeks of postoperative surgery. The follow up period was one month, six month, twelve month and 18 months after returning home. After returning to home, patients were contacted by mailing, telephone and at outpatient clinic. Techniques of follow up included complete history and physical examination to detect remote complications and Ultrasonography if patients are symptomatizing at any time in the follow up period. No cases lost in the follow up period.

3. Statistical analysis

The data were imported into the Social Sciences Statistical Package (SPSS version 20.0). The following tests were used for testing of difference of significance, depending upon the type of data qualitative as number and percentage quantitative continuous group represented by average ± SD, and Chi square test differential and associate qualitative variable (X2). Differences between quantitative independent groups by t test or Mann Whitney, for significant results P value was set at < 0.05 & < 0.001 for high significant results.

Results

There was no significant difference or association between groups as regard age, sex and causes of splenic injury (p=0.374, 0.41, 0.38). Most cases were under 35 years old male patients exposed to motor car accidents. Table (1). As regard intraoperative data, no statistically significant difference between both groups except for blood loss and transfusion that were statistically significant to the open group (p=0.039*). In the laparoscopic group, operational time was longer than open but no statistically significant (p=0.11). As regard conversion, we found that 14% of laparoscopic group (5 cases) had conversion. Most cases operated by laparoscopic approach were in grade III, IV with no cases tried in grade V (p=0.06) (Table 2). No statistically significant difference between both groups as regard postoperative variables except Pain (p=0.0003), and hospital stay(p=0.00) that were significantly longer among open group. The immediate postoperative complications showed that Wound infection, Missed injuries, pancreatic fistula and ileus were significantly higher among open group (p=0.00, 0.006, 0.02, 0.0004). The delayed postoperative complications where Incisional hernia (p=0.001) and Adhesive intestinal obstruction (p=0.00) were significantly associated with open group. Table (3).

Table (1): demographic data
Open splenectomy | Laparoscopic splenectomy | $\chi^2$ | P
--- | --- | --- | ---
(35 cases) | (35 cases) | | |
**Age** | | 4.19 | 0.21 |
15-25 | 5 (14.3%) | 7 (20%) |
26-35 | 22 (62.8%) | 24 (68.5%) |
36-45 | 6 (17.2%) | 1 (2.8%) |
$>$45 | 2 (5.7%) | 3 (8.7%) |
| 34.58±10.58 | 33.41±11.02 | t=0.84 | 0.374 |

**Sex**

| | Male | female |
| --- | --- | --- |
| 25 (71.4%) | 10 (28.6%) |
| 28 (80%) | 7 (20%) |

**Cause of abdominal trauma**

| | Motor car accident | Blow to the abdomen | Falling from a height |
| --- | --- | --- | --- |
| 28 (80%) | 3 (8.7%) | 4 (11.3%) |
| 27 (77.1%) | 2 (5.7%) | 6 (17.2%) |

There was no significant difference or association between groups.

**Table (2):** Intraoperative data
|                          | Open splenectomy (35 cases) | Laparoscopic splenectomy (35 cases) | $\chi^2$ | P   |
|--------------------------|-------------------------------|-------------------------------------|---------|-----|
| **Operative time**       |                               |                                     |         |     |
| < 60 minutes             | 8 (22.9%)                     | 3 (8.7%)                            | 0.269   | 0.11|
| >60 minutes              | 27 (77.1%)                    | 32 (91.3%)                          |         |     |
| **Blood loss (ml)**      |                               |                                     |         |     |
| 500ml                    | 7 (20%)                       | 15 (42.8%)                          | 4.21    | 0.039*|
| >500ml                   | 28 (80%)                      | 20 (57.2%)                          |         |     |
| **Blood transfusion**    |                               |                                     |         |     |
| (unit)                   |                               |                                     |         |     |
| one unit                 | 7 (20%)                       | 15 (42.8%)                          | 4.21    | 0.039*|
| ≥ 2 units                | 28 (80%)                      | 20 (57.2%)                          |         |     |
| **Grade of splenic injuries** |                       |                                     | 5.41    | 0.06|
| Grade III                | 22 (62.9%)                    | 25 (71.4%)                          |         |     |
| Grade IV                 | 8 (22.9%)                     | 10 (28.6%)                          |         |     |
| Grade V                  | 5 (14.2%)                     | 0 (0.0%)                            |         |     |
| Conversion               | 0 (0.0%)                      | 5 (14%)                             | 12.07   | 0.0005**|

Blood loss and blood transfusion were significantly associated with open group, regard conversion we found that 14.2% of laparoscopic group (5 cases) had conversion

**Table (3):** postoperative data
|                                | Open splenectomy (35 cases) | Laparoscopic splenectomy (35 cases) | X^2   | P       |
|--------------------------------|-----------------------------|-------------------------------------|-------|---------|
| **Postoperative pain**         |                             |                                     |       |         |
| <2days                         | 12 (34.2%)                  | 27 (77.1%)                          | 13.12 | 0.0003**|
| >2days                         | 23 (65.8%)                  | 8 (22.9%)                           |       |         |
| **Postoperative analgesic**    |                             |                                     |       |         |
| <1 week                        |                             |                                     |       |         |
|                               |                             |                                     |       |         |
| >1 week                        | 18 (51%)                    | 25 (71%)                            | 2.95  | 0.08    |
|                               | 17 (48%)                    | 10 (28%)                            |       |         |
| **Postoperative hospital stay**|                             |                                     |       |         |
| <5 days                        |                             |                                     |       |         |
|                               |                             |                                     |       |         |
| >5 days                        | 7 (20%)                     | 25 (71%)                            | 18.66 | 0.00**  |
|                               | 28 (80%)                    | 10 (28%)                            |       |         |
| **ICU admission(days)**        |                             |                                     |       |         |
| 1-3 days                       | 30 (85.8%)                  | 32 (91.6%)                          | 0.59  | 0.74    |
| 4-7 days                       | 3 (8.5%)                    | 2 (5.7%)                            | 5.23  | 0.02*   |
| > 7 days                       | 2 (5.7%)                    | 1 (2.7%)                            | 10.11 | 0.001** |
| Wound infection                | 15 (42.8%)                  | 2 (5.7%)                            | 28.11 | 0.00**  |
| Missed injuries                | 5 (14.2%)                   | 1 (2.8%)                            | 7.42  | 0.006*  |
| Pancreatic fistula             | 4 (11.4%)                   | 1 (2.8%)                            | 5.23  | 0.02*   |
| Incisional hernia              | 6 (17.1%)                   | 1 (2.8%)                            | 10.11 | 0.001** |
| Adhesive intestinal obstruction| 8 (22.8%)                   | 0                                   | 20.88 | 0.00**  |
| OPSI                           | 0                           | 0                                   | 0.0   | 1.0     |

Pain significantly stays more among open group also post-operative hospital stay was significantly longer among open group. Wound infection, Missed injuries, pancreatic fistula and ileus were significantly higher among open group. Incisional hernia and Adhesive intestinal obstruction were significantly associated with open group.

** Strongly significant
Discussion

Laparoscopic approach for splenectomy in elective cases is the standard treatment but laparoscopic approach in traumatic high grade splenic injuries is not common. Changes in surgical approach evolved in the last decade secondary to the urging of technology.

Studies performed on grade III splenic injuries and stated that the operative time is longer in laparoscopic splenectomy than open approach while no difference in morbidity and mortality between both approaches and stated that laparoscopic splenectomy is a safe approach [14-15]. The present study agree with the previous studies, most cases were in grade III (47/70) with less intraoperative bleeding in laparoscopic group but with longer operative time (91% of cases). Longer laparoscopic time is attributed to time taken for introduction of trocars and laparoscopic instruments. Minimal intraoperative bleeding was due to panoramic view that helped us in controlling the bleeding site and thanks to the presence of Harmonic scalpel instrument. New technologies provided a special excellent instrument as harmonic scalpel and ligasure that are excellent tool in hemostasis during the surgery and the operation must be performed after availability of these tools [16]. In the present study, the harmonic scalpel allowed us to quickly dissect the short gastric vessels, especially the ligamentous attachments of the lower poles of the spleen and hence decrease operative time and bleeding.

Conversion to open occurred in 5 cases (14%) due to failure to control bleeding during the operation. three cases converted at the first few minutes of operation due to inability to control bleeding and the last two cases are converted during dissection of the hilum of the spleen.

Panoramic view of the abdomen by laparoscopy helps to detect associated injuries and avoid missed injuries that may reach up to 18% of cases [17]. In our study; the missed injuries were high in open than laparoscopic group (14% vs. 3%) and mostly due to missed injury of pancreatic tail. Cases presented with intra-abdominal abscess and pain with fever. 4 cases of missed injuries in open group and one missed case in laparoscopic group were due to missed pancreatic tail injuries. All of them were grade B fistula and were treated successfully by percutaneous drainage under ultrasonography guidance, nothing per oris, metronidazole 500mg injection and third generation cephalosporin. No cases needed re-exploration. While the fifth missed case of open group was due to colonic injuries and diagnosed 5 days postoperative by abdominal pain and fever and underwent re-exploration and temporarily simple loop colostomy that was closed 8 weeks after.

Among advantages of laparoscopy over open approach are small operative wound and hence pain and infection. Rapid resumption of oral feeding and rapid return to works are also advantages. [18]. the present study confirmed the importance of laparoscopy in less postoperative pain, less duration of analgesic intake and shorter hospital stay in laparoscopic approach than open approach.

Postoperative wound infection is related to the size of the wound, so larger wound in open approach is more liable to wound infection than in laparoscopic approach. In the present study, 15 cases (43%) in
open approach and 2 cases (6%) with laparoscopic approach were complicated with wound infection. All cases treated according to culture and sensitivity with local wound drainage and antibiotic injection.

Overwhelming post-splenectomy (OPSI) infection is a serious condition following splenectomy and its incidence may be up to 2%. Infection occurred by capsulated bacteria and it is usually fatal in 70% of cases complained of this problem [19]. Post-splenectomy vaccinations against the causative agents are available and are giver after 2 weeks of operation. [20] In the present study, no cases developed OPSI as all cases received polyvalent vaccines within 2 weeks after splenectomy and every 5 years till 25 years old.

Adhesive intestinal obstruction occurred in 8 cases in open approach and no one in laparoscopic approach. 6 cases responded to conservative treatment in the form of nothing per mouth nasogastric tube and adequate hydration. 2 cases not responding to conservative treatment with signs of strangulation that required re-exploration with resection and anastomosis of small bowel. one cases showed good outcome while the other developed fecal fistula 10 days postoperative and died of sepsis.

Conclusions

In hemodynamically stable patients with high-grade splenic injuries, laparoscopic splenectomy may be performed safely in the presence of experienced surgeons and anesthesiologists. Surgery is easy by using modern ligasure apparatus that decrease intraoperative blood loss and hence blood transfusion but it added more cost to the surgery in our study. Postoperative pain and hospital stay were higher in open group. Early complications as pancreatic fistula, wound infection as well as delayed complications as incisional hernia and ileus were more common in open than laparoscopic approach.

Abbreviations

CT - computed tomography scanning

Vs.: versus

Lap: laparoscopic

Limitations Of This Study

The role of laparoscopy in splenic trauma is needed to perform on larger number of cases. Another limitation we faced in this study is the availability of experienced anesthesia team to control hemodynamicality of the patients in emergency units all the time. Also, the short follow up period for the last cases to detect adhesive intestinal obstruction and OPSI. (1.5 years)

Declarations
Contributions of the Authors:

All the authors shared important intellectual content in study design, data analysis, written and critical revision. The version they submitted shared in their final approval.

INTEREST CONFLICT: It is not declared.

Availability of data and material statement: The datasets generated and/or analysed during the current study are not publicly available but are available from the corresponding author on reasonable request.

The Registration Registered quality control review criteria for clinicaltrials.gov protocol: NCT04329845 registered retrospective 01/04/2020.

Ethics approval:

Faculty of Medical Ethical Committee Zagazig University gave us all the ethical agreement.

The described work has been carried out for human experiments in accordance with the World Medical Association's Code of Ethics (Helsinki Declaration).

The work has been reported in line with consolidated standards of reporting trials (CONSORT) guidelines.

Consent for participation and publication: after the study was included, all involved persons gave their informed written consent for participation and publication.

Conflict of interest: no

funding conflict: 'Not applicable'

Acknowledgements: 'Not applicable'

References

1. Aubrey-Bassler FK, Sowers N. 613 cases of splenic rupture without risk factors or previously diagnosed disease: a systematic review. BMCEmerg Med 2012;12:11.

2. Poletti PA, Mirvis SE, Shanmuganathan K et al. Blunt abdominal trauma patients: can organ injury be excluded without performing computed tomography? J Trauma 2004; 57(5): 1,072–1,081.

3. Gutierrez G, Reines HD, Wulf-utierrez ME. Clinical review: hemorrhagic shock. Crit Care 2004;8:373 – 81.

4. Schurink GW, Bode PJ, van Luijt PA, et al. The value of physical examination in the diagnosis of patients with blunt abdominal trauma: a retrospective study. Injury 1997;28:261–5.

5. Schneir A, Holmes JF. Clinical findings in patients with splenic injuries: are injuries to the left lower chest important? Cal JEmergMed 2001;2:33 – 6.

6. Barquist ES, PizanoLR, FeuerW, et al. Inter and intra rater reliability in computed axial tomographic grading of splenic injury: why so many grading scales Trauma 2004;56:334–8.
7. Federle MP, Griffiths B, Minagi H, Jeffrey RBJr. Splenic trauma: evaluation with CT. Radiology1987;162:69–71.

8. Moore EE, Moore FA. American Association for the Surgery of Trauma Organ Injury Scaling: 50th anniversary review article of the Journal of Trauma. J Trauma 2010;69:1600–1.

9. Marmery H, Shanmuganathan K, Alexander et al. Optimization of selection for nonoperative management of blunt splenic injury: comparison of MDCT grading systems. AJRAmJRoentgenol2007;189:1421–7.

10. Royal College of Radiologists. Standards of practice and guidance for trauma radiology in severely injured patients. Royal College of Radiologists, 2011.

11. Poulin EC, Thibault C, DesCoˆteaux JG, et al. Partial laparoscopic splenectomy for trauma: technique and case report. Surg Laparosc Endosc. 1995;5:306–310.

12. MELIS M.: Laparoscopic treatment of blunt splenic injuries: Initial experience with 11 patients. Surgical Endoscopy, Volume 21, Number 8, 1469, 2007.

13. VILLAVIENCIO R.T.and AUEAR J.A.: Analysis of laparoscopy in trauma. J. Am. Coll. Surg., 189 pp. 11–20, 1999.

14. Ermolov AS, Tlibekova MA, Yartsev PA, et al. Laparoscopic splenectomy in patients with spleen injuries. Surg Laparosc Endosc Percutan Tech. 2015;25:483–486.

15. Huscher CG, Mingoli A, Sgarzini G, et al. Laparoscopic treatment of blunt splenic injuries: initial experience with 11 patients. Surg Endosc. 2006;20:1423–1426.

16. Vejdan Seyyed Amirkazem and Khosravi Malihe. Randomized clinical trial of ligasure™ versus conventional splenectomy for injured spleen in blunt abdominal trauma. International journal of surgery 38(2017) 48–51.http://dx.doi.org/10.1016/j.ijsu.2016.12.036

17. Zafar SN, Onwugbufor MT, Hughes K, et al. Laparoscopic surgery for trauma: the realm of therapeutic management. Am J Surg. 2015;209:627–632

18. Yong F, Chen W, Lan P, et al. Applications of laparoscopic technique in spleen surgery. Eur Rev Med Pharmacol Sci. 2014;18:1713–1716

19. Lynn KN, Werder GM, Callaghan RM, et al. Pediatric blunt splenic trauma: a comprehensive review. Pediatr Radiol. 2009;39:904–16.

20. Leone G, Pizzigallo E. Bacterial infections following splenectomy for malignant and nonmalignant hematologic diseases. Mediterr J Hematol Infect Dis. 2015;7.

Figures
Figure 1

CT shows grade IV splenic injury.
Figure 2

laparoscopic view showing lacerated spleen

Figure 3

dissection of hilum of spleen with care to pancrease
Figure 4

ligation of the hilar vessel with hemoclip.
Figure 5

the first case converted to open approach due to uncontrolled bleeding from the hilum.
the 2nd case converted to open approach due to uncontrolled bleeding from the hilum.
Figure 7

the spleen is enclosed inside endobag

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- CONSORT2010Checklist1.doc