

INTRODUCTION

The first laparoscopic splenectomy was performed by Delaitre and Maignen in 1991. In 1992, Carrol, Philips, Semal, Fellas and Morgenstern of Cedars-Sinai medical center reported three cases of successful laparoscopic splenectomy. The first laparoscopic splenectomy in children was performed in 1993 by Tulman. Laparoscopic splenectomy first started in early 90s, but due to very high conversion rate it was not accepted by most of the laparoscopic surgeons. Now due to increased proficiency in the performance of laparoscopic procedures, conversion rate is now inexistent even with large spleens. To date, this procedure continues to be associated with a steep learning curve but remains very rewarding elegant procedure. The indications for this procedure have broadened and are now the same as with open procedures. They range from idiopathic thrombocytopenic purpura, unresponsive hemolytic anemia to staging procedures and to primary splenic cysts.

Laparoscopic splenectomy can be safely performed to treat certain conditions such as hereditary hemolytic anemias, autoimmune cytopenias, or symptomatic splenomegaly. One of the most common uses of elective splenectomy is for treatment of idiopathic thrombocytopenic purpura with severe thrombocytopenia that does not respond to a course of glucocorticoids.

Only contraindication of laparoscopic splenectomy is excessively large spleens with weight over 1,000 g. We personally believe that the maneuvers used to remove such large spleens do not warrant these procedures. One should always remember that by laparoscopic approach, the spleen cannot be removed in its integral anatomical form and is usually shredded. If there is any need to preserve splenic integrity, then laparoscopic approach is not indicated.

ANATOMY OF SPLENIC VASCULATURE (FIG. 1A)

For successful laparoscopic splenectomy, the surgeon should be familiar with the three-dimensional relations of the spleen and be conversant with the variations of the blood supply. The important anatomical aspects of the spleen are its vascularization and its great number of relationships with

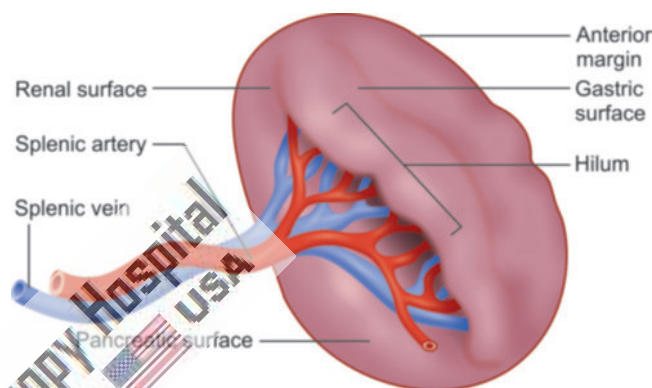


Fig. 1A: Splenic anatomy.

adjacent organs. The spleen being a reticuloendothelial organ is soft, friable and deserves careful handling by the surgeon as well as the assistants. Despite the fragility of the splenic parenchyma, its capsule is solid and can be manipulated without rupture if handled with care. Capsular tears can lead to bleeding, splenosis, and conversion into open.

Two types of splenic blood supply exist around spleen are magistral and distributed. Transverse anastomosis exists between the splenic artery branches. The gastrosplenic ligament contains short gastric and gastroepiploic vessels. The lienorenal ligament contains the hilar vessels and the tail of the pancreas. Other suspensory ligaments are avascular, except in portal hypertension and myeloid metaplasia. The tail of the pancreas lies within 1 cm of the inner surface of the spleen in 73% of patients. The tail of the pancreas is in direct contact with the spleen in 30% of patients. The size of the spleen does not determine the number of entering arteries.

The spleen has in essence a double blood supply: short gastric vessels and a main hilar vascular trunk. Although highly variable, splenic artery anatomy has been classified more simply into two patterns: (1) magistral and (2) distributed. The more common distributed type found in around 70% of the dissections and the magistral type found in the rest. By definition, in the distributed type, the trunk is short and many long branches enter over three-fourths the medial surface of the spleen. The branches originate 3-13 cm from the hilum. There are also accessory polar

vessels and anastomoses with gastroepiploic vessels. These anatomic details require that the surgeon be completely familiar with variable and anomalous extrasplenic vascular anatomy. The more the number of notches on the spleen, the more is a segmental distributed pattern of blood supply likely. Accessory spleens are more likely with this pattern of blood supply.

ADVANTAGES OF LAPAROSCOPIC SPLENECTOMY

Reasons to prefer laparoscopic splenectomy include the following:

- **Lower surgical mortality:** In a systematic review that included over 6,000 splenectomies for immune thrombocytopenia, laparoscopic splenectomy was associated with a mortality of 0.2% (3 of 1,301 patients) whereas laparotomy with an open procedure was associated with a mortality of 1% (48 of 4,955 individuals).
- **Shorter hospitalization and faster recovery:** One of the reviews from the National Surgical Quality Improvement Program (NSQIP) also evaluated length of hospital stay and found that this was approximately 2 days shorter with the laparoscopic procedures.
- **Reduced complications:** Long-term complications such as infection and venous thromboembolism (VTE) appear similar with open and laparoscopic splenectomy. In the perioperative period, individuals undergoing laparoscopic rather than open splenectomy have been reported to receive fewer transfusions. In a report from a high-volume center, the median blood loss was only 50 mL (interquartile range, 20–150 mL).

DISADVANTAGES OF LAPAROSCOPIC APPROACH

Settings in which an open procedure may be preferred include the following:

- Massive splenomegaly with concern about the ability to remove the spleen via a laparoscopic procedure.
- Local expertise favoring an open procedure or lack of support or equipment for laparoscopy.
- Ability to search more thoroughly for an accessory spleen.
- Cancer surgery or adhesion of the spleen to adjacent organs requiring laparotomy.

In some cases, laparoscopic splenectomy may need to be converted to an open procedure. The likelihood of this happening has been estimated to be in the range of 3–10%. Reasons for conversion included excess bleeding, technical problems, splenic size, and other abnormalities such as friability or infiltration of surrounding structures.

VACCINATION

Patients undergoing laparoscopic splenectomy should receive vaccinations against encapsulated organisms

(*Haemophilus influenzae*, *Pneumococcus*, *Meningococcus* species) in order to prevent overwhelming postsplenectomy infection (OPSI). Optimally, vaccinations should be administered 2 weeks prior to surgery. However, in emergent cases, vaccinations can be postponed until 1–2 weeks postoperatively.

OPERATING ROOM SETUP AND PATIENT POSITION

Patient is placed in supine and semi-right lateral position on the table although laparoscopic splenectomy can be performed either in the supine or right semi-lateral decubitus position. Surgeon stands to the right of patient (**Fig. 1B**). Operating table is flexed at approximately 30 degrees to increase space between the costal margin and iliac crest, and the patient is placed in semi-lateral position.

Semilateral position allows the spleen to hang by its diaphragmatic attachments, thus acting as a natural counter traction while gravity retracts the stomach, transverse colon, and greater omentum inferiorly, and places the hilum of the spleen under tension. Bean bag is used to secure patient position and all pressure points are padded. Camera operator stands to right side of the patient next to the surgeon toward right hand side of surgeon. Monitor is placed left to the patient and Mayo's stand is placed near the feet of the patient (**Figs. 2A and B**). Various steps of splenectomy shown in (**Fig. 3**).

Port Position

Port position should be decided according to baseball diamond concept depending on the size of spleen.

Operative Procedure

Laparoscopic splenectomy can be described in five steps:

Step 1: Dissection of the inferior aspect of the spleen.

Step 2: Dissection of the lateral and retroperitoneal attachments.

Step 3: Transection of the splenic hilum.

A 10-mm fan retractor is inserted and will lift the inferior aspect spleen superiorly. The tail of the pancreas should be identified. The splenorenal and colosplenic ligaments are divided with sharp dissection. The splenorenal ligament should be divided without Gerota's fascia. The gastrosplenic ligament containing the short gastric vessels are divided with an energy device. The dissection is continued superior and lateral to mobilize the entire spleen (**Figs. 4 and 5**). Search for accessory spleens is traditionally performed at the onset of the procedure. Common locations include the splenic hilum, gastrosplenic ligament, splenorenal ligament, and greater omentum. Accessory spleens can also be embedded in the pancreas.

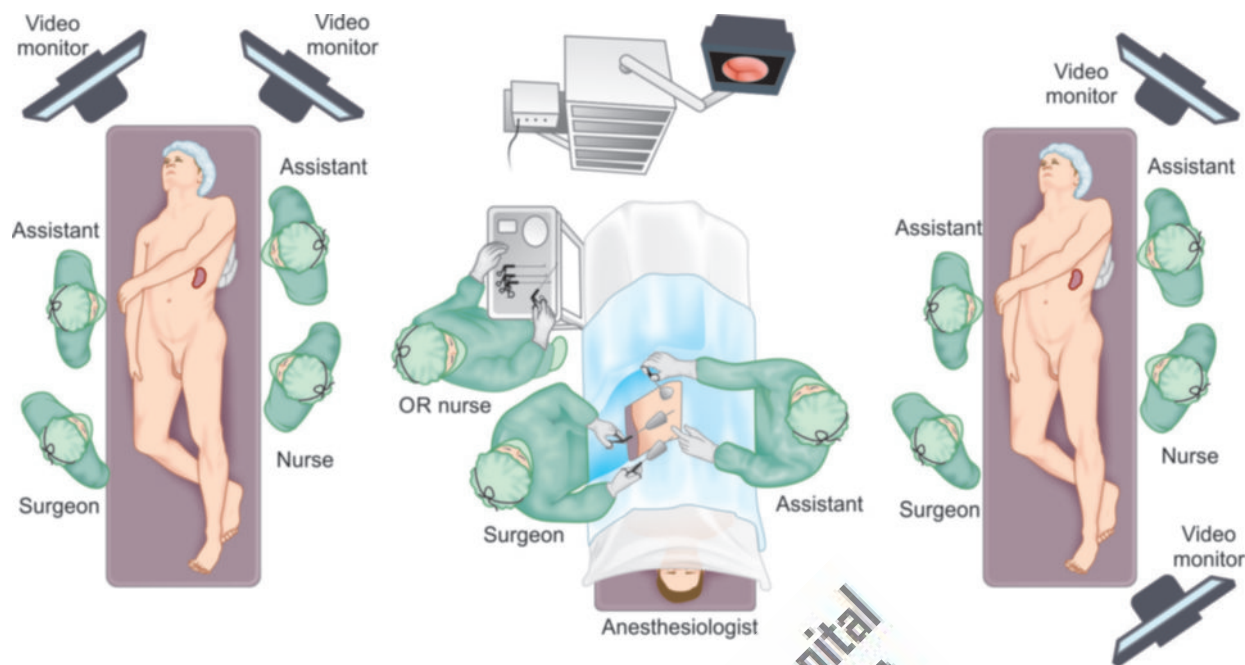
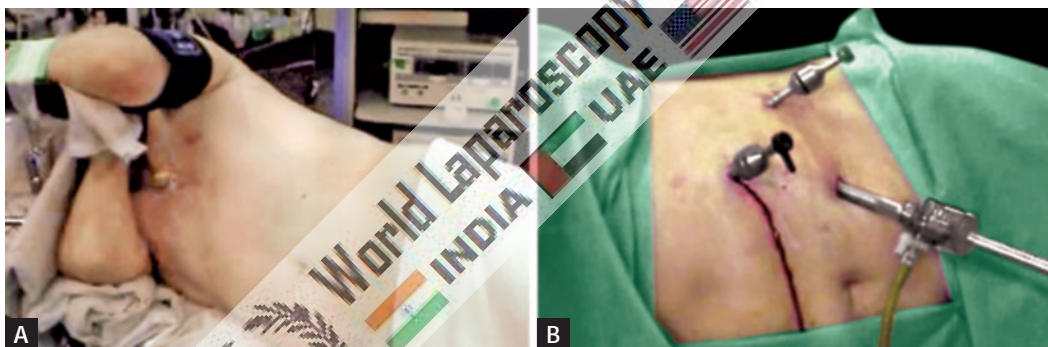


Fig. 1B: Position of surgical team.



Figs. 2A and B: Position of patient in laparoscopic splenectomy.

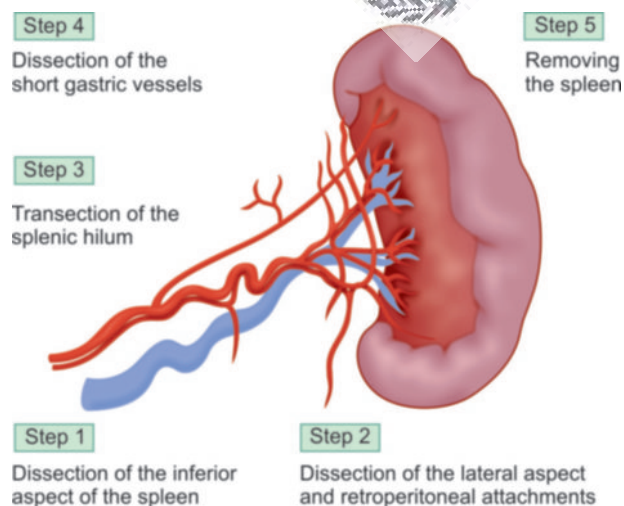


Fig. 3: Various steps of splenectomy.

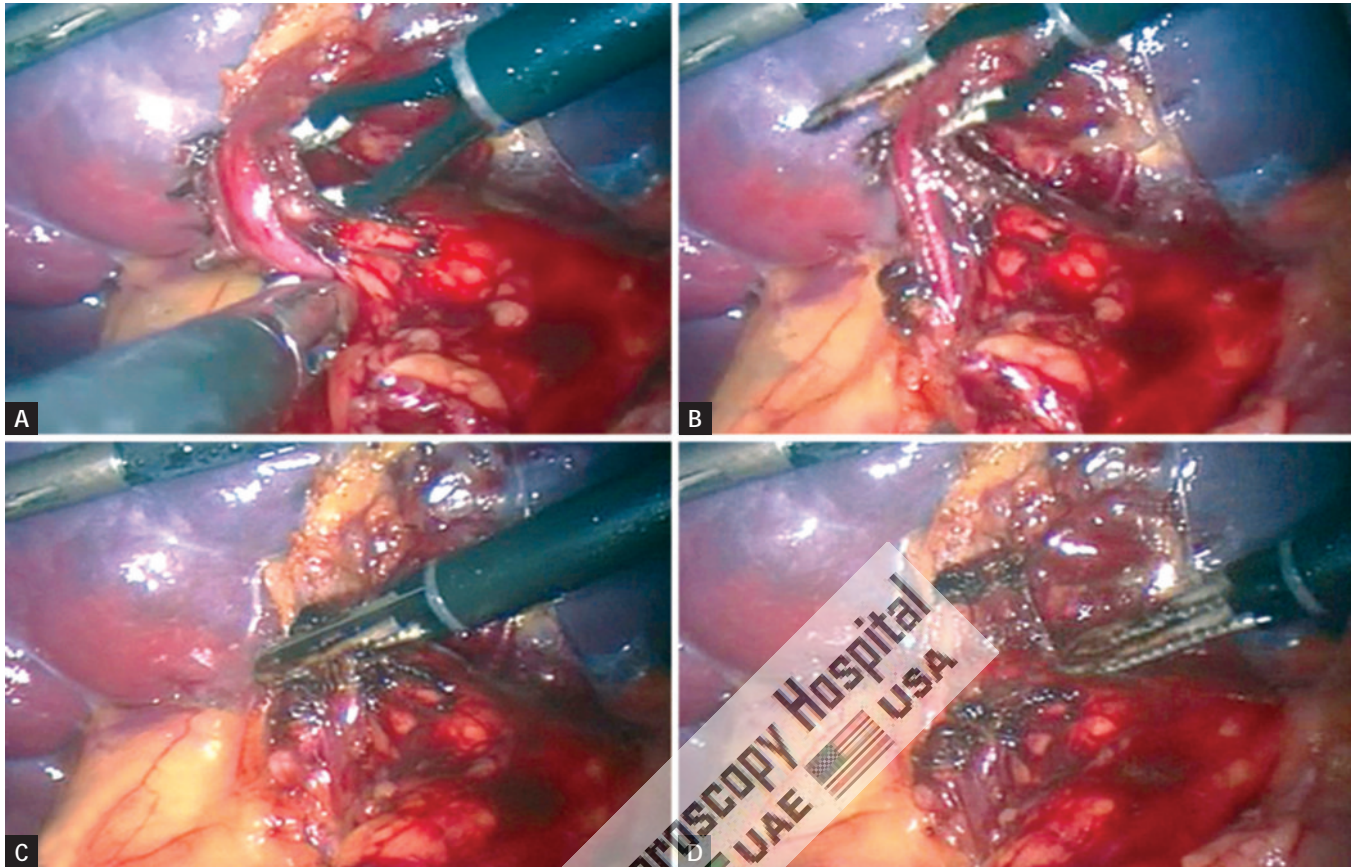
It is essential to continue our dissection posterior and inferior to the spleen as far as possible. Its purpose is to sufficiently expose the posterior aspect of the splenic hilum

(Fig. 6). The entire anterior aspect of the hilum should also be well-visualized (Figs. 7A to D).

Occasionally, the short gastric vessels will have to be first transected to gain additional exposure. While the assistant elevates and retracts the spleen, the hilum should be distinguished from the tail of the pancreas and an endoscopic linear stapler with vascular load should be used to divide the vessels.

Stapler is inserted and each jaw should be positioned anterior and posterior to the splenic vessels (Figs. 8A to F). Advances in linear stapling devices have enhanced laparoscopic splenectomy. In general, 2.5-mm vascular loads are sufficient for hemostasis, but 2.0-mm staple loads are used for thin pedicles and skeletonized vessels. A large spleen dictates an approach to the hilum through less than optimal port placement. The tail of the pancreas should be well visualized to avoid inadvertent injury at the time of firing stapler.

Step 4: Dissection of the short gastric vessels.



Figs. 7A to D: Dissection of splenic hilum.

which can develop as a complication of chronic hemolysis, such as with an inherited hemolytic anemia.

COMPLICATIONS OF LAPAROSCOPIC SPLENECTOMY

Surgical complications of laparoscopic splenectomy are similar to those for the open splenectomy.

Early complications include:

- Bleeding
- Pneumonia
- Left pleural effusions
- Atelectasis
- Injury to colon, small bowel, stomach, liver, and pancreas

Late complications include:

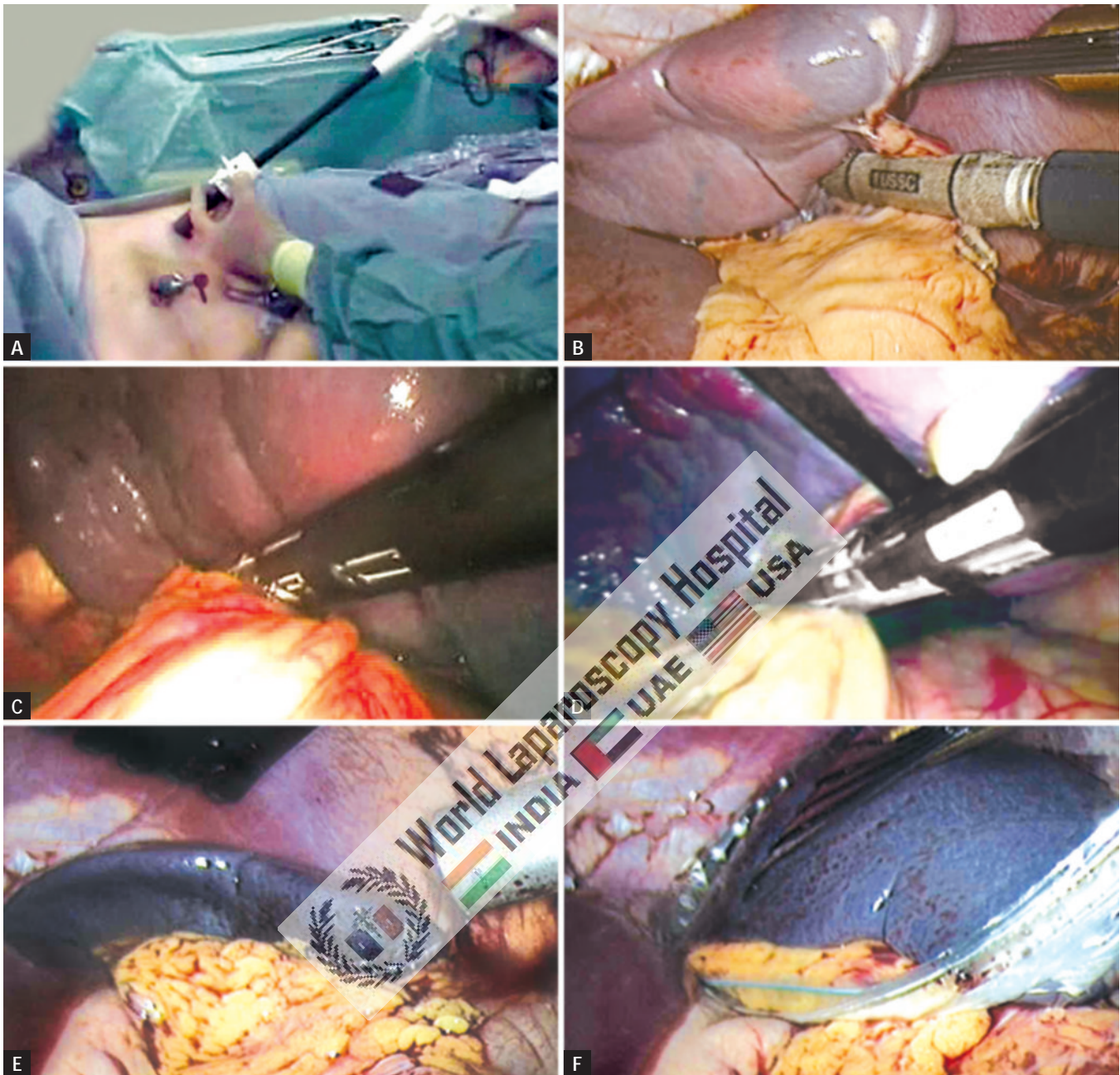
- Subphrenic abscess
- Splenic or portal vein thrombosis (or both)
- Failure of the procedure to control the primary disease
- Recurrent disease as a result of accessory spleens
- Overwhelming postsplenectomy infection

Independent of any complications inherent to laparoscopic surgery (LS) in general (e.g., related to pneumoperitoneum injuries from trocars), LS is associated with several potential perioperative complications that the surgeon should be aware of and be able to treat. The greatest potential problem is hemorrhage. Hemorrhage from a larger

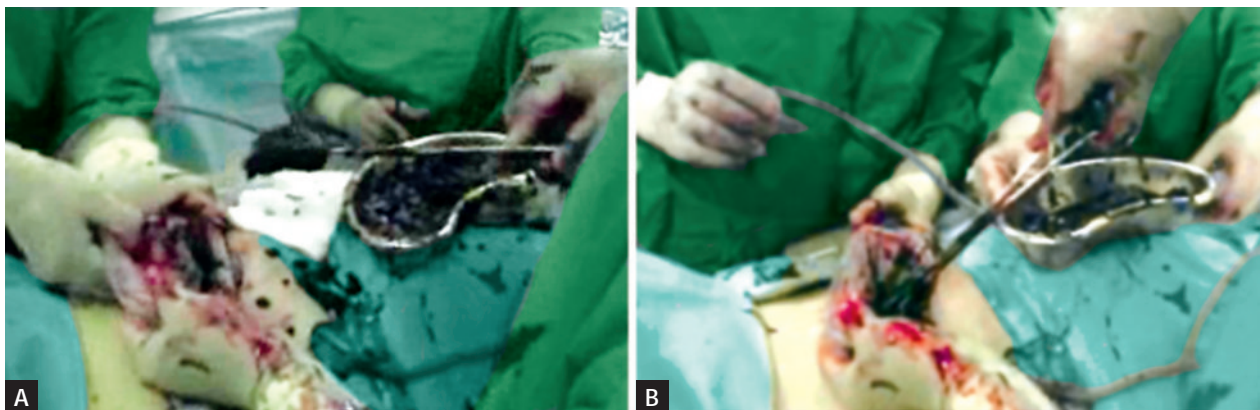
vessel may be an indication for immediate conversion to laparotomy. The best means for its prevention is delicate dissection of the artery and vein to prevent rupture of smaller splenic and pancreatic blood vessels. The dissected artery and vein should then be clipped prior to any movement of the spleen. Injury to these vessels can occur simply due to the rigidity of the clamping instruments. Hemorrhage originating in the parenchyma is less dangerous and can be managed by clamping the artery or by applying slight pressure with gauze, as well as by the use of electrocoagulation.

Another potential complication of LS is injury to the tail of the pancreas. Proper dissection and placement of the endostapler can avoid this problem. A further possible complication of LS is perforation of the diaphragm during dissection of the superior pole of the spleen. A small puncture may be quickly amplified by the presence of pneumoperitoneum, causing a pneumothorax. This can be controlled laparoscopically and by the use of a pleural drain. Other complications reported with LS include deep vein thrombosis, pulmonary embolus, and wound.

Rapid advances in minimal access surgery technology and improvement in noninvasive imaging tests, laparoscopic splenectomy is now being advocated for most of the patient. It has shorter operative time and recovery period and excellent cosmetic results as compared to the open splenectomy. Laparoscopic splenectomy though has a



Figs. 8A to F: Use of endo-gastrointestinal (GI) linear stapler or vascular stapler can make the laparoscopic splenectomy easy but many surgeon use extracorporeal knot as their main skill to secure splenic umenti.



Figs. 9A and B: Manual morcellation of the spleen inside endobag.




definite learning curve is not difficult if one has experience in open splenectomy. Advanced laparoscopic instruments such as harmonic scalpel, endoscopic vascular stapler, LigaSure[®], and good quality endobag aid the surgeons in removing spleen.




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

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Contact us

 World Laparoscopy Hospital
 Cyber City, Gurugram, NCR Delhi
 INDIA : +919811416838

 World Laparoscopy Training Institute
 Bld.No: 27, DHCC, Dubai
 UAE : +971523961806

 World Laparoscopy Training Institute
 8320 Inv Dr, Tallahassee, Florida
 USA : +1 321 250 7653