

Laparoscopic splenectomy: Consensus and debatable points

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Summary

Introduction. The emergence of minimally invasive techniques has broadened interest in splenectomy for a variety of haematological illnesses. Laparoscopic splenectomy (LS) is currently considered the gold standard for the treatment of various haematological disorders.

Purpose. The literature was reviewed to highlight points of consensus and debatable points regarding best practice in LS, looking at issues such as bleeding and conversion, splenomegaly, splenic retrieval techniques, types of instruments used, hand-assisted LS (HALS), complications, approaches, accessory spleen and splenosis. Our goal was to share our experience with LS and compare it with other reports.

Background. LS has emerged as the standard of care for elective splenectomy for benign haematological diseases. However, doubts have been raised regarding the suitability of patients with splenomegaly for LS. There is also uncertainty about its efficacy in major trauma. HALS has emerged as an option for safe manipulation and splenic dissection.

Method. We performed 25 consecutive LSs at King Abdullah University Hospital (KAUH), Jordan, from 2001 to 2008. Patient demographics, operative time, intra- and postoperative complications, conversion rate, additional procedures and length of hospital stay were retrospectively reviewed.

Results. The mean age of the patients was 38.8 years (range 11 - 77 years), mean operative time was 132 minutes (90 - 170 minutes), and length of hospital stay was 2.9 (standard deviation 2.7) days. One case was converted to open surgery (5%). There was 1 case of superficial wound infection in the series (5%), and no deaths.

Conclusion. LS is a well-accepted minimally invasive procedure, but knowledge and skill are required to perform it with minimal morbidity and mortality.

Splenectomy is an established therapeutic intervention for benign haematological disorders. Laparoscopic splenectomy (LS) has become accepted as an alternative to the open procedure. First described in 1991 by Delaitre *et al.*,¹ this technique became more popular after the introduction of newer instruments that made dissection easier, shortened operative time and decreased blood loss. Like other laparoscopic procedures, LS has proved to have advantages over open splenectomy (OS) with regard to aspects such as decreased postoperative pain, shorter hospital stay, faster functional recovery and a lower rate of complications (pneumonia and ileus).²⁻⁵ The spleen is located deep in the abdominal cavity, and laparoscopy improves exposure to it.^{6,7} Originally LS was considered ideal for normal-sized and mildly enlarged spleens, but nowadays it is being increasingly used in patients with splenomegaly.⁸ In most published papers the rate of conversion from a laparoscopic to an open procedure is reported as between 2% and 10%,^{4,9} with splenomegaly and bleeding the factors most commonly leading to conversion. Like laparoscopic cholecystectomy, anti-reflux surgery and gastric cancer procedures, LS is currently considered the gold standard and is used for the treatment of various haematological disorders.¹⁰⁻¹³

Materials and methods

Between the years 2001 and 2008, 25 elective LSs were performed at King Abdullah University Hospital (KAUH), Jordan, for a wide range of indications. Clinical data included patient age, sex, diagnosis, operation time, length of hospital stay and morbidity. The study was performed in collaboration with three consultant surgeons at KAUH.

Of the 25 patients, 18 (72%) were female and 7 (28%) male. The mean age was 38.8 years (range 11 - 77 years). The most common indication for surgery was idiopathic thrombocytopenic purpura (ITP) (17 patients, 68%), and there were 3 cases of spherocytosis (12%) and 2 of hydatid cyst (8%). The 3 remaining patients had chronic myelogenous leukaemia, myelofibrosis and sarcoidosis.

The pre-operative platelet count in cases of ITP ranged from 16 to 65×10⁹/l. All patients received meningococcal, pneumococcal and *Haemophilus influenzae* type B vaccines pre-operatively. Platelet and red blood cell transfusions were avoided unless the platelet count was less than 50×10⁹/l or the haematocrit less than 25%. Pre-operative assessment of spleen size was done by ultrasound and/or computed tomography (CT) scan. Three patients with symptomatic cholelithiasis underwent concomitant cholecystectomy.

The right hemilateral decubitus position was used in all cases, with the surgeon and the assistant on the right side of the patient. Four trocars were administered, as follows: a 10 mm peri-umbilical port was inserted using the Hasson technique (a 30° angled telescope was used), followed by insertion of a 12 mm port in the left flank and two 5 mm ports (one midway between the camera port and the epigastrium, and the other in the epigastrium used for retraction of the stomach and spleen as needed). All trocar positions were adjustable depending on the size of the spleen in relation to the size of the abdominal cavity. Dissection with an ultrasonic dissector (Ultracision LCS-5, Ethicon, Cincinnati, Ohio, USA) was commenced by mobilisation of the inferior pole of the spleen after division of the splenocolic ligament. Next, the short gastric vessels were cut after successful achievement of haemostasis. Finally the hilar splenic vessels were freed and divided with a 45 mm vascular linear stapler. The spleen was put in a plastic bag and extracted by fragmentation and passage through the orifice of the 12 mm port. Mini-laparotomy was performed through a midline incision in 3 cases. A drain was left *in situ* in all patients. Repositioning for cholecystectomy was necessary in 3 patients with gallstones, and an additional port was used.

Results

Mean length of hospital stay was 2.9 (standard deviation (SD) 2.7) days, and mean operative time 132 minutes (range 90 - 170 minutes). The mean spleen weight was 424 g (range 92 - 1 655 g). There were 6 cases (24%) of massive splenomegaly (>500 g). One case (5%) was converted to OS because of uncontrollable bleeding following application of a malfunctioning clip applicator on the splenic vein. Three cases of accessory spleen (15%) missed by the pre-operative CT scan were discovered at the beginning of the laparoscopic session and removed, 3 patients with symptomatic cholelithiasis had concomitant laparoscopic cholecystectomy without any additional morbidity, 1 patient had prolonged postoperative ileus that resolved after 3 days, and 1 patient had wound infection at the umbilical incision with no consequences. Ten of the 17 patients with ITP showed an immediate improvement in their platelet count, ranging from 314 to 455×10⁹/l. The remaining 7 patients' counts were almost back to normal in the second postoperative week. There was no mortality or recurrence in any of the treated patients in this series.

Discussion

Today LS is an established technique for treatment of various disorders of the spleen. However, there have been many technological advances since its introduction in 1991. We intended our review of the literature to highlight solid points

of consensus regarding the best practice in LS and state-of-the-art technology. In doing so, we touched upon issues such as bleeding, conversion, splenomegaly, splenic retrieval techniques, types of instruments, hand-assisted laparoscopic splenectomy (HALS), complications, approaches, accessory spleen and splenosis.

Bleeding risk during splenectomy is due to technical factors related to resection of a highly vascularised organ with thin-walled veins. The organ is difficult to remove and susceptible to bleeding due to tearing of the splenic capsule or venous branches near the hilum. Underlying thrombocytopenia is an additional problem in the majority of patients.¹⁴ The rate of conversion from laparoscopic to open splenectomy due to uncontrollable or massive bleeding is as high as 9%.^{15,16} Some investigators have suggested that the rate can be reduced by performing splenic artery embolisation to prevent staple line bleeding following LS.¹⁷⁻²⁰ This may also bring about an increase in the platelet count between arterial embolisation and the time of surgery. Takahashi *et al.*²¹ reported 5 cases of splenic artery embolisation 1 day before LS, and concluded that embolisation was a safe and useful adjuvant procedure to minimise bleeding. Others consider that pre-operative splenic arterial embolisation causes an inflammatory response in the hilum and compromises the integrity of the spleen and the splenic capsule, precipitating bleeding.² Furthermore, complications such as post-embolic pain, pancreatitis, atelectasis, pneumonia, pleural effusion and embolic material migration are known to occur after embolisation.^{16,18,22} These could be related to limitations in the radiologist's experience.^{20,23}

Other authors have suggested early ligation of the splenic artery as a means of controlling haemostasis. Palanivelu *et al.*²⁴ performed 120 LSs using the leaning splenic approach along with early ligation of the splenic artery, and their results indicate that this technique greatly reduces blood loss and speeds up the surgery. In our series, we performed early ligation of the splenic artery in most cases to decrease the incidence of bleeding. In 1 case conversion to an open procedure was required because of uncontrollable bleeding following application of a malfunctioning clip applicator to the splenic vein.

Splenectomy in patients with splenomegaly remains a challenge. Authors have used various definitions of splenomegaly according to weight and length. In terms of weight some define it as >500 g and others as >1 000 g,²⁵ while with regard to length some believe that the long axis of the spleen assessed by ultrasound or CT scan should be more than 15 cm and others that 22 cm is the minimum to define splenomegaly. Excessive size and length of the spleen may necessitate conversion to an open approach. Laparoscopic resection of a large spleen (>500 - 600 g)²⁶ has several inherent challenges, including limited working space, difficulty with retrieval and adherence to adjacent organs, which can potentially lead to trauma to enlarged veins or the splenic capsule, resulting in bleeding. Smith *et al.*²⁷ reported minimal blood loss and decreased morbidity in a small series of 7 patients with splenomegaly (450 - 3 500 g) treated by LS.

In a retrospective study on 108 patients with giant spleens (>1 000 g) Patel *et al.*²⁸ found that LS is feasible but that the benefits of the minimally invasive approach were often lost. Other studies reported that weights above 1 000 g were associated with higher conversion rates, increased morbidity,

prolonged operative time and vague benefits compared with OS.²⁹ The advantages of HALS are still under discussion. Although the maximum size of spleen that can be approached with a hand-assisted technique (hand port or pneumosleeve) remains unclear, it is extremely helpful to have a hand in the abdomen, working in concert with standard laparoscopic equipment. Many researchers cite the main advantages of the HALS approach as including expedition and facilitation of dissection, manipulation, retraction and bagging. In addition, with a hand in the abdomen the surgeon is able to maintain tactile sensation, and HALS may reduce intra-operative complications, decrease operative time and have minimally invasive benefits similar to those of conventional LS.

Kercher *et al.*³⁰ reported their experience in HALS for spleens of more than 22 cm in length or weighing more than 1 600 g. They documented a decrease in operative time with minimal blood loss. Hellman *et al.*³¹ described a series of 7 patients with massive splenomegaly (3 500 - 5 800 g), 6 of whom were successfully operated on using HALS techniques. In their preliminary study, Targarona *et al.*³² successfully performed 10 procedures for splenomegaly (average weight 1 616 g) using conventional LS. However, accessory incision was necessary for removal of the spleen, which was theoretically the same incision as for the hand port. Ailawadi *et al.*³³ compared 19 LSs with 22 HALSs in patients with spleens weighing >500 g. They found that HALS resulted in a significantly shorter operating time with no difference in morbidity, mortality or length of hospital stay. These studies along with others concluded that splenomegaly should not be considered a contraindication to conventional LS.

We operated on 6 patients whose spleens weighed more than 500 g. The case with the largest splenic weight (1 655 g) was converted to an open procedure, partly due to difficult dissection and manipulation and uncontrollable bleeding. Accordingly, our main technique in the current study depended on LS, keeping in consideration the need to apply HALS in certain cases.

Splenic retrieval in LS is technically demanding and imposes a significant challenge to the operating surgeon. A number of commercially available retrieval bags facilitate bagging of the spleen, such as Endocatch IITM (Autosuture, London, UK), E200TM (Espiner Ltd., Bristol, UK). The ideal retrieval bag should be easy to use and to keep wide open during the procedure, and strong enough to hold the spleen safely, allowing its morcellation without fear of tearing or causing damage to the surrounding organs, and without spillage or dissemination into the peritoneal cavity. Retrieval bags have been associated with perforation and cannot be used for large spleens. The alternatives described in the literature include extended trocar incisions, small midline or Pfannenstiel incisions, or a transvaginal approach.^{34,35} We had to do a mini-laparotomy in 3 cases by extension of the periumbilical incision to remove the massively enlarged spleen.

Another critical issue in LS is the different types of instruments used in dissection to ensure good haemostasis. Clips, sutures, monopolar-bipolar coagulation, ultrasonic coagulation, the linear stapler and a radiofrequency device (LigaSure) are all used, each device having its proponents and opponents.

The linear stapler (Endo-GIA II, Surgical Norwalk, Conn., USA) is currently used for *en bloc* transection of the

splenic pedicle, which requires accurate hilar dissection, skeletonisation of the vascular bed and application as close as possible to the spleen (within 1 cm from the splenic hilum). Improper positioning of the device may lead to inclusion of the pancreatic tail into the dissected specimen, leading to pancreatitis or pancreatic fistula. Furthermore, it is dangerous to insert the endovascular stapler blindly on the hilar vessels and to remove it without firing; this may lead to laceration of the thin-walled splenic veins, with subsequent bleeding.

LigaSure (Valleylab, Tyco Healthcare, Boulder, Colo.), a new vessel sealing system, employs an energy-based method that works by applying a precise pressure and bipolar energy to tissues. Gelmini *et al.*³⁶ reported on 63 LSs in which LigaSure was used as the only means of achieving haemostasis. They concluded that it is safe, effective, reduces blood loss, reduces operating time, and is a valid and a cheap alternative to the use of endostaplers.

Clips still have a role in LS, and there are various types. Grahn *et al.*² reported on 85 cases of LS using mainly locking haemoclips to control the skeletonised splenic hilar vessels.

The proponents of using endoloops claim that in their experience these provide effective control of bleeding from thin-walled veins and also make LS cost-effective.²⁴

Our routine practice is to use the harmonic scalpel for dissection and Endo-GIA for the splenic hilum for proper haemostasis.

As with any new procedure, the wide acceptance of LS is based on its simplicity and the ease with which it can be performed by the surgeon. Acceptance also depends on the rate of complications and the advantages offered by the procedure. Two large series^{37,38} analysed factors related to post-LS complications and found that advanced age, malignant neoplasms and large spleens are associated with higher rates of complications. In addition, the anterior approach was associated with more complications than the lateral one.

In investigating ways to minimise injury to the tail of the pancreas in LS (which occurs in 6 - 15% of cases),³⁹ Saber *et al.*⁴⁰ reported on the use of CT scan mapping of the tail of the pancreas in relation to the splenic hilum and considered it a valuable tool to minimise this complication. They found that the average distance from the tail of the pancreas to the splenic hilum was 3.42 (SD 1.5) cm (95% confidence interval 3.17 - 3.67). Such information could provide a rational base for suggesting a strategy to minimise the likelihood of injury to the pancreas during splenectomy.

A variety of approaches have been proposed for LS, including the anterior approach, the lateral approach (hanging spleen technique), and the semi-lateral approach (leaning spleen technique). However, there is no general consensus as to which is best, largely because each has its advantages and disadvantages. General guidelines for use of the anterior approach may include easier visualisation of the peritoneal cavity for staging purposes, easy performance of other surgical procedures, easy access to the lesser sac, and rapid conversion to an open procedure when needed. Advocates of the hanging spleen approach stress benefits such as enhanced retraction of the bowel necessitating less manipulation of the spleen, and achieving better exposure of the tail of the pancreas, lower-pole splenic vessels and splenic pedicle. Better ergonomics and easier control of the pedicle

in case of injury and haemorrhage have also been reported.²⁴

Accessory spleen and residual splenic tissue (splenosis) are common causes of relapse. Relapse rates for ITP and haemolytic anaemia after LS have been reported to be 16 - 25%^{10,41} and 0 - 30%,^{41,42} respectively.

Accessory spleen is found in 6 - 39% of reported cases in both OS and LS.⁴³ Splenosis may result from tearing of the splenic capsule, intra-operative spillage and implantation of splenic tissue or breaking of the retrieval bag. It is usually found in the splenic hilum, peritoneal spleen attachments, and greater and lesser omentum. Surprisingly, splenosis has been traced in the brain, indicating haematogenous spread of the splenic cells.⁴⁴ Port site splenosis was also reported by Kumar and Borzi.⁴⁵ Kirshtein *et al.*⁴⁶ reported on 3 cases in which heat-damaged Tc99m-labelled red blood cells with intra-operative gamma probe guidance were used to reduce the incidence of relapse, and they concluded that the use of intra-operative nuclear imaging can greatly aid localisation and confirm complete laparoscopic excision of nuclear focus. Others have suggested the use of CT scans and laparoscopic ultrasound hand-assisted devices.

Our practice is to detect accessory spleen by using a pre-operative CT scan as a guidance tool in addition to direct visualisation at the beginning of the laparoscopic session. In the current series we were able to detect 3 accessory spleens and remove them intra-operatively.

Conclusion

LS is a well-accepted minimally invasive procedure, requiring considerable knowledge and skills to perform.

REFERENCES

- Delaitre B, Maignien B. Splenectomy by the laparoscopic approach: report of a case. *Presse Med* 1991; 20: 2263.
- Grahn W Sarah MD, Alvarez III Jesus MS, Kirkwood K. Trends in laparoscopic splenectomy for massive splenomegaly. *Arch Surg* 2006; 141: 755-762.
- Glasgow RE, Yee LF, Mulvihill SJ. Laparoscopic splenectomy: the emerging standard. *Surg Endosc* 1997; 11: 108-112.
- Park A, Marcaccio M, Sternbach M, *et al.* Laparoscopic vs open splenectomy. *Arch Surg* 1999; 134: 1263-1269.
- Velanovich V. Laparoscopic vs open surgery: a preliminary comparison of quality-of-life outcomes. *Surg Endosc* 2000; 14: 16-21.
- Katkhouda N, Mavor E. Laparoscopic splenectomy. *Surg Clin North Am* 2000; 80: 1285-1297.
- Klingler PJ, Tsiotos GG, Glaser KS, *et al.* Laparoscopic splenectomy: evolution and current status. *Surg Laparosc Endosc* 1999; 9: 1-8.
- Targarona EM, Balague C, Ceradam G, *et al.* Hand-assisted laparoscopic splenectomy (HALS) in cases of splenomegaly: a comparison analysis with conventional laparoscopic splenectomy. *Surg Endosc* 2002; 16: 426-430.
- Walsh RM, Heniford BT, Brody F, *et al.* The ascendance of laparoscopic splenectomy. *Am Surg* 2001; 67: 48-53.
- Rosen M, Brody F, Walsh RM, *et al.* Outcome of laparoscopic splenectomy based on hematologic indication. *Surg Endosc* 2002; 16: 272-279.
- Schulze S, Thorup J. Pulmonary function, pain, and fatigue after laparoscopic cholecystectomy. *Eur J Surg* 1993; 159: 361-364.
- Hinder Ra, Filipi CJ, Wetscher G, *et al.* Laparoscopic Nissen fundoplication is an effective treatment for gastroesophageal reflux disease. *Ann Surg* 1994; 220: 472-481.
- Adachi Y, Suematsu T, Shiraishi N, *et al.* Quality of life after laparoscopic assisted Billroth I gastrectomy. *Br J Surg* 1999; 86: 541-544.
- Ohta M, Nishizaki T, Matsumoto T. Analysis of risk factors for massive intraoperative bleeding during laparoscopic splenectomy. *J Hepatobiliary Pancreat Surg* 2005; 12: 433-437.
- Poulin EC, Thibault C, Mamazza J. Laparoscopic splenectomy. *Surg Endosc* 1995; 9: 172-177.
- Poulin EC, Thibault C, Mamaza J, *et al.* Laparoscopic splenectomy: Clinical experience and the role of preoperative splenic artery embolization. *Surg Laparosc Endosc* 1993; 3: 445-450.
- Machado MA, Makdissi FF, Herman P, *et al.* Exposure of splenic hilum increases safety of laparoscopic splenectomy. *Surg Laparosc Endosc Percutan Tech* 2004; 14: 23-25.
- Kercher KW, Novitsky YW, Czerniach DR. Staple line bleeding following laparoscopic splenectomy: intraoperative prevention and postoperative management with splenic artery embolization. *Surg Laparosc Endosc Percutan Tech* 2003; 13: 353-356.
- Iwase K, Higaki J, Yoon HE. Splenic artery embolization using contour emboli before laparoscopic or laparoscopically assisted splenectomy. *Surg Laparosc Endosc Percutan Tech* 2002; 12: 331-336.
- Totte E, Van Hee R, Kloeck I. Laparoscopic splenectomy after arterial embolisation. *Hepatogastroenterology* 1998; 45: 773-776.
- Takahashi T, Arima Y, Yokomuro S, *et al.* Splenic artery embolization before laparoscopic splenectomy in children. *Surg Endosc* 2005; 19: 1345-1348.
- Poulin EC, Mamazza J, Schlachta CM. Splenic artery embolization before laparoscopic splenectomy: an update. *Surg Endosc* 1998; 12: 870-875.
- Flowers JL, Lefor AT, Steers J, *et al.* Laparoscopic splenectomy in patients with hematologic diseases. *Ann Surg* 1996; 212: 19-128.
- Palanivelu C, Kalpesh J, Vijaykumar M, *et al.* Early ligation of the splenic artery in the leaning spleen approach to laparoscopic splenectomy. *Surg Laparosc Endosc Percutan Tech* 2006; 16: 339-344.
- Boddy P, Mahon D, Rhodes M. Does open surgery continue to have a role in elective splenectomy? *Surg Endosc* 2006; 20: 1094-1098.
- Terrosu G, Baccarani U, Bresadola V, *et al.* The impact of splenic weight on laparoscopic splenectomy for splenomegaly. *Surg Endosc* 2002; 16: 103-107.
- Smith L, Luna G, Mery AR, *et al.* Laparoscopic splenectomy for treatment of splenomegaly. *Am J Surg* 2004; 187: 618-620.
- Patel AG, Parker JE, Wallwork B. Massive splenomegaly is associated with significant morbidity after laparoscopic splenectomy. *Ann Surg* 2003; 238: 235-240.
- Mahon D, Rhodes M. Laparoscopic splenectomy: size matters. *Ann R Coll Surg Engl* 2003; 85: 248-251.
- Kercher K, Matthews BD, Walsh RM. Laparoscopic splenectomy for massive splenomegaly. *Am J Surg* 2002; 183: 192-196.
- Hellman P, Arvidsson D, Rastad J. Handport-assisted laparoscopic splenectomy in massive splenomegaly. *Surg Endosc* 2000; 14: 1177-1179.
- Targarona EM, Espert JJ, Balague C. Splenomegaly should not be considered a contraindication for laparoscopic splenectomy. *Ann Surg* 1998; 288: 35-39.
- Ailawadi G, Yahanda A, Dimick JB, *et al.* Hand-assisted laparoscopic splenectomy in patients with splenomegaly or prior upper abdominal. *Surgery* 2002; 132: 689-694.
- Cordera F, Long KH, Nagorney DM. Open versus laparoscopic splenectomy for idiopathic thrombocytopenic purpura: clinical and economic analysis. *Surgery* 2003; 134: 45-52.
- Vereczkei A, Illeenyi L, Arany A, *et al.* Transvaginal extraction of the laparoscopically removed spleen. *Surg Endosc* 2003; 17: 157.
- Gelmini R, Romano F, Quaranta N, *et al.* Sutureless and stapleless laparoscopic splenectomy using radiofrequency. *Surg Endosc* 2006; 20: 991-994.
- Targarona EM, Esper JJ, Bombuy E, *et al.* Complications of laparoscopic splenectomy. *Arch Surg* 2000; 135: 1137-1140.
- Kavic SM, Segan RD, Park AE. Laparoscopic splenectomy in the elderly. *Surg Endosc* 2005; 19: 1561-1564.
- Chand B, Walsh RM, Ponsky J, *et al.* Pancreatic complications following laparoscopic splenectomy. *Surg Endosc* 2001; 15: 1273-1276.
- Saber AA, Khaghany K, Nirmal G, *et al.* Safety zone for splenic hilar control during splenectomy: a computed tomography scan mapping of the tail of the pancreas in relation to the splenic hilum. *Am Surg* 2007; 73: 890-894.
- Katkhouda N, Hurwitz MB, Rivera RT. Laparoscopic splenectomy: outcome and efficacy in 103 consecutive patients. *Ann Surg* 1998; 228: 568-578.
- Torelli P, Cavaliere D, Casaccia M. Laparoscopic splenectomy for hematological diseases. *Surg Endosc* 2002; 16: 965-971.
- Katkhouda N, Manhas S, Umbach TW, *et al.* Laparoscopic splenectomy. *J Laparoendosc Adv Surg Tech A* 2001; 11: 383-390.
- Rickert CH. A unique case of cerebral spleen. *Am J Surg Pathol* 1998; 22: 894-896.
- Kumar RJ, Borzi PA. Splenosis in a port site after laparoscopic splenectomy. *Surg Endosc* 2001; 15: 413-414.
- Kirshtein B, Lantsberg S, Hatskelzon L, *et al.* Laparoscopic accessory splenectomy using intraoperative gamma probe guidance. *Laparoendosc Adv Surg Tech A* 2007; 17: 205-208.