Laparoscopic splenectomy: lessons from the learning curve

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Objective: Initial reports suggest that laparoscopic splenectomy is a difficult procedure with a steep learning curve and limited scope. The objective of this study was to review various approaches to simplify the operation.

Design: A descriptive study of a prospective database.

Setting: A tertiary care teaching hospital.

Patients: Fifty-one consecutive patients, seen over a 4-year period, who underwent laparoscopic splenectomy (partial laparoscopic splenectomy in 1 patient) for a wide variety of disorders.

Interventions: Anterior and lateral surgical approaches to laparoscopic splenectomy and the selective use of preoperative splenic artery embolization.

Main outcome measures: Blood loss, morbidity, mortality and rate of conversion to open splenectomy, operating time and postoperative hospital stay.

Results: The morbidity (11%), death rate (2%), and rate of conversion were low. The recovery rate of accessory spleens was high (24%). Average operating time (3 hours), postoperative stay (3 days) and volume of blood loss improved with time.

Conclusions: Laparoscopic splenectomy is a reliable procedure for patients with spleens less than 20 cm long. For spleens 20 to 30 cm long, preoperative embolization is advisable, and the surgeon should be experienced. Laparoscopic splenectomy should not be performed for spleens more than 30 cm long. The lateral approach has eliminated most of the difficulty with this procedure for spleens less than 20 cm long (no embolization). The anterior approach is reserved for large spleens and partial laparoscopic splenectomy (with embolization).

Objectif : Les premiers comptes rendus indiquent que la splénectomie par laparoscopie est une intervention difficile, qui est difficile à apprendre et a une envergure limitée. Cette étude visait à revoir diverses façons de simplifier l'intervention.

Conception : Étude descriptive d'une base de données prospective.

Contexte : Hôpital d'enseignement de soins tertiaires.

Patients : Cinquante et un patients consécutifs reçus en quatre ans et demi qui ont subi une splénectomie par laparoscopie (splénectomie partielle par laparoscopie dans un cas) pour toutes de sortes de problèmes.

Interventions : Approches chirurgicales antérieure et latérale de la splénectomie par laparoscopie et d'utilisation sélective de l'embolisation de l'artère splénique avant l'intervention.

Principales mesures de résultats : Perte de sang, morbidité, mortalité et taux de conversion en splénectomie sanglante, durée de l'intervention et séjour à l'hôpital après l'intervention.

Résultats : La morbidité (11 %), le taux de mortalité (2 %) et le taux de conversion ont été faibles. Le taux de rétablissement des rates accessoires a été élevé (24 %). La durée moyenne de l'intervention (3 heures), et du séjour après l'intervention (3 jours) et le volume de la perte de sang se sont améliorés avec le temps.

Conclusions : La splénectomie par laparoscopie est une intervention fiable pour les patients dont la rate a

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moins de 20 cm de longueur. Dans le cas des rates de 20 cm à 30 cm de longueur, l'embolisation préparatoire est recommandée et le chirurgien devrait avoir de l'expérience. Il faudrait éviter la splénectomie par laparoscopie lorsque la rate a plus de 30 cm de longueur. L'approche latérale a éliminé la majeure partie de la difficulté posée par cette intervention dans le cas des rates de moins de 20 cm de longueur (sans embolisation). L'approche antérieure est réservée aux cas de rates de taille importante et de splénectomie partielle par laparoscopie (avec embolisation).

The field of laparoscopic surgery has recently progressed to include surgery of solid organs. In late 1991 and early 1992, Delaître and Maignien in Paris,[1] Carroll and associates in Los Angeles[2] and our group in Canada[3] published the first reports of laparoscopic splenectomy in patients with hematologic disorders. Laparoscopic splenectomy presents unique problems, such as having to deal with a fragile and richly vascularized organ situated close to the stomach, colon and pancreas, and having to devise an extraction strategy compatible with proper histologic confirmation of the disorder, while maintaining the advantages of minimal access surgery. After more than 4 years of experience with laparoscopic splenectomy, a review is warranted of the lessons learned and of the improvements in clinical results with this procedure.

Patients and methods

From March 1992 to September 1996, 55 consecutive patients were considered candidates for laparoscopic splenectomy. The mean age was 39 years (range from 13 to 77 years). Three patients who had spleens longer than 30 cm were excluded. One patient with thrombotic thrombocytopenic purpura was excluded after preoperative angiography revealed severely stenotic arteries and evidence of multiple small-vessel thrombosis in the renal, mesenteric and hepatic territories. Moreover, on venous return, most of the portal flow came from the splenic vein. With restricted arterial flow, splenectomy would have deprived the liver of a critical portion of its total blood flow; consequently, surgery was not recommended. Patients with splenic trauma, with 1 exception, were not considered candidates for laparoscopic management. All perioperative data were recorded prospectively in a longitudinal database. Statistical comparisons between population means were made using the independent sample's Student *t*-test and the Wilcoxon rank sum test; *p* values less than 0.05 were considered significant. A descriptive cohort of 51 patients constitutes the subject of this report.

Because most patients who undergo laparoscopic splenectomy suffer from hematologic disorders, preparation is the same as for open surgery, that is, steroids and gamma globulins when required. All patients received polyvalent pneumococcal vaccine before surgery. Ultrasonography is used to assess spleen size, measured as the joining line between the 2 organ poles. The 3 categories, according to size, were: normal spleen (less than 11 cm long), moderate splenomegaly (spleen 11 to 20 cm long) and severe splenomegaly (spleen more than 20 cm long).[4] Computed tomography (CT) was carried out, especially in patients with spleens longer than 16 cm, in whom ultrasonography can be inaccurate. Evaluation of spleen size by ultrasonography or CT was used to determine whether the anterior or lateral approach would be used. The radiologist was also asked to try to identify accessory spleens.

Preoperative splenic artery embolization was used as an adjuvant technique in some patients to make laparoscopic splenectomy possible and reduce blood loss. This technique in-

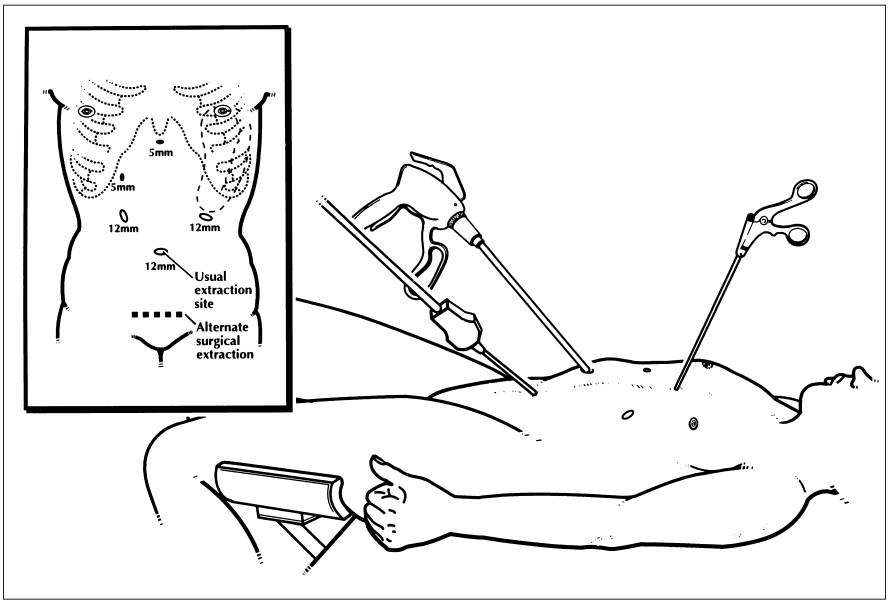

FIG. 1. Anterior approach to laparoscopic splenectomy: patient position, trocar placement and specimen extraction sites.

volves embolization of the spleen by placing coils proximally in the splenic artery and placing absorbable gelatin sponge fragments and small coils distally in each splenic arterial branch (double-embolization technique), taking care to spare vessels at the tail of the pancreas. This technique has been described previously.[5]

Operative technique

Laparoscopic splenectomy is performed through either an anterior or a lateral approach. For the anterior approach, the patient is placed in a modified lithotomy position to allow the surgeon to operate between the legs and the assistants to be on either side of the patient. Surgery is performed through 5 trocars (3 of 12-mm diameter and 2 of 5-mm diameter) in the upper abdomen with the patient placed in a steep Fowler position and left-side elevation. First, a search is done for accessory spleens. When these are found, they are removed immediately because they are much more difficult to locate once the spleen is removed. Then the phrenocolic and splenocolic ligaments and the sustentaculum lienis are incised near the lower pole using electrocautery through the left 12-mm port.[6,7] The gastrocolic ligament is carefully dissected close to the spleen, and the left gastroepiploic vessels are ligated one by one with metallic clips or simply cauterized if they are small. The upper or lower poles of the spleen are gently lifted with 1 or both palpators through the 5-mm ports to expose the splenic hilum and the tail of the pancreas within the lienorenal ligament. This facilitates individual dissection and clipping all the branches of the splenic artery and vein close to the spleen. The short gastric vessels then are identified and ligated with clips or occasionally with a stapler. No sutures are used (Fig. 1). This technique has not changed much since it was originally described.[3]

The lateral approach was first described for laparoscopic adrenalectomy.[8] The patient is put in right lateral decubitus position, similar to that used for left-side posterolateral thoracotomy. The operating table is flexed, and the bolster is raised to increase the distance between the lower rib and the iliac crest. Four 12-mm trocars are used around the costal margin to allow maximum flexibility for interchange of the camera and the instruments. Enough distance between trocars is required to preserve good working angles. There is some advantage in tilting the patient slightly backward, with support from a beanbag as this allows more freedom in moving the instruments placed along the left costal margin. For the same reason, it is also advantageous to place the anterior or abdominal side of the patient closer to the edge of the operating table. Usually, the fourth posterior trocar cannot be inserted until the splenic flexure of the colon is mobilized. Therefore, the procedure is started with 3 trocars.

The splenic flexure is partially mobilized by incising the splenocolic ligament, the lower part of the phrenocolic ligament and the sustentaculum lienis, allowing access to the gastrosplenic ligament, which can be readily separated from the lienorenal ligament in this position. Separating the gastrosplenic from the lienorenal ligament and its respective structures is the most productive manoeuvre of the lateral approach. The branches of the left gastroepiploic artery are controlled with cautery or clips. The avascular portion of the gastrosplenic ligament is then incised partially, enough to expose the hilar structures in the lienorenal ligament by gently elevating the lower pole. In this position, the spleen almost retracts itself as it naturally falls toward the left lobe of the liver. At this point, the surgeon usually can assess the geography of the hilum (magistral or distributed) and the degree of difficulty of the operation.[6] Then the fourth trocar is placed posteriorly under direct vision, taking care

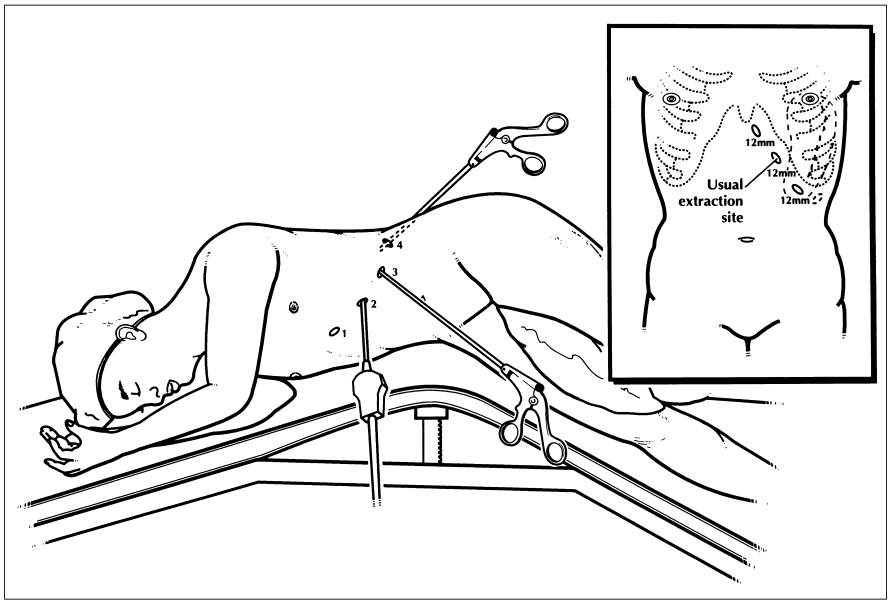

FIG. 2. Lateral approach to laparoscopic splenectomy: patient position, trocar placement and specimen extraction site.

to avoid the left kidney. Care must also be taken in placing the trocars situated immediately anterior and posterior to the iliac crest. This is because the iliac crest can impede movements to mobilize structures upward if the trocars are placed over it rather than in front and behind it (Fig. 2).

The tail of the pancreas is carefully dissected from the structures of the hilum in the areolar avascular tissue of the retroperitoneum. The tail of the pancreas lies within 1 cm of the hilum in 70% of cases.[9,10] When possible, a window is created above the hilar pedicle in the lienorenal ligament so that under direct vision all structures can be included within the markings of the linear stapler. Dissection continues with individual dissection and clipping of the short gastric vessels. Occasionally, these vessels can also be taken *en masse* with the linear stapler. This portion of the operation is performed while the spleen hangs by the upper portion of the phrenocolic ligament. At this point, the spleen is inserted in a plastic bag, as in the anterior approach; this step is simplified by preserving the upper portion of the phrenocolic ligament.

The spleen is extracted through one of the anterior ports by the same technique used in the anterior approach. Extraction through the posterior port is more difficult because of the thickness of the muscle mass, and requires opening the incision and fulgurating more muscle than necessary. After verification of hemostasis, trocar sites are closed with resorbable sutures and paper strips. No drains are used.

Extraction of specimens

A medium-sized or large heavy-duty "ziplock" plastic freezer bag that has been sterilized and folded is introduced into the abdominal cavity through 1 of the 12-mm trocars. The bag is unfolded and the spleen slipped inside to avoid splenosis during the subsequent manipulations. A biopsy specimen of a size suitable for pathological identification is obtained by incising the splenic tip. Subsequently, the spleen is fragmented with finger fracture, and the resulting blood is suctioned. The remaining stromal tissue of the spleen is then extracted through the umbilical trocar site with the anterior approach or through a subcostal trocar site with the lateral approach. It is rarely necessary to enlarge these incisions to more than 2 or 3 cm. Occasionally, for a spleen more than 20 cm long, a 7.5- to 10-cm Pfannenstiel incision is used, and the operator's forearm is introduced into the abdomen to deliver the spleen in the pelvis for extraction in large fragments under direct vision.[11] The abdomen is irrigated copiously before closure to avoid splenosis.

Special mention should be made of laparoscopic splenectomy for malignant disease. When lymphoma or Hodgkin's disease is suspected, preoperative splenic artery embolization or finger fragmentation in a plastic bag is not used for fear of making the histologic diagnosis difficult. Extraction of an intact spleen (when required) through a small Pfannenstiel, left subcostal or median incision to preserve tissue architecture has also been described. The various techniques of fragmentation and extraction of splenic tissue during laparoscopic splenectomy should be discussed and agreed on with the pathologist to ensure that proper pathological diagnoses are not compromised by necrotic tissue, as could occur in the case of preoperative splenic artery embolization or altered tissue architec-

Table I

Conditions Requiring Laparoscopic Splenectomy and Conversions to Open Splenectomy in 51 Patients

Condition	No. (and %) of patients
Successful surgery	
Immune thrombocytopenic purpura	28 (55)
Spherocytosis	5 (10)
Autoimmune hemolytic anemia	3 (6)
Chronic myelogenous leukemia	3 (6)
HIV/Lymphoma-related thrombocytopenia	2 (4)
Lymphoma	2 (4)
Chronic lymphocytic leukemia	1 (2)
Thrombotic thrombocytopenic purpura	1 (2)
Trauma	1 (2)
Converted surgery	
Enlarged spleen	
Lymphoma (34-cm spleen)	1 (2)
Myeloid metaplasia (26-cm spleen)	1 (2)
HIV-related thrombocytopenia (34-cm spleen)	1 (2)
Hemorrhage	
Immune thrombocytopenic purpura	1 (2)
Autoimmune anemia	1 (2)

HIV = human immunodeficiency virus

ture through finger fragmentation, especially if a diagnosis of malignant disease is suspected but not proven.

Postoperative care

The postoperative care of patients who have undergone laparoscopic splenectomy is usually simple. A nasogastric tube, inserted after induction of general anesthesia, is removed either in the recovery room after ensuring that the stomach has been emptied or the next morning, depending on the duration and technical difficulty of the procedure. The urinary catheter is usually removed before the patient leaves the recovery room. The patient is allowed to drink clear fluids on the morning after the operation and then allowed to proceed to a diet of his or her choice if the fluids are well tolerated.

Postoperative pain medication is individualized, with the aim of ensuring complete patient comfort. Initially, meperidine injections were used during the first night, followed by an oral acetaminophen/codeine preparation. More recently, when the patient has no history of ulcer or dyspepsia, a 100-mg suppository of indomethacin is inserted before induction of anesthesia and every 12 hours for 3 to 5 doses. Then, depending on the intensity of postoperative pain, meperidine injections are used for the first 12 to 24 hours followed by acetaminophen orally. This combination produces the best results. Because of codeine's side effects of nausea, vomiting, abdominal fullness and constipation, this drug is now avoided if possible. When indomethacin is used, prophylactic doses of heparin subcutaneously are empirically avoided, especially when the platelet count is low or if there is an abnormality of platelet function.

Patients who are covered by intravenous cortisone are given steroids orally on the first postoperative day after an overlap intravenous injection. Thereafter, steroids are gradually decreased. Patients are allowed to take showers 4 days after surgery and are advised to keep the paper strips covering trocar incisions for 8 to 10 days. No limitation of physical activity is imposed, and the patient is allowed to tailor activities to the degree of asthenia or discomfort experienced.

Results

Fifty patients underwent laparoscopic splenectomy for a variety of hematologic diseases, and 1 underwent partial laparoscopic splenectomy for trauma (Table I). In 5 patients (10%) the operation was converted to an open procedure, in 2 patients because of ongoing hemorrhage and in 3 patients for technical difficulties encountered while attempting to dissect large spleens: 2 of these were 34 cm long and 1 was 26 cm long. Accessory spleens were found in 11 (24%) of 46 patients who successfully underwent laparoscopic splenectomy. The diameters of the accessory spleens ranged between 5 mm and 4 cm; 1 patient had 2 accessory spleens. Mean operating time was 3 hours (range from 70 to 330 minutes). For the majority (28 cases) the procedures took less than 3 hours. The average operating time for the first 20 cases was 215 minutes and for the last 15 cases it was 138 min (Wilcoxon rank sum test, $p = 0.0002$). Five of the last 10 procedures were completed in 2 hours or less, all by the lateral approach, but no enlarged spleens were involved. Spleens longer than 20 cm took an average of 265 minutes of operating time (range from 190 to 300 minutes), spleens 11 to 20 cm long took 189 minutes (range from 105 to 330 minutes) and spleens less than 11 cm long required on average 158 minutes (range from 70 to 300 minutes). Four patients (9%) received blood in the perioperative period, 3 of whom had spleens more than 20 cm long that had been embolized preoperatively. Blood loss is shown in Table II. Twenty spleens that were approached anteriorly were extracted from the umbilical incision, 1 from a small (5 cm) subcostal incision and the 3 massively enlarged spleens from a 7.5- to 10-cm Pfannenstiel incision. In all 22 cases in which surgery was performed through the lateral approach, the spleens were extracted from an anterior subcostal trocar site.

Whenever possible, the spleen is placed in a plastic bag; however, to date, we have not been able to bag a spleen longer than 24 cm. A 27-cm spleen successfully removed laparoscopically was delivered into the pelvic cavity, where it was fractured and removed in large fragments. The pelvis

Table II

Blood Loss During Successful Laparoscopic Splenectomy (46 Patients)

Blood loss, mL	No. of patients
0–250	30
251–750	11
751–1000	3
> 1000	2

Table III

Length of Postoperative Stay After Successful Laparoscopic Splenectomy (46 Patients)

No. of days	No. of patients
1	2
2	19
3	16
4	3
5	2
6–9	4

was irrigated and the incision closed. The abdomen was reviewed for the presence of splenic fragments or accessory spleens. Spleen scans were negative at 1 and 5 months postoperatively, well exceeding the time when splenic function should be detected.[12]

During surgery, 1 patient required placement of a left chest tube because a small perforation was made in the diaphragm during dissection of fibrotic adhesions at the superior pole of the spleen, and 1 patient had some pulmonary edema caused by inadvertent fluid overload by the anesthetist. One patient (2%) with a 6-year history of chronic myelogenous leukemia and a 24-cm spleen died of uncontrolled rapid-onset septic shock on the sixth postoperative day. No hemorrhagic complications occurred in the immediate postoperative period that required surgery. Five (11%) of the 46 patients who had successful laparoscopic surgery experienced postoperative complications: 1 had prolonged ileus, 3 had respiratory complications (atelectasis/pleural effusion), and 1 had septic shock. Two of the 3 pulmonary complications were believed to be related to the preoperative embolization procedure. These 2 patients complained of severe pain after the embolization procedure; in both, microspheres or gelatin foam powder had been used. One patient required drainage of a symptomatic pleural effusion and also had abdominal pain and fever 4 months after surgery. A 20-mL sterile collection in the splenic fossa was drained with use of CT-guided needle aspiration. Another patient, who left the hospital on the seventh postoperative day, experienced abdominal pain and fever of undetermined origin; investigation for sepsis was negative. The low-grade fever persisted for several days at home and then disappeared without specific treatment. Gelatin foam powder had been used for her preoperative splenic artery embolization procedure. Microspheres and gelatin foam powder have not been used since for embolization.

The overall mean postoperative stay was 3 days (range from 1 to 9 days [Table III]). For the first 10 patients the mean stay was 3.5 days (range from 2 to 9 days) and for the last 10 patients it was 2 days (range from 1 to 3 days) ($p = 0.03$) . The last 6 patients operated on for immune thrombocytopenic purpura were investigated as outpatients and admitted on the morning of surgery; their overall stay ranged from 1 to 3 days. Twenty-seven patients (54%) had a distributed-type blood supply and 20 a magistral-type. In 4 patients the type of blood supply was not known. Eighteen spleens were less than 11 cm long (range from 7.7 to 11 cm, average 9.72 cm), 25 were moderately enlarged (range from 11 to 19.5 cm, average 13.5 cm) and 3 were massively enlarged (23, 24 and 27 cm). Spleen size for patients who had conversion from laparoscopic splenectomy to open splenectomy is shown in Table IV.

Table IV

Conversion of Laparoscopic to Open Splenectomy According to Spleen Size

Spleen size, cm	No. of patients	Conversion to open surgery, no. (%) of patients
< 20	45	2 (4)
20–30	4	1 (25)
> 30	2	2 (100)

Discussion

The results of laparoscopic splenectomy have been satisfactory since it was first carried out, despite problems related to the learning curve of the surgical procedure and of preoperative splenic artery embolization.[3,5,13] Results have tended to improve with time and experience, and the spectrum of splenic problems tackled by laparoscopy is also widening. We now prefer the lateral approach for laparoscopic adrenalectomy (described by Gagner and associates[8]) to remove spleens that are of normal size or moderately enlarged. We no longer use preoperative splenic artery embolization for these cases because of our increased experience and because of this improved surgical approach. The lateral approach permits dissection of the splenic vessels in the relatively avascular areolar tissue of the retroperitoneum, an easier access route than the anterior approach. It also virtually eliminates inadvertent trauma from the instruments, usually held by assistants to lift the lower pole of the spleen, as in the anterior approach. In the lateral approach, little force is needed to retract the spleen. Gravity is almost all that is required, as the spleen will fall naturally toward the left lobe of the liver and out of the way, permitting identification of the vessels and the tail of the pancreas after the lower portion of the phrenocolic ligament is sectioned. With use of this approach, it is much easier to distinguish and separate the gastrosplenic and lienorenal ligaments and to identify the anatomic structures they contain; the branches of the gastroepiploic artery and the short gastric ves-

sels are within the gastrosplenic ligament, and the tail of the pancreas, splenic artery and vein lie within the lienorenal ligament. After taking the ligaments at the lower pole, gently lifting the splenic tip creates a tent-like configuration in which the 2 separated ligaments form the "walls" of the tent. This is the single most important manoeuvre for simplifying laparoscopic splenectomy. It is then easy to create windows safely through the ligaments to place clips or staples, especially above the tail of the pancreas which is more accessible, particularly in its superior and posterior aspect, than in the anterior approach. Finally, refraining from cutting the last portion of the phrenocolic ligament at the end of the procedure allows more room in this position to insert the spleen into a plastic bag before extraction. All these advantages translate into a procedure that can take 30 to 60 minutes less to perform than the anterior approach.

The anterior approach does have some advantages. It is probably better suited to a situation in which concomitant surgery is needed, cholecystectomy for example, and is theoretically better suited to search for accessory spleens, especially in the pelvis, the area of the right colon and the small-bowel mesentery. However, this latter situation may be more theoretic than real, as the literature states that more than 80% of the accessory spleens are located in areas accessible to the lateral approach. Moreover, in the present series, accessory spleens were found in 27% of patients (6 of 22) successfully operated on using the anterior approach and 21% (5 of 24) using the lateral approach. These rates compare favourably with the 15% to 30% rate cited in the literature for open splenectomy.[14,15] A recent report of 8 cases of recurrent hematologic disease after splenectomy that resolved only after removal of accessory spleens serves as a reminder that searching for and excising accessory spleens is an essential step in this procedure, regardless of whether the access is conventional or laparoscopic.[16]

We now use the anterior approach and preoperative splenic artery embolization for massive splenomegaly and partial laparoscopic splenectomy. Massive splenomegaly is defined as a spleen with an interpole length greater than 20 cm by ultrasonography or one that weighs 1000 g or more. Attempting to remove spleens of this size laparoscopically presents problems related mostly to the size of the organ in relation to body habitus. The spleen is large and heavy to manipulate. Its blood vessels are impressive, and the danger of serious hemorrhage is always present. For these reasons, properative splenic artery embolization is used before attempting to remove a large spleen laparoscopically.[5] Similarly, for open splenectomy, preoperative splenic artery embolization reduces operative blood loss and perioperative morbidity for massive splenomegaly.[17,18] Also, finding a sensible way to retrieve the specimen presents an important challenge. The Pfannenstiel incision is the least traumatic alternative we have used to extract 3 spleens more than 20 cm long. In the present series, the conversion rate in relation to spleen size is indicative of these problems (Table IV). Although we have described the laparoscopic technique used to remove spleens up to 27 cm and 1785 g, we believe that with current technology this is probably the upper size limit for which the laparoscopic approach has any chance of success. Attempts to remove spleens longer than 30 cm laparoscopically are probably unwise.

We also successfully used splenic artery embolization to occlude the superior polar artery in a patient who had sustained traumatic fragmentation of the superior pole from a skiing accident, and were able to perform a successful partial laparoscopic splenectomy.[19] In the future, partial laparoscopic splenectomy may have a role in the treatment of benign solid or cystic lesions of the spleen and some cases of isolated splenic trauma.

The low conversion rate (4%) for spleens less than 20 cm long is partly owing to our use of preoperative splenic artery embolization during our learning curve (i.e., for 22 of the first 24 patients, all were operated on

Table V

Reported Postoperative Morbidity and Mortality of Open Compared With Laparoscopic Splenectomy

Series	No. of patients, %	Morbidity, %	Mortality, %
Open splenectomy			
Ly and Albrechtsen, 1981[22]	221	22	3.6
MacRae, Yakimets and Reynolds, 1992[23]	142	22	6
Ziemski et al, 1987[24]	688	51	4.7
Malmaeus et al, 1986[25]			
Overall	167	42	5
Autoimmune disorders	52	19	6
Laparoscopic splenectomy			
Flowers et al, 1996[20]	35	11.4	4.7
Present series	46	10.8	1.9

through the anterior approach). It is also partly owing to the use of the lateral approach in the latter half of this series. Of the last 27 patients, 24 were operated on through the lateral approach, and only 1 required conversion to open surgery. The 3 remaining patients were operated on for large spleens through the anterior approach and sustained preoperative embolization. We believe that our low overall (10%) and size-related conversion rate is explained by these 2 factors and stands in contrast to the 19% conversion rate reported in 2 recent series of laparoscopic splenectomy.[20,21]

Flowers and associates,[20] reporting on a significant clinical experience, suggested that laparoscopic splenectomy can be performed with a good outcome, yet maintain the traditional advantages associated with minimally invasive surgery. Our combined results serve as preliminary clinical indicators that decreased mortality and morbidity and better overall outcome may be associated with laparoscopic splenectomy for a wide variety of disorders (Table V[20,22–25]); however, these clinical, descriptive studies of open and laparoscopic splenectomy are not entirely comparable.[22–25] Poorer outcomes have been demonstrated in series of open splenectomies that include more patients with massive splenomegaly and myeloproliferative disorders. Now that sufficient clinical experience has eliminated the learning curve bias from laparoscopic splenectomy, these preliminary favourable clinical observations need to be confirmed through prospective, randomized studies.

Conclusions

Laparoscopic splenectomy is our preferred technique for patients with spleens less than 20 cm long. The conversion rate should be about 5%. Morbidity is low and hospital stay is short.

The lateral approach should be used without prior embolization for spleens less than 20 cm long. This reduces operating time by 30 to 60 minutes. The anterior approach is reserved for spleens more than 20 cm long or when concomitant surgery is required.

Laparoscopic splenectomy for massive splenomegaly (more than 20 cm long or weighing more than 1000 g) requires experience. Preoperative embolization is advisable. The conversion rate was 25% for spleens 20 to 30 cm long.

Laparoscopic splenectomy for spleens more than 30 cm long is probably futile at present (100% conversion rate).

Partial laparoscopic splenectomy with prior segmental embolization has been performed safely.

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