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SURGICAL TECHNIQUE

TECHNICAL DEVELOPMENTS AND A TEAM APPROACH LEADS TO AN IMPROVED OUTCOME: LESSONS LEARNT IMPLEMENTING LAPAROSCOPIC SPLENECTOMY

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Background: To document the technical aspects, outcome and lessons learnt during the learning curve phase of implementing laparoscopic splenectomy, by comparing the results before and after the introduction of a standardized technique.

Methods: We present a retrospective and prospective review of laparoscopic splenectomies over a 4-year period. Two chronological periods were studied, before and after the implementation of a standardized technique of a laparoscopic splenectomy involving: (i) hilar dissection with ultrasonic shears; (ii) two experienced laparoscopic surgeons; and (iii) trained dedicated equipment and staff using a checklist approach in the preparation and conduct of the operation. Two groups of patients were studied relating to the periods before and after the implementation of a standardized technique. Statistical methods used were the Wilcoxon's rank sum test and the two-sample test.

Results: Thirty-one laparoscopic splenectomies were attempted. The most common indication was for idiopathic thrombocytopenic purpura. When comparing the early phase (n = 15) with the standardized technique phase (n = 16), there was a significant reduction in conversion rates (40% *vs* 6%), operating times (218 min *vs* 171 min), complication rates (6 cases including 1 death *vs* none) and length of stay (11 days *vs* 4 days). The results were significant for reduction in hospital stay, conversion rates and complications rates.

Conclusions: A reduction in conversion rates, operating time, morbidity and length of stay was realized during the learning curve of implementing laparoscopic splenectomy by adopting a standardized technique. This technique involved hilar dissection using the ultrasonic shears, two experienced laparoscopic surgeons performing the surgery, dedicated equipment and trained staff using the checklist approach. We recommend such a standardized technique in performing laparoscopic splenectomy.

Keywords: laparoscopy, splenectomy, splenosis.

Abbreviations: CT, computed tomography; ITP, idiopathic thrombocytopenic purpura.

INTRODUCTION

Laparoscopic splenectomy has been documented as a safe alternative to the open approach in several non-randomized trials.[1–7] As with most new procedures, an increased morbidity occurs in the learning phase of implementation.

The present paper presents the largest reported case series of laparoscopic splenectomies in Australasia (MEDLINE literature review), with the aims of documenting the technical developments and effects of a team approach during the learning curve phase of implementing laparoscopic splenectomy in a teaching hospital.

Thirty-one laparoscopic splenectomies were performed over a 4-year period. Indications, technical developments, outcome and lessons learnt are outlined and discussed in implementing this novel approach.

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METHODS

Patients

Between February 1995 and December 1998, 31 splenectomies utilizing the laparoscopic approach were attempted at the Monash Medical Centre, Clayton, Southern Healthcare Network, Victoria, Australia.

A retrospective and prospective review of patients records was performed and information documented. The median age was 35 years (range 19–82).

The indications for splenectomy are shown in Table 1. Patients with idiopathic thrombocytopenic purpura (ITP) were managed in conjunction with the haematologists. The management of profound thrombocytopenia was on established principles with a minority requiring perioperative platelet transfusion (6%), polyclonal antibodies (Intragam) and steroid cover.

The exclusion criteria were patients with massive spleens (greater than 20 cm in length on computed tomography (CT) scan), multiple previous abdominal surgery, significant obesity (body mass index > 35), and when a complete spleen was required for diagnosis. Preoperative abdominal CT scan was performed routinely to assess splenic size.

Preoperative vaccinations against capsulated bacteria (Pneumovax, Meningovax, Haemophilus vaccine) were routinely given.

Operative technique

The procedures were performed with the patient in the left lateral position on a Vac-pack (Olympic Medical) with a kidney bridge in position (Fig. 1). The table was extended and split to increase the space between the twelfth rib and the iliac crest. The video monitor was placed to the left of the patient with the surgeon and assistant working on the patient's right side. We later routinely had two surgeons experienced in laparoscopy working together on the patient's right (twin surgeon approach).

Under general anaesthetic, intravenous antibiotic prophylaxis and deep venous thrombosis prophylaxis were routinely administered.

Following establishment of pneumoperitoneum, four ports (one 5-mm and three 10-mm ports) were used as indicated in Fig. 2. Working ports were introduced and a search for accessory splenic tissue was conducted. Using a two-handed approach, the splenocolic ligament, followed by the gastrosplenic ligament and short gastric vessels were divided. The next step involved division of the gastrophrenic and lienorenal ligaments to completely mobilize the spleen. Gradual rolling of the spleen to the patient's right allowed visualization of the hilar vessels.

During the latter half of the study period, we routinely utilized the ultrasonic shears (Johnson and Johnson Endosurgery) for securing and dividing the short gastric vessels. Careful dissection was performed to exclude the tail of the pancreas. The splenic pedicle was stapled and divided with an endoscopic linear-cutting stapler (Autosuture EndoGIA II).

The spleen was placed in a specimen retrieval bag (Autosuture EndoCatch II) introduced via a 15-mm port, which replaced the previous 10-mm left subcostal port placed at the conclusion of securing the hilar vessels. The spleen was morcellated by finger fracture and extracted with ovum forceps, and submitted for pathology.

All cases had a splenic bed drain (low suction Exudrain; Astra, or Jackson-Pratt; Allegiance, Baxter) placed. Port sites larger than 10 mm were suture approximated to prevent port-site herniation.

A standardized technique involving dedicated laparoscopic equipment, specially trained nursing staff and a twin surgeon approach was adopted routinely in the last 18 months of the study period involving 16 cases. A checklist format similar to routines established in preflight checking by airline pilots was utilized by nursing staff when setting up for laparoscopic splenectomy.

Table 1. Indications for splenectomy

Indications	Cases
Idiopathic thrombocytopenic purpura	20
Spherocytosis	3
Haemolytic anaemia	4
Lymphoma	1
Subacute endocarditis	1
Thalassaemia	1
Splenic artery aneurysm	1

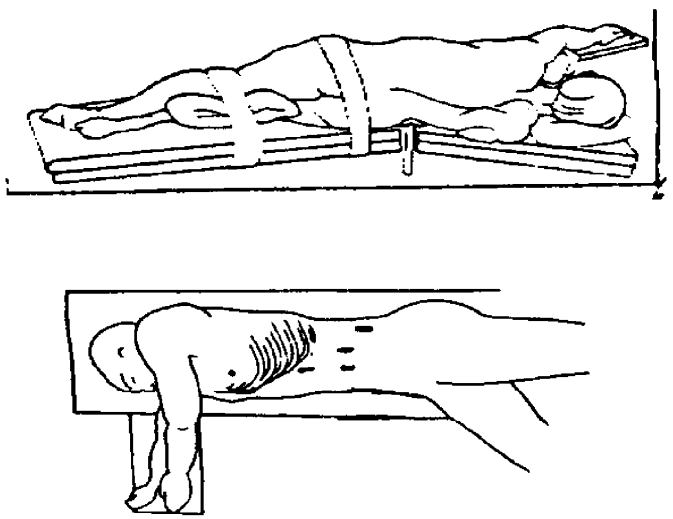

Fig. 1. Patient positioning.

RESULTS

Of the 31 cases selected for laparoscopic splenectomy, 24 cases (77.4%) had successful completion of the procedure laparoscopically. Seven cases (22.6%) had to be converted to an open splenectomy. There was only one conversion in the latter half of the series as opposed to six in the initial phase. The reason for the conversions were uncontrolled bleeding occurring during hilar dissection. A summary of the results is illustrated in Tables 2 and 3, documenting our initial experience with that of a standardized dedicated team approach in the latter half.

Two cases had combined splenectomy and laparoscopic cholecystectomy.

Overall mean operative time for successful laparoscopic splenectomy was 132 min (range 75–295 min), with mean operative time in the initial phase at 218 min, and in the latter half at 171 min. The average haemoglobin fall was 19.2 dg/L (19.1 dg/L in the initial phase and 14.8 dg/L in the latter phase). Seven cases (23%) each required transfusion of 2 units of blood. The average

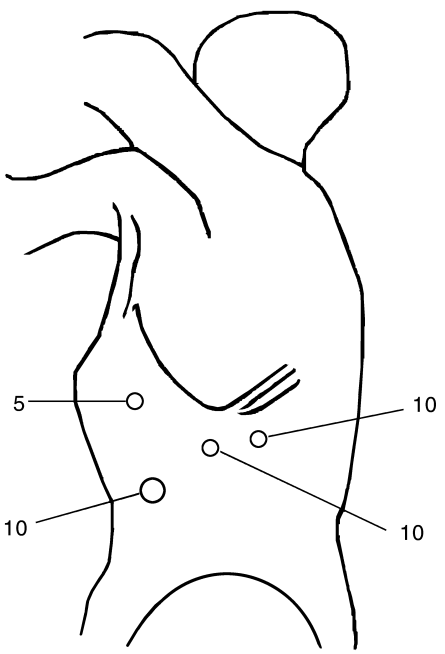

Fig. 2. Patient and port positioning; 5 and 10 indicate port size in millimetres.

weight for spleen in successful cases was 225 g. In the converted cases, the average splenic weight was 221.3 g.

All patients who had successful laparoscopic splenectomy were able to eat and drink the next day.

Postoperative analgesic requirements were limited to 3–4 doses of narcotic analgesia (range 50–75 mg Pethidine) in the immediate postoperative period. Parenteral narcotic was not required in any patient after day 2 following laparoscopic splenectomy. The immediate platelet response rate after splenectomy in our series was 85% (platelet rise of 150 000/μL without medical therapy).

Average length of hospital stay for all laparoscopic cases was 4.9 days (range 3–8 days). The average length of stay was reduced from 11 days to 4 days in the latter half of the study period.

The following complications occurred during the study period. These occurred during the early part of the series. One patient developed atelectasis and fever, which responded to intravenous antibiotics and chest physiotherapy, and the patient was discharged on day 5. One patient had a urinary retention, and another developed a pulmonary embolism, which prolonged her hospital stay.

In the converted cases, one patient developed an iliopsoas haematoma and two others developed paralytic ileus. One patient developed multiple complications with pneumonia, mild stroke and urinary retention.

There was a single death in the early phase of the series. A 76-year-old man underwent an attempt at laparoscopic splenectomy for unresponsive autoimmune haemolytic anaemia. During the procedure, uncontrolled haemorrhage was encountered during hilar dissection and the decision to convert to an open splenectomy was made. The splenectomy was completed successfully. On day 5, he developed a pancreatic fistula, with subsequent pancreatic tail necrosis and abscess formation confirmed on CT scanning. Despite relaparotomy, debridement and drainage, he continued to have sepsis unresponsive to medical measures and died in the intensive care unit on day 48 due to multiorgan failure.

Using the Wilcoxon's unpaired rank sum test and the two-sample test, the results were statistically significant for hospital stay ($P = 0.0043$), complication rates ($P = 0.0048$) and conversion rates ($P = 0.0247$) between the two periods. Length of operation was 41 min shorter in the latter period, but the difference was just statistically significant ($P = 0.0266$). The rest of the differences between the two periods were not statistically significant.

Table 2. Comparison between the groups before and after standardized technique

	Initial experience ($n = 15$)	Latter experience ($n = 16$)
Median age (years)	36	28
Male/female ratio	4:11	0:16
Indications		
Idiopathic thrombocytopenic purpura	9	11
Haemolytic anaemia	1	3
Spherocytosis	2	1
Lymphoma	1	0
Subacute endocarditis	1	0
Thalassaemia	0	1
Splenic artery aneurysm	1	0
Average weight of spleen (g)	214.5	239.2

DISCUSSION

Laparoscopic splenectomy was first reported in 1991 and has gained popularity since with many cohort studies and case series proving that laparoscopic splenectomy can be carried out safely and effectively with potential benefits to the patient.[1–5,8–20] However, to date, there has been a lack of level I and II evidence comparing the benefits and efficacy of laparoscopic and open splenectomy.[21] Reduction in postoperative pain, reduced hospital stay and early establishment of oral intake are some of the potential benefits of the laparoscopic approach.

The aims of this study were to evaluate the learning curve associated with the implementation of a standardized technique for laparoscopic splenectomy.

Technical developments such as the use of ultrasonic dissection for laparoscopic splenectomy have been previously documented.[19] However, the effect of a standardized technique using the twin surgeon and dedicated team approach on outcome has never been reported.

During the learning curve phase, a splenic size exceeding 20 cm as measured on CT scan was considered a contraindication, as we felt that it may compromise the safety of the patient and the success of the procedure. Other relative contraindications such as adhesions due to previous surgery and morbid obesity were considered on an individual basis. Dense adhesions can compromise the laparoscopic technique, but predicting adhesions due to previous surgery preoperatively has been shown to be difficult, with many authors advocating laparoscopy as the only reliable method to assess the severity of adhesions. The one premise is that an open technique such as the Hasson technique be used as the method of choice for peritoneal access in order to minimize iatrogenic injury. Morbid obesity may increase the level of difficulty of this technique, especially in the lateral position.

The lateral approach was adopted in all patients in the current series. The superior visualization of the hilum, gravity retracting

Table 3. Summary of results comparing our initial experience with that of a standardized approach in the latter period

Summary of details ($n = 31$ cases)	Initial experience ($n = 15$)	Latter experience ($n = 16$)
Conversion to open splenectomy	6 cases (40%)	1 case (6%)
Average operating time (range)	218 min (123–495)	171 min (115–205)
Average hospital stay (range)	11 days (3–66)	4 days (3–7)
Average haemoglobin drop	19.1 dg/L	14.8 dg/L
Length of parenteral narcotic requirement	3–4 doses within 48 h	3–4 doses within 48 h
Commencement of oral intake	Next day	Next day
Immediate platelet response rate (%)	86.6	85.7

the small intestine and omentum coupled with the spleen suspended by its attachment (the hanging spleen technique) allowed for easier access and dissection of hilar structures. Careful hilar dissection using a combination of ultrasonic division of short gastric vessels and stapling of the pedicle structures, lead to reduction in the risk of uncontrolled bleeding.

A limitation of a laparoscopic approach is inadequacy of visualization of accessory splenunculi. This has the unwanted consequence of recurrent thrombocytopenia. The compromised view due to patient positioning on the left lateral is thought to limit a thorough laparoscopy and, hence, there is a potential to miss any accessory splenunculi.[19] Alternatively, the supine position could be used.[5,8,10–14] The supine position may allow for better visualization for accessory splenunculi.[15]

Another possible limitation of the laparoscopic approach is splenosis due to inadvertent capsular breaching or spillage during extraction.[22] Although the incidence of splenosis following elective open splenectomy is rare,[22,23] and the immunorestorative effects of reimplanted splenic tissue is minimal,[15,24] the theoretical concern regarding the risk of splenic tissue spillage has contributed to some surgeons being reluctant to utilize the laparoscopic approach. We stress the importance of minimal direct handling of the spleen to avoid capsular breaches, together with the routine use of a tissue extraction device such as a purpose-built specimen bag to minimize splenosis.

The immediate response rate (rise in platelet count) following laparoscopic splenectomy for ITP in the current series, 85% is similar to other studies (76% to 95%) and is similar to the result of open splenectomy (71% to 93.1%).[16] There are concerns regarding higher long-term recurrence rate following the laparoscopic approach due to missed accessory splenunculi and splenosis. Follow up of recurrence rates of patients in the current series is not available, but will be the subject of a future communication.

The operating times for laparoscopic splenectomy were long in comparison with historical controls when open splenectomy was performed.[1–7] In the latter half of the study period, operating times were shortened as experience was gained and the team concept was implemented. The utilization of the ultrasonic shears to secure the short gastric vessels and to perform splenic mobilization has lead to a reduction in operating time partly due to reduced instrument exchanges. The use of ultrasonic shears is safer than electrosurgery, which carries unique adverse effects specific to the minimal access environment.[19]

Shortened hospital stay and reduced postoperative pain levels leading to a reduction in narcotic analgesic requirements with early commencement of oral intake has been previously described. Other less obvious potential benefits includes an earlier return to work, common to the minimal access approach.

Complications were encountered with the laparoscopic approach. The most significant problem was uncontrolled bleeding during the dissection of the splenic hilum. Blood interferes with the visualization of the surgical field due to absorption of light, and measures to control bleeding are limited with the minimal access approach. Hence, it was not surprising that uncontrolled bleeding was the primary reason for conversion to the open approach, especially in the early phase of the study.

One death occurred during the initial part of study period and was directly related to pancreatic tail injury at the time of hilar dissection. This highlights the fact that careful visualization of the tail of the pancreas is required at the time of hilar dissection. Some authors have argued against en-mass stapling of the hilar vessels to avoid the risk of inadvertent pancreatic injury, with its consequences of fistula formation.[15] An alternative technique has been advocated for securing the splenic vessels, which can be isolated individually and controlled.[15]

We routinely used a stapling technique (GIA) to secure the splenic vessels. Previous experience gained from advanced laparoscopic procedures coupled with a meticulous dissection technique to isolate the pancreatic tail proved to be safe.

In the latter half of the study period, advanced laparoscopic procedures were performed as a team with two experienced surgeons present at all operations. This was a result of the setting up of a dedicated minimal access unit within the teaching hospital. We believe that this twin surgeon approach in combination with dedicated nursing staff contributed to a reduction in morbidity as well as the success of laparoscopic splenectomy. This was reflected in lower conversion rate and morbidity, shorter operating time and hospital stay. The learning curve would have contributed to this to some extent, but, in the latter half of the study, some of the primary surgeons involved were new to the technique of laparoscopic splenectomy.

The laparoscopic approach can be a safe and effective method for selected patients requiring splenectomy as shown in this study, but there is a learning curve during which complications do occur. We therefore recommend that the combination of a standardized technique utilizing ultrasonic shears for hilar dissection and a team concept with two experienced surgeons, dedicated equipment and trained nursing staff using a checklist for implementing successful laparoscopic splenectomy.

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BOOK REVIEW

Statistical Methods in Medical Research, 4th edition. By P. ARMITAGE, G. BERRY and J. N. S. MATTHEWS. Oxford: Blackwell Science, 2002. Illustrated; xi + 817 pages. ISBN 0-632-05257-0 . Price (hardback) $193.60.

The authors are to be commended on this expanded, revised and radically reorganized edition of an already excellent work. It is not a course textbook, but rather a sourcebook for medical researchers lacking advanced mathematical expertize but able to follow algebraic formulae. The emphasis is on the concepts underlying formulae with frequent examples drawn from medical and epidemiological research. The range of topics included is very broad and therefore the coverage of some is necessarily brief and possibly a little terse in places. One encounters some undefined terms and concepts and passages that would make sense to a statistician but could be perplexing to a non-statistically trained medical researcher. Nevertheless, the breadth of coverage of both traditional and newly developing methods and the copious referencing make this an admirable guide to contemporary applications of statistics in biomedicine.

For users of earlier editions, some of the changes include a more homogeneous treatment of sampling variation and inference for means, proportions and other simple measures; an expanded discussion of methods for non-normal data; introduction of a much wider range of regression procedures including non-parametric and non-linear regression; a greatly expanded section on methods for categorical data; an integrated and amplified treatment of Bayesian methods; an enlarged review of experimental designs; a much enlarged discussion of the statistical aspects of clinical trials; a re-structured and considerably expanded chapter on epidemiological methods; and a new chapter on laboratory assays. However, these are only some of the more major changes. Throughout the book, much new material has been added and more minor alterations made, so that now the text alone extends to 741 pages plus standard statistical tables, extensive references, an author index and a very complete subject index. The numerous diagrams are clear and instructive, and the frequent examples are consistently helpful.

This excellent new edition covers a very wide range of topics and methods in contemporary medical statistics, both traditional and Bayesian, and is directed towards the practical needs of researchers, whether in laboratory work, clinical medicine, epidemiology, the pharmaceutical industry or public health. It also provides a conceptual introduction to new areas of statistics still under development, of which we may expect to see wider practical application in the future. It would be a useful addition to the personal library of any surgical researcher who ‘does their own statistics’, and certainly should be readily available in the institutional libraries of such researchers.

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