LAPAROSCOPIC SPLENECTOMY IN CHILDREN: EXPERIENCE AT THE ROYAL MEDICAL SERVICES

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ABSTRACT

Objective: The role of laparoscopic surgery in children continues to expand at rapid rate. Laparoscopic splenectomy is an example of the recent continued advancement. The purpose of the present study is to evaluate the feasibility, safety, and outcomes of patients undergoing laparoscopic splenectomy.

Methods: This is a retrospective study conducted during the period from January 1998 to December 2004. All children who underwent elective laparoscopic splenectomy were included in the study. Data on patient's demographics, indications for surgery, operative time, intraoperative events, surgical morbidity, time until regular diet was began, hospital stay, and time until return to daily activity were collected and analyzed to evaluate the feasibility and safety of laparoscopic splenectomy.

Results: A total of 21 patients underwent laparoscopic splenectomy. Indications for surgery were idiopathic thrombocytopenia, hereditary Spherocytosis, and splenic Hydatid cyst. Mean size of spleen was 12cm. Mean surgical time was 100 minutes and greater in the first 10 cases than the last 11. Accessory spleen was found in one patient with ITP. In two instances (9%) conversion to open splenectomy was necessary due to failure to progress in dissection, and a technical reason. Mean post surgical stay was two days. One patient developed lung atelectasis that was successfully treated. No long term complications were observed.

Conclusion: Our study clearly indicates that laparoscopic splenectomy is a safe and successful procedure in children. It offers the well-known advantages of minimal invasive surgery.

Key words: Laparoscopic, Splenectomy, Children

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Introduction

Following the rapid and wide acceptance of laparoscopic surgery as an alternative to conventional procedures in adult surgical disease and the early reports showed the feasibility of laparoscopy in children.[1,2] It is becoming more and more evident that with appropriate training and expertise, laparoscopic techniques can be applied safely and successfully to children for a wide variety of diseases with minimal morbidity and mortality.[1,2,3]

Nowadays the role of laparoscopic surgery in children continues to expand at rapid rate. It has been reported by Ure *et al*. and Davenport that sixty percent of the abdominal operations were performed endoscopically.[1,4] Some of the reasons for this rapid progress in this field include modern technology which has vastly improved the safety and efficacy of laparoscopic surgery, the availability of high quality laparoscopic smaller instruments, and the public enthusiasm for the potential benefit of minimal access surgery.[3,4,5,6] The list of pediatric endosurgical procedures being routinely performed is growing steadily and includes cholecystectomy, appendicectomy, nissen fundoplication, pull through for Hirschsprung's disease, and evaluation of cryptorchidism.[2,3,6]

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In the last few years laparoscopic splenectomy has been described by several investigators. We report our experience with laparoscopic splenectomy in children, the operative technique we applied and the influence of new the instruments on the selection of patients.

Methods

This is a retrospective study conducted at Queen Alia Hospital in Amman, Jordan during the period of January 1998 to December 2004. All children who underwent elective laparoscopic splenectomy were involved in the study. For each patient, baseline demographic data, together with details of diagnosis, indication for surgery, operative time, estimated blood loss, identification of accessory spleen, time until a regular diet was began, and length of hospital stay. Additionally each case was reviewed for perioperative and long term morbidity such as intestinal obstruction and incisional hernia. Data collected were analyzed to examine the feasibility, safety, and advantages of minimal access surgery observed in cases of laparoscopic splenectomy.

The preoperative preparation for laparoscopic splenectomy is the same as for patients under going open splenectomy. It includes preparation of blood in the form of packed red blood cells, abdominal ultrasound scan to assess the size of spleen, to look for accessory spleen, and gall bladder stones in patients with hemoglobinopathy that may require concomitant cholecystectomy. The patients were immunized with polyvalent vaccine against streptococcal pneumococcus and hemophilus influenzae. Pre-operative platelets infusion to increase platelets count to above 50,000 was done in certain cases, third generation cephalosporin were given at induction as a prophylactic antibiotic and a steroid was given if warranted.

The procedure was performed under general anesthesia, a nasogastric tube was inserted to decompress the stomach and the patient was placed into a 30^0 right lateral decubitus position. A supra umbilical incision was made and a 5mm port placed using a Hasson cut down technique. This port has been used for the introduction of 5mm video telescope. After pneumoperitonum was achieved a diagnostic laparoscopy was performed, including a thorough search for accessory spleen. An additional three ports were inserted under direct vision. A 5mm port was inserted in the epigastrium which was used for dissection. A 12mm port was inserted beneath the left sub-costal margin in the midclavicular line; it was used for hemoclips and Endo GIA stapling device application. A 5mm port was inserted beneath the right sub-costal margin in the midclavicular line; it was used for liver traction.

Dissection began at the lower pole of the spleen. The splenocolic and splenorenal ligaments were sharply incised using electrocautery scissors, and the vessels encountered were clamped with hemoclips and dissected. The splenic hilum was then dissected until the splenic vessels were visible. The End-GIA 30 vascular stapler was applied across the splenic hilar vessels and fired. The short gastric vessels were ligated with clips and divided. The superior and post-lateral attachments were divided with electrocautery and the spleen became ready for extraction. A plastic bag was then introduced into the abdominal cavity and the spleen was mobilized into it. The neck of the bag was exteriorized through the supraumbilical incision, and tissue was morcellated manually until the entire sac could be removed. Then the abdomen was carefully explored to ensure adequate hemostasis especially at splenic bed and pancreas. All trocars were removed under direct vision and the wounds were closed by closing facial layer firstly followed by skin, no drains were placed. Afterward, the nasogastric tube was removed. The patients were offered fluids on the evening of their surgery and usually had solids the following day. Most patients were discharged on the evening of the first post operative day, with a prescription for penicillin and analgesia.

Results

During the study period 21 patients underwent laparoscopic splenectomy. The patients mean age was eight years, with 11 (52%) male patients. The most common indication was idiopathic thrombocytopenic purpura (ITP) in 17 (81%) patients. Spherocytosis was the indication for surgery in three patients; one of them underwent associated cholecystectomy for gallbladder stones. The median size of the spleen was 12cm (range 9 to 20cm). Further analysis for demographic, clinical preoperative data and the indication for surgery are listed in Table I.

Table I. Demographic and clinical data and indication for laparoscopic splenectomy.

Age (years)	median	8
	range	4-14
Gender No. of patients	male	11
	female	10
Size of spleen (cm)	median	12
	median	9-20
Indication for surgery	ITP	17
	Spherocytosis	3
	Hydatid splenic cyst	1

Laparoscopic surgery was completed in 19 patients, with conversion to laparotomy in two cases (9%) due to failure to progress in dissection in one case, and technical failure in the other. The median operative

time was 100 minutes (range 60 to 180 minutes). Postoperative stay was two days (range 1 to 3 days). The mean estimated blood loss was 50 ml in the first ten cases and it was negligible in the last ten cases after the introduction of ligasure. In one patient an occult 1cm accessory spleen was detected during dissection of the splenic hilum and it was removed. The postoperative course was unremarkable in all except one patient who had a 48 hours atelectasis, which prolonged his hospital stay an extra two days. No long term sequelae such as incisional hernia, small bowel obstruction, and recurrent of ITP were identified during the follow up period, which ranged from six months to six years. Further analysis is seen in Table II and Table III.

Table II. Operative details, including rate and reasons for conversion to open surgery.

Operative time (minutes)	mean	100
	range	60-180
Estimated blood loss (ml)	mean	25
	range	5-150
Identification of accessory spleen		1
Rate and Reason for conversion to open surgery	2/21	-Failure to progress in dissection -Instrumentation

Table III. Short-term and long-term postoperative recovery in patients treated by laparoscopic surgery.

Hours until oral diet started	median	8
	range	6-12
Hours until regular diet started	median	20
	range	18-24
Postoperative stay (days)	median	2
	range	1-3
Interval before resumption of home activities (days)	median	5days
	range	3-7
Early postoperative complications	ileus	None
	pulmonary	1
	wound complication	None
Late postoperative complication	intestinal obstruction	None
	incisional hernia	None
	recurrent ITP	none

Discussion

Until recently the standard approach for splenectomy in children in Jordan has been open surgery, with low morbidity and mortality and good long term hematological success. However, traditional splenectomy, performed through an upper abdominal incision, is associated with a number of complications including hemorrhage, atelectasis, pneumonia, ileus, sub-diaphragmatic abscess, wound dehiscence and incisional hernia. These may prolong the hospital stay and convalescence.[5,7,8]

In 1996 the first minimal access pediatric surgical unit was established in Jordan at Queen Alia Hospital part of the Royal Medical Services. Initially we started to perform diagnostic laparoscopy for impalpable testis. In 1997 we performed our first laparoscopic splenectomy.

There were no rigid criteria regarding the selection of patients. We excluded patients who were unfit for general anesthesia and patient with uncorrectable bleeding diathesis. Some authors have considered previous upper abdominal surgery and large spleen to be relative contraindications.[5,6,9] This is due to the fact that adhesions from previous surgery and large spleens which reduce the volume that the surgeon has to work in, render dissection difficult and predispose to increased risk of uncontrollable bleeding.[6,10,11] Mahon and Rhodes reported a conversion rate of 60% for patients with spleen larger than 1000g, and higher rate of intra-operative and post operative complication in this group of patients. They and Yamashita *et al*. recommended that open surgery is the procedure of choice for patients with spleens larger than 1000g.[10,11] Targarona *et al*. conversely, suggested that laparoscopic splenectomy is safe and effective for all patients, no matter the degree of splenomegaly.[11]

In our series we did not encounter any patient with previous upper abdominal surgery. With reference to the size of the spleen, we operated on four patients with spleens larger than 1000g, none of whom required conversion. In one case we employed hand assisted surgery to aid dissection and retrieval of spleen. Regarding the age and the total body weight of patients there were no specific restrictions in our series for the use of laparoscopy. It is reported that laparoscopy in children weighing less than five kilograms is feasible and the rate of conversion did not correlate with the body weight of the patient.[1,8]

To assess the feasibility of laparoscopic splenectomy technically, several parameters needed to be evaluated which include, operative time, estimated blood loss, identification of accessory spleen, rate and reason for conversion to open surgery, and operative technique applied regarding exposure of surgical field, dissection, control of bleeding, and retrieval of spleen.

The operative time in our series ranged from three hours initially to one hour at the end of the series. This is similar to the reported operative time by Moore *et al.*[3] and Gigot *et al.*[9] As experience is gained by surgeon and the operating room personnel become more familiar with the equipment, the operative time will reduce.[3,5] A hidden but substantial operative time was lost to technical problems with the instruments. Ure *et al*. reported time loss due to this reason ranging

from six minutes to 23 minutes in 15% of all laparoscopic procedures.[1]

The estimated blood loss in our series was 25 ml. This is well below that reported by others which ranged from 90 to 110ml.[3,9,12] Following the introduction of ligasure blood loss was reduced to around five ml. The use of ligasure not only reduced the blood loss but also allowed us to work in a dry surgical field, with better control of bleeding from tissues and vessels and minimizing the rate of conversion.

Accessory splenic tissue should be sought in patients with hematological disease requiring splenectomy for hypersplenism. Although these may occur within the attaching ligaments of the spleen, in the mesentery and omentum, they most often occur in the hilum along the splenic vessels. There is variation in the reported incidence of accessory spleen ranging from 9% to 30% of patient under going laparoscopic splenectomy.[9,12,13] A thorough search was performed in all of our patients, aided by the magnified view of the video telescope, only one patient was found to have accessory spleen in the hilum of the spleen with size 10 mm. All of our patients continued to have stable and normal hemoglobin and platelets counts postoperatively.

Two patients (10%) required conversion to open surgery. The reasons for conversion were failure to progress in dissection and technical failure of instruments. Moore *et al.* and Gioget *et al.* reported a conversion rate of zero percentage while Yee *et al.* reported a conversion rate of 16% mostly due to bleeding.[3,8,9] Chen *et al.* reported a conversion rate of 3% mostly due to technical reasons[2]. Both of our patients recovered without sequelae. The ability to recognize the need to abandon laparoscopic approach to open for better exposure and control is paramount to successful use of MAS and should be one of the golden rules, and should not be viewed as a failure.[2,8]

Exposure of the surgical field can be maximized by sliding the laparoscope up beneath the costal margin to within centimeters of the operative field.[3,5] This combined with image magnification and optical system allows accurate identification of vital structures and vessels and permits accurate microsurgical dissection and meticulous hemostasis.[3,5,13] The only disadvantages of laparoscopy is the loss of tactical sensation, depth perception and difficulty to control bleeding.[3,5] In the patient with multiple Hydatid cysts involving both spleen and liver, to over come the difficulty of dissection and to prevent intraperitoneal rupture, hand assisted surgery was used. This technique was also applied in patient with massive splenomegaly. There was no difficulty in retrieving the spleen from the abdominal cavity using plastic bag and manual morcellation.

The theoretical advantages of laparoscopic approach to splenectomy are well observed in our series for both patient and health care provider. In our series only one patient developed early post operative complication, namely lung atelectasis necessitating an extra hospital stay of two days. This low incidence of post operative complication also reported by Moore *et al*. and Baird *et al.*[3,5], each reporting a single case of atelectasis and ileus respectively. There are many reasons for this low morbidity. Firstly, the small incision of laparoscopic surgery instead of conventional large upper abdominal incision leads to less post operative pain, and the need for analgesia.[2,3,5,6,12] This leads to rapid return of pulmonary function[3,5,12] and fewer respiratory complications. Secondly, bowel manipulation is minimal during visceral dissection, and the duration of post operative ileus is shortened.[5,12] The nasogastric tube is removed at the end of surgery and oral fluid introduced on the evening of surgery.[3] These factors contributed to early ambulation, rapid recovery and shortened hospital stay.[2,3,7,8,9,14,15] Forty percent of our patients were discharged home on the first post operative day on regular diet. This was consistent with findings by Moore *et al.*, Tulman *et al.* and Gioget *et al.*[3,9,12]

The long term follow up of our patients did not show any late sequelae such as adhesive intestinal obstruction, due to the fact that laparoscopic techniques minimize the risk of adhesions.[2,3] No incisional hernia was detected at the trocars sites due to the fact that small incisions are unlikely to herniated.[5] Ure *et al.* has reported an incidence of 2.7% of incisional hernia at trocar sites, and he recommended that the fascial plane of all trocar sites should be sutured meticulously in children[1,2] a technique we applied in our procedures.

Minimization of scarring is an additional benefit.[12] Both parents and patients found small scars cosmetically preferable to large sub costal or midline scars.[2,5,9,12]

The benefit of laparoscopic splenectomy to health care providers is well established. Initially the cost of laparoscopic splenectomy is higher than for open splenectomy chiefly because of the cost of extra instrumentation, additional operating room time and the need for expertise and training.[2] However, once experience is gained for both surgeons and theatre staff and training program is well established, the operative time will decrease sharply. By the end of our series, the operative time was 60 minutes compared to 180 minutes initially. This marked reduction in addition to reduced post operative stay to one or two days, lower morbidity rates for both short and long term have reduced the cost of laparoscopic splenectomy similar to that of open splenectomy. Yee *et al.* found that the total hospital cost for laparoscopic splenectomy is less than open splenectomy.[3,4,8] A scenario previously documented for laparoscopic cholecystectomy.

The ability of the child to return to full activity within seven days of surgery, allows their parents to return to fulfill their duties with minimum time lost from work. This is a hidden but substantial advantage for armed forces.[1,15]

In conclusion, we believe that splenectomy is safe and feasible extension of minimally invasive surgery in children in the hands of experienced pediatric surgeons.

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