LAPAROSCOPIC *VERSUS* OPEN SPLENECTOMY: A SINGLE CENTER ELEVEN-YEAR EXPERIENCE

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SUMMARY – The 11-year experience with open (OS) and laparoscopic (LS) splenectomy at a single center is reported. A total of 201 splenectomies were performed and clinical and demographic data were retrospectively analyzed. Patients were classified according to the type of operation as LS or OS. The mean age of patients was 45.1±17.1, and 141 patients were male. Out of 43 LS, 40 were done for hematologic causes, and they had a significantly shorter hospital stay compared to OS for hematologic causes (6.87±2.2 *vs*. 9.84±2.9 days; p=0.000003) and significantly less requirement for blood transfusion (26.2±93.4 *vs*. 132.4±252.3 mL; p=0.0152). In the OS group, comparison of patients with trauma and those with hematologic causes showed that significantly more males underwent surgery for trauma causes (35 of 43 *vs*. 16 of 21), hospital stay was longer (18.9±27.4 *vs*. 9.8±2.9 days) and blood requirement higher (708.1±603.7 mL *vs*. 132.4±252.3 mL; p=0.0004, p=0.047 and p=0.000001, respectively). Laparoscopic splenectomy is a safe procedure for spleen removal.

Key words: *Splenectomy; Laparoscopy; Hematologic diseases*

Introduction

Minimally invasive surgery has several advantages over open surgery. The most important are reduced intraoperative stress and faster return to normal daily activities[1]. In recent years, laparoscopic surgery in general has proved to be comparable to open surgery in the management of both benign and malignant diseases[2].

In the last two decades, laparoscopic splenectomy (LS) has become the gold standard for spleen removal, mainly for benign causes. As these indications for LS are not very frequent, it takes time for a surgeon to become an expert in this field[3].

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Received August 23, 2012, accepted June 5, 2013

This technique is a minimally invasive and safe approach for splenectomy, but as a laparoscopic procedure, it is complex and therefore most suitable for small spleens. The larger the spleen, the greater the morbidity, and the laparoscopic surgery becomes more difficult. Recently, however, there are authors who find LS feasible and safe in cases of hypersplenism and malignancy, offering the same advantages as in benign cases[4].

It has been reported by many authors that postoperative stay in hospital and recovery time are shorter with LS, while surgical time, although variable, is generally longer with LS compared to open splenectomy (OS)[5-7].

There is no doubt that LS should be the treatment of choice in the majority of patients who require elective surgery, have small spleens and no additional high comorbidity.

At Department of Abdominal Surgery in Skopje, LS was introduced in 2005, gradually increasing the number of patients up to the present. Herewith, we report our experience with LS and compare the results with those of OS.

Patients and Methods

During a period of 11 years (2000-2010), a total of 201 splenectomies were performed for a wide range of splenic disorders at Department of Abdominal Surgery in Skopje, Macedonia. Laparoscopic splenectomy was introduced in 2005, mainly indicated for patients with hematologic diagnoses. Clinical data, immediate postoperative outcome, age, diagnosis, surgical time, transfusion requirement, conversion rate, hospital stay and complications were retrospectively recorded and analyzed. Out of 201 procedures, complete data were obtained for 199 patients. There were 101 male patients. The mean age of patients was 45.1±17.1 years. A total of 43 LS were performed, 40 for hematologic causes, one for trauma, one for malignant disease (splenic metastases) and one for splenic hemosiderosis. Open splenectomy was undertaken mainly for malignant, trauma, and other causes. Only patients with isolated spleen trauma were included in the study, and not those with multiple traumatic injuries, including spleen injury.

Since only three patients underwent LS for non-hematologic causes, and the rest of the laparoscopic spleen removals were performed in patients for hematologic causes, only patients with hematologic causes for splenectomy were classified according to the type of operation as LS or OS. Student's t-test and χ^2-test were used for relevant comparisons between the series.

Surgical technique

General anesthesia was used in all patients undergoing LS. A nasogastric tube was inserted routinely. All procedures were carried out by six surgeons and all patients received vaccinations against pneumococcus and *Haemophilus influenzae* at least 1 week before surgery. A single dose of prophylactic intravenous antibiotic was administered immediately before surgery, and in the majority of patients, lower extremity compression devices were used to minimize the risk of deep venous thrombosis. The patients were placed in the right lateral decubitus position. The operating table was flexed to expose the area between the left costal margin and the iliac crest. Four trocars (Ethicon, Autosuture), each 5 cm apart, were placed along an imaginary left subcostal incision with the most medial on the midline and most lateral on the left anterior axillary line (two 5-mm, one 10-mm and one 12-mm). The 30° optic (Storz) was introduced through the middle of the lateral three trocars. The stomach was manipulated through the most medial fourth trocar. A pneumoperitoneum with carbon dioxide was achieved up to 15 mm Hg. The surgeon mobilized the spleen from the colon and its lateral attachments using either Liga Sure Atlas, short, 20 cm (Covidien) or harmonic scalpel (Ethicon), less often. Then the surgeon rotated the spleen laterally to expose the hilum, and the hilar vessels were divided using a vascular endostapler (Autosuture, Covidien) or large clips (Ethicon, Autosuture). The spleen was then placed in an impermeable retrieval bag and morcellated for removal through the 10-mm trocar. The splenic bed was irrigated and the facial openings of the port sites were closed. In the majority of patients, drainage was enabled. The spleens were sent to a pathologist for further assessment.

Table 1. Demographic and clinical parameters of patients undergoing splenectomy in the 2000–2010 period

Diagnosis	Gender (M/F)	Mean age (yrs)	Laparoscopic/ open surgery	Death
Hematologic diseases 77	27/50	38.5±15.5	40/37	0
Trauma 44	36/8	45.2±17.5	1/43	3
Malignant diseases 22	13/9	55.5±13.0	1/21	0
Other diagnoses 56	22/34	50.2±16.8	1/55	1

Table 2. Comparison between laparoscopic and open splenectomy in patients with hematologic causes for spleen removal

Variable	Laparoscopic splenectomy n=40	Open splenectomy n=37	p value
Age (yrs)	37.3±14.5	39.7±16.6	0.486
Duration of surgery (min)	166.1±54.9	144.7±48.8	0.09
Days of hospitalization	6.87±2.2	9.84±2.9	0.000003
Blood transfusion (mL)	26.2±93.4	132.4±252.3	0.0152
Gender (male/female)	11/29	16/21	0.148

Results

A total of 77 splenectomies were carried out for hematologic causes, 44 for trauma causes, 22 for malignant diseases, and 56 for other causes. Demographic and clinical parameters of the patients are shown in Table 1. Statistical analysis showed that patients with hematologic causes for spleen removal who underwent LS had longer duration of surgery, yet statistically nonsignificant, significantly shorter hospital stay, and lower requirement for blood transfusion compared to those with OS (Table 2).

We also compared patients undergoing OS for trauma and hematologic causes (Table 3). Significantly more males than females had spleen removal for trauma causes; the duration of surgery was longer in those with hematologic causes, but hospital stay was significantly shorter and blood requirement lower.

When we compared patients undergoing OS for hematologic causes with all other causes for spleen removal, it appeared that those with hematologic diagnoses were significantly younger than all others and required less blood transfusion (Table 4).

Figure 1 shows the distribution of LS and OS during the 2000-2010 period. It is evident that since 2005, when LS was introduced, there was gradual but continuous increase in the number of patients undergoing LS.

Table 3. Differences in patients undergoing open splenectomy (OS) for trauma versus *hematologic causes*

Variable	Trauma causes for OS n=43	Hematologic causes for OS n=37	p value
Gender (male/female)	35/8	16/21	0.0004
Age (yrs)	45.9±17.1	39.7±16.6	0.109
Duration of surgery (min)	121.3±46.4	144.7±48.8	0.031

Table 4. Differences in variables between hematologic indications and all other indications for splenectomy (patients who underwent open splenectomy only)

Variable	Hematologic n=37	Other n=119	χ^2	p value
Age (yrs)	39.7±16.6	49.3±16.4		0.0025
Duration of operation (min)	144.7±48.4	141.7±55.9		0.76
Days of hospitalization	9.8±2.8	14.9±19.4		0.11
Blood transfusion (mL)	132.4±252.3	482.3±655.5		0.001
Gender (male/female)	16/21	69/50	2.47	0.115

Table 5. Comparison of laparoscopic splenectomy (LS) data between our center and Surgery Department of Maryland University in Baltimore

Parameter	Data by Jankulovski N.	Data by Bell R.
Number of patients with LS	43	109
Mean age (yrs)	38.9±16.05	41 (6-79)
Male	13 (30.2%)	51 (46.8%)
Female	30 (69.8%)	58 (53.2%)
Benign pathology	42 (97.7%)	70 (64.2%)
Malignant pathology	1 (2.3%)	39 (35.8%)
Conversion rate	5 (11.6%)	8 (7.3%)
Operating time (minutes)	164.1±53.3	155±9
Blood loss (mL)	146.5±801.9	426±66
Hospital stay (hours)	165.5±54.4	101±28
Complication rate	5 (11.6%)	12 (11%)

During the study period, there were 5 (11.6%) conversions from LS to OS and only one serious complication was recorded. Four patients died in the immediate postoperative period. One of them had splenic abscess, and the other three had splenic trauma. All four patients underwent OS.

Discussion

The first splenectomy was performed by Andirano Zaccarello in 1549 in a young woman for hypersplenism, who survived for 6 years afterwards[8]. Up to 1991, open splenectomy was the traditional surgical approach for spleen removal for various reasons. With the development of minimally invasive surgical procedures, LS has gradually increased, since it was first reported by Delaitre and Maignien in 1991[9].

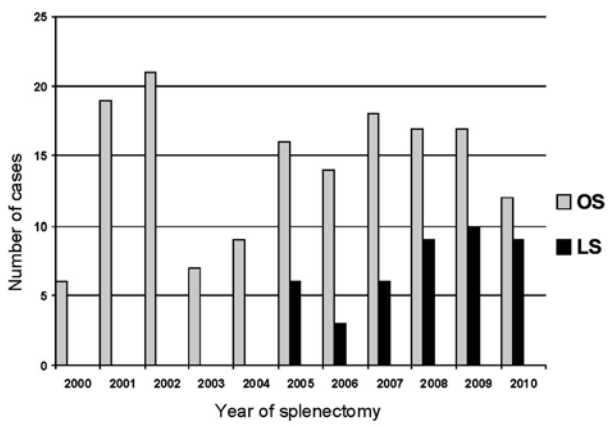

Fig. 1. Open (OS) and laparoscopic (LS) splenectomies performed between 2000 and 2010 at Department of Abdominal Surgery, University Department of Surgery in Skopje.

The indications for LS at present are almost the same as for OS, except when urgent and exploratory splenectomy is needed for traumatic injuries. Apart from benign hematologic indications, LS is currently widely used for malignant, traumatic causes, and even for a substantial number of cases with hypersplenism as well. The advantages of the laparoscopic approach compared to the open (conventional) surgery are mainly related to small incision, less postoperative pain and shorter recovery period[10].

Department of Abdominal Surgery in Skopje started performing LS in 2005. Sixteen open splenectomies for hematologic causes were performed during the 2000-2005 period, when LS had not yet been introduced, and 21 for the same causes during the 2005-2010 period. In the same period, another 40 LS were carried out for hematologic causes. It required some time until all splenectomies for hematologic causes were carried out by LS. Surgeons are still cautious and prefer OS for patients with malignancies, although the European Association for Endoscopic Surgery (EAES) clinical practice guidelines include malignant hematologic diseases as well[11].

Surgical time in our study was 166 min in the LS group compared to 145 in the OS group; the difference did not reach statistical significance. Other authors report variable surgical times for LS, from 88 min to 170 min[12-18], but always longer compared to OS.

Hospital stay of patients who underwent LS was significantly shorter in our study group, i.e. 6.9 days compared to 9.8 days in the OS group with hematologic causes, whereas compared to OS for trauma causes and other causes it was much shorter (18.9 and 14.9 days, respectively). Other authors report much shorter hospital stays than ours, 2.5, 3.3 and 5.8 days[12,14,15], also significantly shorter than in the OS group.

While other authors report conversion rates to OS of 4% to 6%[13-15], we had 5 (11.6%) cases converted to OS, mostly as a result of excessive bleeding. It appeared that conversions were not associated with the surgeon's experience, since they did not occur only in the first years, but throughout the study period.

Mortality rate in patients undergoing LS is variable, but low[16,18]. We did not observe either deaths or major complications in the LS group, except for one case. A 62-year-old female underwent LS due to diffuse lymphoma. There was no conversion to OS; she was transfused with 5250 mL blood, but needed two more surgeries for a serious complication of colon perforation. She was discharged from the hospital in a relatively good condition after 90 days.

Blood requirement was highest in patients with trauma causes for spleen removal compared to other causes or hematologic causes. However, when LS was compared to OS in patients with hematologic causes, blood loss or requirement was significantly greater in the OS group in our study, which was consistent with the observations of other authors[19].

Table 5 depicts data regarding pathology type, conversion rate, operating time, blood loss, hospital stay and complication rates in patients who underwent LS in our center compared to data reported by Bell *et al.* on LS performed in a single center for abdominal surgery at University School of Medicine in Maryland, Baltimore[20]. Hospital stay and operating time were longer and conversion rate was higher in our patient group, but surgical experience was shorter compared to the surgery center in Maryland.

Conclusion

Laparoscopic splenectomy is a safe procedure for hematologic indications for spleen removal, with several advantages, such as small incisions, shorter hospital stay and patient recovery. After acquiring substantial experience and skills in the procedure, surgeons should broaden indications for LS towards traumatologic, malignant hematologic diseases and other causes of hypersplenism. Surgeons should also change their habits and allow shorter hospital stay in patients with LS.

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Sažetak

LAPAROSKOPSKA PREMA OTVORENOJ SPLENEKTOMIJI: JEDANAESTOGODIŠNJE ISKUSTVO U JEDNOM CENTRU

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U radu je prikazano 11-godišnje iskustvo s otvorenom splenektomijom (OS) i laparoskopskom splenektomijom (LS) u jednom centru. Ukupno je izvedena 201 splenektomija, a klinički i demografski podaci su analizirani retrospektivno. Bolesnici su grupirani prema tipu operacije: OS ili LS. Srednja dob bolesnika bila je 45,1±17,1 godina, a ukupno je bio 141 bolesnik muškog spola. Od 43 bolesnika s LS 40 ih je podvrgnuto splenektomiji zbog hematoloških uzroka i oni su imali značajno kraću hospitalizaciju u usporedbi s OS izvedenom zbog hematoloških uzroka (6,87±2,2 prema 9,84±2,9 dana; p=0,000003), kao i značajno manju potrebu za transfuzijom krvi (26,2±93,4 mL prema 132,4±252,3 mL; p=0,0152). U skupini OS je usporedba bolesnika s traumom i onih operiranih zbog hematoloških uzroka pokazala značajno veći broj bolesnika muškog spola operiranih zbog traume (35 od 43 prema 16 od 21), dužu hospitalizaciju (18,9±27.4 prema 9,8±2,9 dana) i veću potrebu za transfuzijom krvi (708,1±603,7 mL prema 132,4±252,3 mL; p=0,0004, p=0,047 odnosno p=0,000001). Laparoskopska splenektomija je siguran zahvat za uklanjanje slezene.

Ključne riječi: *Splenektomija; Laparoskopija; Hematološke bolesti*