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Effect of spleen size on splenectomy outcome

A comparison of open and laparoscopic surgery

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Abstract
Background: Laparoscopic splenectomy (LS) is gaining acceptance as an alternative to open splenectomy (OS). However, splenomegaly presents an obstacle to LS, and massive splenomegaly has been considered a contraindication. Analyses comparing the procedure with the open approach are lacking. The purpose of this study was to analyze the effect of spleen size on operative and immediate clinical outcome in a series of 105 LS compared with a series of 81 cases surgically treated by an open approach.
Methods: Between January 1990 and November 1998, 186 patients underwent a splenectomy for a wide range of splenic disorders. Of these patients, 105 were treated by laparoscopy (group I, LS; data prospectively recorded) and 81 were treated by an open approach (group II, OS analyzed retrospectively). Patients also were classified into three groups according to spleen weight: group A, <400 g; group B, 400–1000 g; and group C, >1000 g. Age, gender, operative time, perioperative transfusion, spleen weight, conversion rate, mode of spleen retrieval (bag or accessory incision), postoperative analgesia, length of stay, and morbidity were recorded in both main groups.
Results: Operative time was significantly longer for LS than for OS. However, LS morbidity, mortality, and postoperative stay were all lower at similar spleen weights. Spleens weighing more than 3,200 g required conversion to open surgery in all cases. When LS outcome for hematologic malignant diagnosis was compared with LS outcome for a benign diagnosis, malignancy did not increase conversion rate, morbidity, and transfusion, even though malignant spleens were larger and accessory incisions were required more frequently. Postoperative hospital stay was significantly longer in malignant than in benign diagnosis (5 ± 2.4 days vs. 4 ± 2.3 days; $p < 0.05$).
Conclusions: In patients with enlarged spleens, LS is feasible and followed by lower morbidity, transfusion rate, and shorter hospital stay than when the open approach is used. For the treatment of this subset of patients, who usually present with more severe hematologic diseases related to greater morbidity, LS presents potential advantages.

Key words: Laparoscopic splenectomy — Open splenectomy — Splenomegaly

Laparoscopic surgery is gaining ground as a technical approach for splenectomy. The main indications for laparoscopic splenectomy (LS) are benign hematologic diseases not associated with splenomegaly, such as idiopathic thrombocytopenic purpura (ITP) [3, 4]. Intrabdominal manipulation of bulky organs during laparoscopic surgery increases the technical difficulty of the procedure and the retrieval of the specimen from the abdomen. Splenomegaly initially was considered a contraindication for LS, and the clinical advantages of the procedure have not been firmly established, but improvement and refinement of LS techniques have shown that an enlarged spleen can be managed successfully by laparoscopy [7–9, 13].

In a previous report [10], we showed that LS is feasible with enlarged spleens and presented much the same advantages as those observed in the group with smaller organs. However, comparative studies with open surgery are lacking, and prospective and randomized trials are difficult to perform. We therefore sought to compare a prospective series of 105 LS with a retrospective group of 81 open splenectomies (OS) according to spleen weight in order to analyze the hypothetical advantages of laparoscopic surgery in this challenging subgroup of patients.

Materials and methods

Between January 1990 and November 1998, 186 patients at two surgical units underwent splenectomy for a wide range of splenic disorders. Op-

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Table 1. Demographic and clinical features of patients submitted to splenectomy comparing open and laparoscopic approaches according to spleen weight

	Group A (<400g)		Group B (400–1,000 g)		Group C (>1,000 g)	
	Lap	Open	Lap	Open	Lap	Open
Number of cases	66	43	18	18	21	20
Age	38 ± 17	40 ± 17	46 ± 19	50 ± 4	58 ± 12	56 ± 12
Sex	18 m/48 f	15 m/28 f	6 m/12 f	7 m/11 f	9 m/12 f	10 m/10 f
Hematocrit	38 ± 5	38 ± 5	31 ± 8	34 ± 8	30 ± 7	28 ± 6
Platelets	92 ± 99	48 ± 55	109 ± 71	197 ± 171	147 ± 127	120 ± 150
Benign/malignant	61 b/5 m	43 b	12 b/6 m	11 b/7 m	4 b/17 m	4 b/16 m

eration by laparoscopy was used for 105 patients (group I) and 81 patients were treated by the open approach (group II).

All patients scheduled for LS received a preoperative pneumococcal vaccine, and antibiotic prophylaxis was initiated intraoperatively. Laparoscopic splenectomy was performed through an anterior or lateral approach, using techniques previously described in detail elsewhere [11, 12]. In most cases, the spleen was retrieved after morcellation in a bag (Lapsac®, Cook España S.A., Spain; EndoCatch II, AutoSuture, USSC, Norwalk, USA). Morcellated pieces and aspirated splenic pulp were sent for histologic analysis and weighed. In cases of massively enlarged spleen (weighing more than 1,000 g), or cases requiring intact organ retrieval (i.e., splenic tumor), the spleen was extracted through an accessory incision in the subumbilical midline or between two trocar orifices in the left iliac fossa.

Open splenectomy was performed through a midline or subcostal incision at the choice of the surgeon. Usually, the splenic artery was ligated early during the operation, before spleen mobilization in thrombocytopenic patients or in those with substantially enlarged spleens.

Patients were classified according to spleen weight: group A (<400 g), group B (400–1000 g), and group C (>1,000 g). Age, diagnosis, gender, operative time, perioperative transfusion, spleen weight, conversion rate, mode of spleen retrieval (bag or accessory incision), postoperative analgesia, hospital stay, and morbidity all were analyzed. To establish the effect of malignant disease on LS outcome, outcomes from LS performed in patients with benign hematologic diagnosis were compared with outcomes from the procedure used in cases involving a malignant diagnosis.

Complications were grouped according to the classification of Clavien et al. [1]: grade I (minor), grade II (require therapeutic intervention, but do not present residual disability), grade III (result in residual disability), and grade IV (result in death).

Data were expressed as mean plus standard deviation and range. The chi-square test was used for comparison of the two proportions, and Student's *t* test was used to compare differences between the two series.

Results

Both groups of patients (LS and OS) were comparable for main clinical features (Tables 1 and 2), and the three subgroups, according to spleen weight, also had similar clinical features. However, group A patients (<400-g spleen) were younger, with a significantly higher preoperative hematocrit and lower prevalence of malignant hematologic diseases than present in groups B and C (Table 1).

Comparisons of LS and OS according to weight, demonstrated that in the smaller spleen (group A, <400 g), despite a significantly longer operative time, transfusion rate and morbidity were lower than with the open approach, and analgesia requirements and hospital stay presented statistically significant differences (Table 3).

With the intermediate spleen weight (group B), a significantly longer operative time was observed than with the open approach. In this subgroup, transfusion, morbidity, and analgesia requirements were similar after both open and laparoscopic approaches, but hospital stay was significantly shorter with the LS group (5 ± 2 days vs. 12 ± 6 days; $p < 0.001$).

In the group with larger spleens (group C, <1000 g), LS was performed in 77% of the patients having spleen weights up to 3,200 g. However, in five patients with spleen weights between 3,200 and 3,500 g, LS was impossible because sufficient working room could not be obtained in the interior of the abdomen. In this subgroup, after successful spleen mobilization, all of the specimens were retrieved through an accessory incision. Although operative time was twice that in OS, successful LS was associated with lower morbidity and transfusion requirement, similar analgesia requirements, and a significantly shorter hospital stay (6 ± 3 days vs. 12 ± 5 days; $p < 0.001$, Table 3).

Complications were less frequent after LS than after OS, although the difference was not statistically significant. There were four grade III complications in the LS group (three reoperations for bleeding [3/105; 3%] and one diaphragmatic perforation, which was repaired preoperatively). In the OS group, only grade III complications occurred in subgroup C (spleen weight, >1000-g) (two empyemas, one pulmonary embolus, and one pancreatitis), and a grade IV complication with death caused by respiratory insufficiency.

No intraoperative complications occurred during exploratory laparoscopy in converted cases, and all evolved satisfactorily except one case with a massively enlarged spleen (3,200 g), which required surgical reexploration caused by bleeding of the splenic fossa.

Comparisons of LS according to the malignant or benign nature of the hematologic disease, age, platelet count, accessory incision requirements, analgesia, and spleen weight revealed significant differences, but there were no differences in the morbidity rate. All of these factors had an impact on hospital stay (5 ± 2.4 days vs. 4 ± 2.5 days; $p < 0.5$).

Discussion

Laparoscopic surgery is indicated increasingly for splenectomy, especially in young, healthy patients with ITP and a normal-size spleen (weight, 80–250 g) [3, 4, 11]. As in laparoscopic cholecystectomy, postoperative recovery is mild, in-hospital stay shorter (maximum of 3 days), and subsequent recovery faster. Some authors have proposed LS as the gold standard for treatment. However, disorders that require splenectomy include a wide variety of diseases with

Table 2. Preoperative diagnosis of patients subjected to splenectomy comparing open and laparoscopic approaches according to spleen weight

	Group A (<400 g)		Group B (400–1,000 g)		Group C (>1,000 g)	
	Lap	Open	Lap	Open	Lap	Open
Number of cases	66	43	18	18	21	20
ITP	45	34	1	—	—	—
AIHA	4	—	5	2	—	1
Spherocytosis	4	1	3	4	2	—
Splenic mass	4	—	—	—	—	1
HIV-ITP	3	7	3	2	1	—
Non-Hodgkin lymphoma	2	—	5	6	11	12
Chronic lymphoproliferative leukemia	—	—	—	1	2	4
Myelofibrosis	—	—	—	—	2	—
Other	4	1	1	3	3	2

ITP, idiopathic thrombocytopenic purpura; AIHA, autoimmune hemolytic anemia; HIV, human immunodeficiency virus

Table 3. Perioperative and immediate clinical outcome of splenectomy comparing open and laparoscopic approaches according to spleen weight (converted cases excluded)

	Group A (<400 g)		Group B (400–1,000 g)		Group C (>1,000 g)	
	Lap	Open	Lap	Open	Lap	Open
Number of cases	66	43	18	18	21	20
Operation time (min)	143 ± 50	102 ± 18[a]	179 ± 77	103 ± 60[a]	176 ± 56	111 ± 19[a]
Conversion	4%	—	0%	—	23%	—
Transfusion	17%	20%	22%	33%	33%	40%
Morbidity	11%	28%	27%	40%	28%	55%
Analgesia (doses)	7.7 ± 4.6	8 ± 6	9 ± 4.6	11 ± 10	14 ± 7	16 ± 10
Stay (days)	3.7 ± 2.4	8 ± 3[a]	5 ± 2	12 ± 6[a]	6 ± 3	12 ± 5[a]
Spleen weight (g)	180 ± 9	182 ± 80	670 ± 184	642 ± 160	1,660 ± 586	1,973 ± 713

[a] $p < 0.001$

Table 4. Complications after splenectomy when comparing open and laparoscopic approaches according to spleen weight

Group A (<400 g)		Group B (400–1,000 g)		Group C (>1,000 g)	
Lap	Open	Lap	Open	Lap	Open
7/66 (11%) I Wound hematoma (2) I Fever II Pneumonia II Subphrenic hematoma III Hemoperitoneum (2)	11/43 (25%) I Fever I Wound sepsis I Phlebitis II Subphrenic collection (2) II Atelectasis (4) II Neumotorax II Hemorrhage	5/18 (27%) I Wound sepsis II Fever, TBC II Atelectasis II Pneumonia III Diaphragmatic perforation	7/18 (40%) I Wound sepsis II Hemorrhage (2) II Lung complications (4) II Subphrenic collection (2)	6/21 (27%) II Ileus II Sweet syndrome III Hemoperitoneum I Wound sepsis I Gout attack I Urinary infection	11/20 (55%) I Gout attack I Fever (2) I Wound sepsis II Empyema (2) II Pneumonia (2) II Pancreatitis II Subphrenic coll II Hemorrhage III Pulmonary embolism IV Pneumonia (exitus)

I, II, III, and IV grade according to Clavien classification [1]

clinical and anatomic characteristics that can influence performance of the LS [5–7]. Furthermore, spleen disorders requiring splenectomy are not frequent, and prospective comparative trials are difficult to perform. Comparative trials reported up to the time of this writing focus mainly on ITP, and only one article has compared the laparoscopic and open approaches in a general group of patients requiring elective splenectomy [5]. Friedman et al. [5] observed after multivariate analysis that spleen size, age, and type of hematologic disease had a predictive value for outcome after LS, and spleen weight directly influenced operative time and hospital stay.

In a previous study, we analyzed the effect of an enlarged spleen on LS outcome [10], concluding that the technique is feasible in cases with spleen weights as great as 3000 g. Thirty-nine patients had spleens weighing 400 to 3500 g, and LS was completed in 34 of them (87%). We included 21 patients with spleen weights greater than 1000

Table 5. Results of laparoscopic splenectomy according to hematologic diagnosis (malignant and benign)

	Malignant	Benign	*p*
Number of cases	28	77	
Age	60 ± 10	37 ± 16	0.001
Hematocrit	30 ± 7	37 ± 6	0.2
Platelets	145 ± 133	92 ± 87	0.004
Operative time	170 ± 59	150 ± 50	0.12
Conversion	14%	5%	0.2
Accessory incision	78%	19%	0.001
Transfusion	32%	20%	0.4
Morbidity	25%	14%	0.8
Hospital stay	5 ± 2.4	4 ± 2.3	0.05
Analgesia	17 ± 7	8 ± 4.6	0.001
Reoperation	3.6%	2.6%	0.8
Spleen weight	1441 ± 1,000	331 ± 458	0.001

g (range, 1000–3,500 g). In 16 of these patients, splenectomy was completed successfully by laparoscopy, and 4 patients (spleen weights, 2,500–3,500 g) were converted because of difficulties in manipulating the spleen.

The aim of this article was to compare OS and LS with regard to spleen size, a key factor for successful LS because the spleen is difficult to manipulate during surgery. Extraction of the spleen from the abdomen also is complicated, and the suitability of the laparoscopic approach in this subset of patients is a controversial issue.

Undoubtedly, the classification according to spleen weight is simplistic because hematologic diseases have many associated factors (age, malignant nature of the disease, associated chemotherapy or corticosteroid treatment, etc.) that also influence outcome, but the comparison with a group of OS cases with similar spleen weights seems to highlight the potential advantages of LS.

Despite a longer operative time, LS presents clear advantages in the smaller spleen subgroup, as several authors (including ourselves) have observed elsewhere [4–5]. These advantages also are found in the intermediate-weight group, in which there were no conversions, even though a spleen weighing more than 400 g is not easy to manipulate. Other advantages of LS were a reduction in morbidity and a significant decrease in postoperative hospital stay.

Massively enlarged spleens present the greatest challenges. In the subgroup with larger spleens, 23% (5 of 21) the patients were converted because the surgeons found it impossible to mobilize the spleen and achieve sufficient working room, but it was observed that spleens as large as 3,000 g can actually be mobilized quite easily. In this subgroup, an accessory incision was made in all cases because the pathologist required that the spleen be intact, and the organ could not be introduced into a bag. However, transfusion requirements, morbidity, and hospital stay were all lower than in the OS group, suggesting that the laparoscopic approach presents a number of advantages. The OS group included patients with larger spleens, and LS was not attempted. It might be argued that this introduces a certain bias. However, both groups were comparable regarding spleen weight, and in the last 3 years, all massively enlarged spleens seen at our service have been explored initially by laparoscopy. A further conclusion can be drawn with regard to the selection of patients for LS. In our experience, patients with spleens that reach the anterior iliac spine or surpass the midline are more likely to be converted and can be better treated with an open approach. But in the case of splenomegaly with a mobile inferior splenic pole and a distensible abdomen, laparoscopic exploration by a skilled surgeon may have potential advantages.

The analysis of this LS series according to the benign or malignant nature of the hematologic disease also confirms the suggestion made by others in a smaller series [2] that patients with hematologic malignant diseases requiring LS were older, were more likely to need an accessory incision for spleen retrieval, and had spleens larger than in benign cases. Furthermore, operative time, conversion rate, transfusion, and morbidity were similar. However, in our experience, the malignant origin of the disease was associated with a longer postoperative stay.

In patients with enlarged spleens, LS is feasible and followed by lower a morbidity and transfusion rate and a shorter hospital stay than OS, except when the spleen weighs more than 3 kg, in which case there is insufficient working room inside the abdomen. In this subset of patients, who usually present with more severe hematologic diseases, LS has potential advantages for treatment.

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