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Comparison of Perioperative Results of Single Port Laparoscopic, Multiple Port Laparoscopic and Open Splenectomy in Patients with Non-Traumatic Splenic Diseases: Clinical Retrospective Trial

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Introduction: The single-port laparoscopic splenectomy procedure is a brand new technique. Although it is reported that perioperative complications are less with conventional laparoscopy and open procedure, the number of studies comparing the perioperative outcomes of all three techniques is not high. This study compares the perioperative outcomes of these three splenectomy techniques in non-traumatic splenic diseases.

Materials and Methods: Total number of 82 patients (aged 18-72 years) who underwent splenectomy due to non-traumatic reasons between June 2011 and December 2016 in Ege University General Surgery Department were investigated, respectively. Patients were divided into three groups according to the procedure type, including single-port splenectomy (SILS), multiple port laparoscopic splenectomy (LS), open splenectomy (OS).

Results: There was no significant difference in intraoperative bleeding and post-op complications between the three groups. Patients who underwent surgery due to ITP were respectively 26.4%, 91.2%, 80% in group 1,2 and 3 (P1 and p3>0.05). The mean operation times were respectively 81±17 min, 81±22 min and 97±22 min in group 1, 2 and 3 (p1 and p3>0.05, p2<0.05). The hospital stay was 3.4 days (±0.72) in group 1, 3.1 days (±1.10) in group 2, and (±0.7) in group 3 (P1<0.05, p2<0.05 and p3<0.05). In group 2, two patients were converted to open splenectomy because of the bleeding. In Group 3, laparoscopic splenectomy was performed because of the difficulty of dissection.

Conclusion: Single port laparoscopic splenectomy is a safe and effective alternative to both standard laparoscopic and open splenectomy.

Keywords: Laparoscopic splenectomy, open splenectomy, single port splenectomy

Introduction

Splenectomy is a widely used procedure in surgical practice. Depending on the surgical indication and the type of surgery chosen, the operative steps, surgical procedure's difficulty, and postoperative outcomes may differ.

Laparoscopic splenectomy was first applied by Rhodes et al. (1), then it was widely used in practice (2-8). Studies indicated laparoscopic splenectomy has a lower complication rate and that all patients can be intervened (9).

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Single-port laparoscopic splenectomy (SILS), a modification of laparoscopic surgery, uses existing laparoscopic instruments and requires minor adjustment to conventional laparoscopic surgery. SILS has recently become available for splenectomy, and better cosmetic appearance, less pain, and fewer port-related complications have been reported compared to conventional laparoscopy (10).

There are not many studies comparing these three techniques in the literature, and studies reported typical results on the need for more studies on this subject. In this study, in patients who underwent splenectomy due to non-traumatic reasons during June 2011-December 2016; we aimed to compare the perioperative results of single-port (SILS), open splenectomy, and conventional laparoscopic.

Materials and Methods

Ethical Statement

The study received the approval of the Ege University Faculty of Medicine Clinical Research Ethic Committee (Approval:20.04.2017/17-4/13). A total of 91 patients' files were analyzed. Four patients who underwent splenectomy and operation simultaneously (cholecystectomy, hernia repair) and 5 patients whose file information could not be reached were excluded from the study. The files of the patients were examined retrospectively. Eighty-two patients between the ages of 18-72 who underwent splenectomy in Ege University General Surgery Department between June 2011 and December 2016 in our hospital for non-traumatic reasons were included in the study. The patients were divided into 3 groups. Group-1 patients represent open splenectomy (n:38). Patients in Group-2 represent multi port laparoscopic splenectomy (n:34). Group-3 patients represents who underwent single-port

laparoscopic splenectomy (n:10). Age, gender, ASA score, spleen size, surgical indication, type of surgery performed, presence of accessory spleen, intraoperative complications, operation time, duration of hospital stay, postoperative surgical complications, and general post-operative complications were analyzed. Spleen size was measured by pre-op ultrasound or tomography. All cases received pneumococcal 23 (Merck & Co. Inc., Whitehouse Station, NJ, USA) vaccine and antibiotic prophylaxis at least one week before surgery. Patients were operated on under general anesthesia.

Statistical Method

As a statistical method, Mann Whitney's non-parametric test, Chi-Square Test, and Kruskal-Wallis Test were used to test the significance of the difference between the means of the three groups in cases that did not show the normal distribution for the three groups. The data were analyzed by entering the Statistical Package for the Social Sciences (IBM®, SPSS, Chicago, IL, USA) version 23.0 program. As the confidence interval; data with a p-value of less than 0.05 were considered statistically significant. P-value was taken for three groups; p1 for group 1 and group 2, p2 value for group 2 and group 3, and p3 value for group 1 and group 3.

Surgical Techniques

Open Splenectomy Technique

It was performed in 38 patients. After necessary sterile dressing and staining in the supine position, it was initiated under general anesthesia with a median incision in 7 and a left subcostal incision in the other 31 patients. The incision was made parallel to the left costal margin and approximately two fingers below it.

Laparoscopic Splenectomy Technique

A total of 34 patients underwent laparoscopic splenectomy. The patients were taken to the

operating table in the right lateral decubitus position or 45 degrees right lateral decubitus position (midway double access technique). The iliac bone was bent at the waist to increase the distance between the rib. After entering with a Veres needle, the abdomen was insufflated with CO₂, and pneumoperitoneum was formed. A 10 mm camera port was placed under the left rib arch at the mid-clavicular line level. Careful abdominal exploration was performed for accessory spleen scanning. One 5 mm working port was entered at the midline level, 5 cm medial to the camera port. The 15 mm working port was entered at the anterior axillary line 5 cm lateral to the camera port.

Single Port Laparoscopic Splenectomy

Single port laparoscopic splenectomy was performed on a total of 10 patients. The patients were operated on in the right lateral decubitus or midway double access technique position as laparoscopic splenectomy. The abdomen was entered with an open method with a vertical incision made from the umbilicus. Pneumoperitoneum was provided with a SILS port or glove port system (Figure 1-3).



Figure 1. Glove port system

Then, the abdomen was explored with a 5 mm 30 degree angle camera. A roticule 5 mm grasper was used in the left hand and ligasure in the right hand in our cases. In our cases,

we usually dissected inferior to superior. After releasing the spleen's lower pole, gastrosplenic ligament was cut with ligasure to enter the retrogastric space. Hilus is released. The next steps were applied in the same way as laparoscopy. The spleen in bag was dissected through a single incision, and fascia was closed.

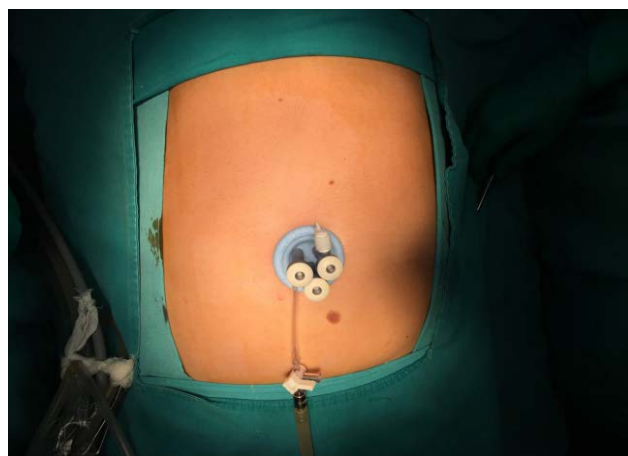


Figure 2. Single port laparoscopy trocar entrances



Figure 3. Image of the incision after SILS

Results

Of the 82 patients operated on, 29 (35.4%) were male, and 53 (64.6%) were female. The mean age of the patients were 47.7, 43.9 and 35.4 in groups 1, 2 and 3, respectively. The accessory spleen was detected in 3 (3.7%) patients. There was no significant difference in all three groups in terms of age, gender, presence of accessory spleen, and ASA score.

Spleen size was measured as 19.8 ± 7 cm in group 1, 11.7 ± 1.6 cm in group 2, and 12 ± 1.6 cm in group 3. While there was a significant difference in spleen size between group 1-group 2 ($p < 0.05$) and group 1-group 3 ($p: 0.01$), there was no significant difference between group 2 and group 3 ($p: 0.634$) (Table-1). The indications for splenectomies were ITP in 49 patients (%59.8) (group 1: 26%, group 2: 91%, group 3: 89%). Patients operated for ITP were significantly higher in group 2 and group 3 than group 1 ($p_1 < 0.05$, $p_3: 0.01$) (Table-1).

Other surgical indications other than ITP were splenic mass, lymphoma, and splenomegaly, in order of their frequency, respectively. When the patients' pathology results were evaluated, lymphoma, hairy cell leukemia, simple splenic cyst, hemangioma, and splenic lipoma were the most common conditions. Operation times for groups 1-2 and 3, respectively; it was 81.9 ± 17 min, 81.9 ± 22 min, and 97 ± 11 min. While there was no significant difference between groups 1 and 2 in terms of the operation time,

a significant difference was found between groups 2-3 and groups 1-3 ($p_1: 0.439$, $p_2: 0.002$, $p_3: 0.010$) (Table: 2). There was no significant difference in estimated blood loss in all three groups ($p: 0.446$) (Table-2). Hospital stay for groups 1-2 and 3, respectively; it was 3.4 ± 0.7 , 3.1 ± 0.1 and 2.5 ± 0.7 days. The hospital stay was significantly shorter in group 3 than in group 2 and in group 2 compared to 1 ($p_1: 0.033$, $p_2: 0.046$, $p_3: 0.01$). Two patients were converted to open surgery in group 2.

The reason for conversion was bleeding in both patients, and open splenectomy was completed without any problem in both patients. Both patients did not need perioperative and post-operative blood product transfusion, and they were discharged without any problem. One patient in group 3 was converted to conventional laparoscopic splenectomy due to dissection difficulty, and the operation was completed without any problems. Mortality did not occur in any of the patients during follow-up.

Table 1. Comparison of Demographic Features Among Patients

Variables	OS (n=38)	LS (n=34)	SILS (n=10)	P-value	P ₁	P ₂	P ₃
Age, year, mean	47.7±15	43.9±13	35.4±16	0.82	-	-	-
Gender, Male/Female	15/23	11/23	3/7	0.763	-	-	-
Spleen size, cm	19.8±7	11.7±1.6	12±1.6	<0.001	<0.001	0.634	0.01
Accessory spleen	1 (%2.6)	1 (%2.9)	1 (%10)	0.521			
ITP	10 (%26.3)	31 (%91.2)	8 (%80)	<0.001	<0.001	0.328	0.02
ASA score, 1/2/3	2 (%75)	2 (%68)	2 (%61)	0.311	-	-	-

As the confidence interval, p for all three groups. p₁ for group 1 and group 2, p₂ for group 2 and group 3, p₃ for group 1 and 3. OS: Open Splenectomy, LS: Laparoscopic Splenectomy, SILS: Single Port Laparoscopic Splenectomy; ASA: American Society of Anesthesiology, ITP: idiopathic thrombocytopenic purpura

Table 2. Comparison of intraoperative / post-operative results between the 3 groups

Variables	OS (n=38)	LS (n=34)	SILS (n=10)	P-value	P ₁	P ₂	P ₃
Mean operation times, min	81.9±17	81.9±22	97±11	0.007	0.439	0.002	0.01
Mean hospital stay, day	3.4±0.7	3.1±1	2.5±0.7	0.002	0.033	0.046	0.001
Conversion rate, n(%)	-	2 (%5.8)	1 (%10)	-			
Blood loss, ml	80±40	82±25	90±20	0.446	-	-	-

Discussion

With the development of minimally invasive techniques, surgeons move towards non-incision surgery instead of traditional open surgery with invasive techniques in almost every surgery field (11). Of course, this is not only because of the appearance of the incision. As surgical techniques and instruments improved, surgeons began to perform operations with fewer trocars, resulting in better postoperative outcomes such as cosmetic, economical, and less pain (12). Some surgeons in general surgery started to perform abdominal surgical procedures with a single port based on these reasons (13-14).

Due to the mentioned advantages, single port laparoscopic surgery can provide patients with a comfortable recovery, and consequently, it is expected to reduce the hospital stay. Hospital stay varies according to the health insurance policies of the countries. This period varies between 1 and 8 days in publications (15). However, in general, the duration of hospital stay in single-port splenectomies has been reported less than both open and laparoscopic splenectomies in the literature. In some series, this period has been reported as three days for SILS (16-17). In our study, mean hospital stay was 3.4 ± 0.7 , 3.1 ± 0.1 , and 2.5 ± 0.7 days for groups 1-2 and 3, respectively. The hospital stay was significantly shorter in group 3 than in group 2 and in group 2 compared to group 1 ($p_1: 0.033$, $p_2: 0.046$, $p_3: 0.01$). These results are generally compatible with the literature.

SILS has disadvantages in terms of surgical instruments and techniques compared to both open surgery and multiport laparoscopic surgery. The biggest problem in SILS is the collision of tools and necessity of repositioning. A parallel arrangement of instruments and

constant interaction between surgeon and camera operator adds complexity to the procedure. If enough angulation cannot be created, it may become impossible to do the procedure. Despite these disadvantages, some studies do not find a significant difference between LS and SILS in operation time (18-19). However, in many studies, the operation time was prolonged in patients who underwent SILS (15-17). We think that the biggest reason for this difference is the learning curve.

In our study, the operation times for groups 1-2 and 3 were 81.9 ± 17 , 81.9 ± 22 , and 97 ± 11 min. While there was no difference between groups 1 and 2 in terms of the operation time, a difference was found between groups 2-3 and groups 1-3 ($p_1: 0.439$, $p_2: 0.002$, $p_3: 0.01$). Operation time was prolonged in the SILS group compared to both LS and OS groups. These cases are the first SILS experience in our clinic. Operation times in our SILS group are similar to those specified in the literature (15-17).

A meta-analysis study comparing open and laparoscopic surgery results in non-traumatic diseases reported that the most common indication for open splenectomy is lymphoma, while laparoscopic splenectomy is ITP (17-18). Many studies show that ITP is the most common indication for both laparoscopic and SILS (15-17). The indications for splenectomies were ITP in 49 patients. (%59.8) (group 1: 26%, group 2: 91%, group 3: 89%). Patients operated for ITP were significantly higher in group 2 and group 3 than group 1 ($p_1 < 0.05$, $p_3: 0.01$). Spleen size was measured as 19.8 ± 7 cm in group 1, 11.7 ± 1.6 cm in group 2, and 12 ± 1.6 cm in group 3. While there was a significant difference in spleen size between group 1-group 2 ($p < 0.05$) and group 1-group 3 ($p: 0.01$), there was no difference between group 2 and 3 ($p: 0.634$).

Open splenectomy was preferred in patients with a spleen size greater than 15 cm and suspected malignancy in pre-op examinations or applied to our clinic for lymphoma staging. The most important reasons for this are sending the spleen to pathology without rupturing the spleen in patients with suspected malignancy and dissection difficulties encountered in laparoscopic procedures due to the spleen size.

Considering the patients' demographic data, 29 (35.4%) of the 82 patients operated on were male, and 53 (64.6%) were female. In average age group 1-2-3, respectively; it was 47.7, 43.9, 35.4. The accessory spleen was detected in 3 (3.7%) patients. There was no significant difference in all three groups in terms of age, gender, presence of accessory spleen, and ASA score. Although there was no statistically significant difference in age in all three groups, the SILS group's average age was 35.4. The accessory spleen has been reported between 2% and 20% in the literature (20). In our study, the accessory spleen was detected in 3 (3.7%) patients, 1 of each group.

In the literature, intraoperative blood loss ranged from 0 to 350 ml for SILS in studies. When we compare the three groups, there was no significant difference between blood loss in general (15-17). In our study, the average blood loss in all three groups was below 100 ml, and there was no significant difference between the three groups. In 1 patient in the SILS group, an additional trocar was needed due to dissection difficulty, and laparoscopic splenectomy was started with three trocars. This case is one of the first SILS cases done in the clinic. In this case, the instruments' parallel arrangement and the incompatibility between the surgeon and the camera operator prolonged the operation time and required additional trocar. The operation

lasted 120 minutes, but laparoscopic surgery was terminated without any complications.

In 2 patients in the LS group, bleeding could not be controlled laparoscopically, so they were converted to open surgery. One of these two cases' spleen size was 20 cm, and the other was 15cm. In both cases, the amount of perioperative bleeding was below 300 ml, and there was no need for perioperative or post-op blood transfusion. In these two cases, no risk was taken because of the low flow rate but ongoing bleeding, and open splenectomy was started in a short time. Various complications have been reported for LS and SILS in the literature. Eui Soo Han et al. reported in their study iatrogenic perforation of the stomach while applying SILS (21). In various studies, reoperation rates vary between 0% and 5% due to postoperative bleeding (21).

There was no need for reoperation in our cases. There were no severe postoperative surgery and general complications. When we look at the shortcomings of our study; firstly, this study is a nonrandomized retrospective study applied to a small number of patients. If randomized, prospective data are collected, more noticeable and beneficial results may be obtained. Second, this study did not investigate the emotional consequences of patients' aesthetic satisfaction and pain. Therefore, a comparison of subjective results between the LS and SILS method is necessary with both a prospective study and a questionnaire study on patients after surgery.

Conclusion

Minimally invasive surgery continues to gain popularity in all areas of surgery. Low morbidity rate, shortened hospital stay, and the good cosmetic outcome are some of the clear benefits of this minimal access technique. As surgeons gain experience and confidence, an

additional reduction in operative time can be expected. Also, new and more sensitive devices can meet ergonomic challenges. In our study, acceptable morbidity rates are seen in both the LS and SILS groups compared with OS.

Although we think that single-port laparoscopic splenectomy is a safe and alternative method to both laparoscopic and open splenectomy in our study, multi-center randomized controlled studies are needed to determine its advantages and disadvantages.

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