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Single Incision Laparoscopy in Solid Organ Surgery: Is there a limit?

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Background

Single incision laparoscopic surgery is recently became popular on behalf of inventing less invasive procedures. In this paper, we present the first cases of SILS pancreas, SILS liver resection and SILS splenectomy cases.

Patients and Methods

Between January 2009 and January 2010, Among total 32 patients of single incision laparoscopic surgery (SILS) patients, 13 cases have undergone SILS solid organ surgery composed of pancreatectomy (n=1), liver resection (n=2) and splenectomies (n=10).

Results

In 10 cases splenectomies, in one case distal pancreatosplenectomy, and in two cases liver resection were performed. The most common splenectomy indication was idiopathic trombocytopenic purpura, distal pancreatosplenectomy indication was renal cell cancer metastases, and liver resection indications were left hepatic masses(adenoma, hemangioma) in segment 1 and 2. Single incision laparoscopic surgery was performed successfully in 13 patients of solid organ pathologies. In a patient was converted to open procedure.

Conclusion

To our knowledge, SILS in liver, pancreas and spleen were thr first cases in lietarture. In experienced centers, single incision laparoscopic surgery is could be performed successfully. However, to be able reveal the differences between Standard laparoscopic surgery and SILS, prospective randomized comparative studies are required.

Key Words: Single incision, Laparoscopy, Surgery

INTRODUCTION

In the last 30 years, laparoscopic procedures have been used in various fields for treatment of many malignant and benign diseases.[1] Currently, laparoscopy is preferred as an alternative to open surgery due to its low complication rates, less postoperative pain, achievement of better cosmetic results, and patients returning to their daily lives faster.[2,1,3]

In order to have better cosmetic results, efforts aiming to reduce incision of laparoscopic surgery have been thought recently. For this purpose safer and equally as cosmetic approach use of single incision laparoscopic surgery (SILS) has gained significant momentum in different fields of surgical practise.[4,5] SILS practice has been started in our clinic since January 2009. Single incision laparoscopic splenectomy technique has been first described by us.[6] In addition to splenectomy, we have performed SILS pancreatectomy and liver resection which were the first cases in the literature in the world to our knowledge.

MATERIALS AND METHODS

We prospectively analyzed the data of 13 patients who have undergone SILS between January 2009 and January 2010, in the Department of General Surgery, Faculty of Medicine, Istanbul University. Demographic data were collected including patient age, gender, diagnoses. Operative data were including operative time (from the first incision to the closure), blood loss, transfusion level, indications for conversion to open surgery, pain score, complications, and length of hospital stay. During their hospital stay, pains of all the patients were scored based on the Visual Analog Scale. All patients were vaccinated with Pneumovax 23 (Merck&Co.Inc., Whitehouse Station, NJ, USA) 2 weeks prior to the splenectomy and pancreatosplenectomy and antibiotic prophylaxis (1g intravenous ampicillin-sulbactam) was applied. The patients were operated on under general anesthesia. The entire series of operations were conducted by the same team presided by UB. Postoperative analgesia was established with PCA (patient controlled analgesia). All the patients received the same nonsteroid antiinflammatory agents (8 mg intravenous lornoxicam, twice a day) and narcotic analgesics (50 mg intramuscular pethidine, twice a day).

SURGICAL TECHNIQUE

All procedures were performed using SILS instruments. In the first 4 splenectomy cases, standard 3 ports with 5mm size were placed through the umbilicus. In the last 6 splenectomies, 1 distal pancreatosplenectomy and two liver resections, interventions were conducted with a special SILS™ port (Covidien, Mansfield,MA), specifically designed for SILS .

SILS Splenectomy:

For splenectomy, all standard laparoscopic splenectomy steps followed by using roticulated instruments. A 5mm telescope with 30° angle was used. After ensuflation of the abdominal cavity, exploration was carried out for exploring the other patologies. Following placement of instruments into the abdomen, the basic mechanism is similar to that in 3-port laparoscopic procedures. The most difficult part of this technique is to work with articulated instruments crossing each other. Ligasure (Valleylab division of Tyco Healthcare, Mansfield, MA) was used during most of the dissection. Lower pole dissection and short gastric vessel ligation were performed with 5 mm Ligasure. Finally at the stapler stage in the splenic hilum, one of the ports was replaced with a 15 mm port and the operation was resumed.(figue 1) Spleen in the endobag morcellated before removal. An aspirative drain was placed in lodge routinely. In the last 6 splenectomy were conducted with a special SILS™ port (Covidien, Mansfield,MA), specifically designed for SILS .(figure 2)

SILS Pancreatectomy:

Patient was placed in a supine and reverse trendelendburg position (30 degree) with open legs. The surgeon stood between the legs, the first assistant was on the left side of the patient with the monitor placed on the cranial side of the patient. Under general anesthesia, completely trans-umbilical skin incision of 2 cm was performed. A special SILS port having four working channels is placed through this abdominal incision of umbilicus. Pneumoperitoneum was applied through this port. After the maintenance of 12 mmHg CO2 pneumoperitoneum, the three cannulas of 5 mm were inserted inside this special port of SILS. We used a rigid 30-degree, 5-mm laparoscope and two standard rigid but articulating 5-mm laparoscopic instruments for all procedures of SILS. Once the laparoscope, grasper, and dissector were placed, the overall procedures were similar to the procedures performed in a five-port laparoscopic pancreatectomy. The most difficult part of this technique was that the working instruments were crossing each other and roticulated. The 5 mm telescope was introduced under both of the working instruments and sometimes over them changing according to the surgical step of the procedure. After less invasive entry into the abdomen nothing different from multi-trocar laparoscopic pancreatectomy

Figure 1 – **Hilum ligation with Endo GIA which was introduced through the SILS port**

technique, was performed. During all these steps at least one of the equipments of roticulated grasper and dissector were used. Following a diagnostic laparoscopy, the lesser sac was entered by dividing the gastrocolic ligament using advanced probe of Liga-Sure (Valleylab, Boulder, CO, USA). The whole pancreatic body and tail were exposed and the 2 cm lesion on the corpus was defined. Before starting pancreatic dissection we placed a loop encircling the stomach corpus by crossing the lesser curvature and greater curvature for preoperative continous retraction. We prepared the loop using polypropylene suture covered with a plastic tube of IV serum set in order to prevent a possible stomach injury. Two tips of this suture were taken out of abdominal cavity with suture passer placed under xiphoid process. During the whole procedure stomach retraction was provided with this tensed loop prolene hanging the stomach. 'Medial-to-lateral' technique for tumours in the body and proximal tail of the pancreas was the chosen method. The peritoneal lining along the inferior edge of pancreas was dissected at the point where transection of pancreas would be carried.(figure 3) An adequate window was created, a roticulated grasper was passed around the body of the gland. The splenic vein was identified and ligated with ligasure at this level. One of the 5 mm trocar sites on Simport was replaced with a 15 mm trocar to be able to introduce lineer stapler. The pancreas was then transected using two 45 mm Endo-GIA

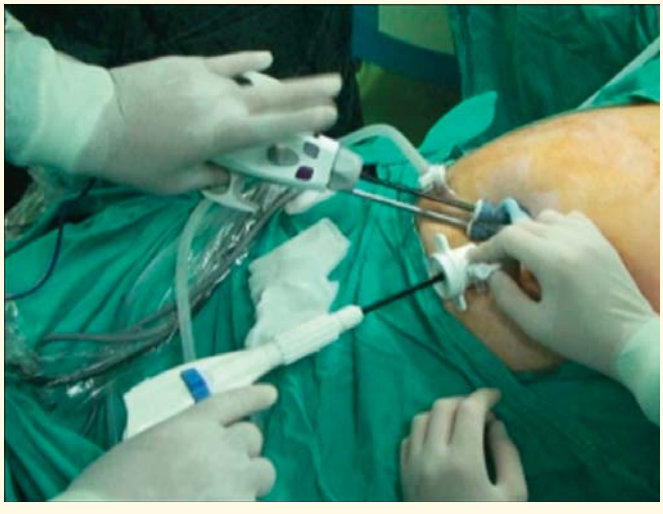

Figure 2 – **SILS port and working equipments**

staplers (US Surgical Corp, Norwalk, CT, USA). Dissection of the pancreas from the pancreatic bed was started after ligation of the splenic artery near the celiac trunk. Dissection was carried out in a medial-to-lateral fashion from the tail towards the hilum of the spleen. Retroperitoneal dissection took time due to dense fibrosis of the region caused by previous left nephrectomy. In this manner, the distal portion of pancreas containing the tumour was removed together with splenic vessels and spleen itself and its retroperitoneal attachments and thus freed. Once the distal pancreas was mobilized, the stapled closure of the proximal pancreatic stump was reinforced with Fibrin

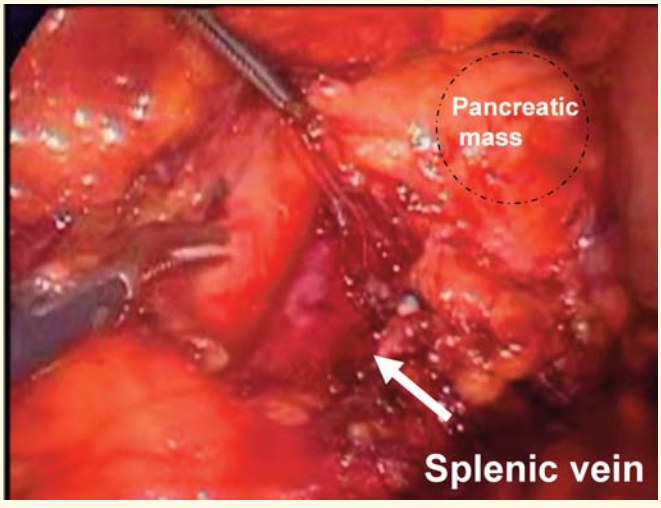

Figure 3 – **Dissected lower pancreatic edge and splenic vein lying under the pancreas**

Figure 4 – **Postoperative closed umbilical incision in which also aspirative drain can be placed**

glue. The splenic part of the specimen was retrieved using the Endo-Catch 15 (US SurgicalCorp, Norwalk, CT, USA) by morcellation, and then, pancreatic part of the specimen was delivered through the umbilical port site as an intact piece. A closed suction drain

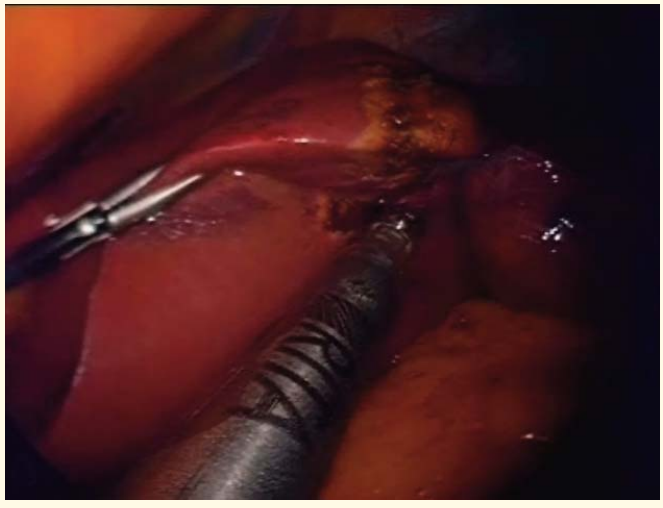

Figure 5 – **SILS irregular left lateral segment resection and radiofrequency probe (Habib IV) use for parenchyma dissection**

was placed in the lesser sac. Umbilical site was sutured with 0 polypropylene and the skin was closed with stapler. (figure 4)

SILS Hepatectomy:

In this case again SILS port was used. Initially round ligament was retracted by using a 0 polyprolene suture from right subcostal region. Left triangular ligament was dissected with angulated scissor and 5 mm Ligasure. Irregular segment 2 and 3 resection was performed with the help of radiofrequency probe (Habib IV).(figure 5). After resection of liver segment, they were placed into a special sterile nylon bag (endobag) before removal. Both of the lesions (adenoma, hemangioma) were benign which were removed with SILS technique.

RESULTS

Mean age of the patients was 37.4 years, and the male/female ratio was 3/10. In 10 cases splenectomy, in 1 case distal pancreatosplenectomy, and 2 cases of irregular segmental liver resection were performed. The type of the SILS and patients number is shown in table 1. None of the cases showed mortality. Indications, demographic characteristics, intraoperative

Table 1. **SILS Splenectomy cases**

No	A/S	SS	LO	BL	Transfusion	LS	D	C	COA	VAS	Diagnoses
1	**28/F ***	**11.9**	**85**	**200**	**2 U PSA**	4	**F:200 S:25 T:10**	**No**	**No**	**F:2**	**ITP**
2	40/F	15	120	Abundant	2 U PSA + 2 U ES	5	0	Hemorrhage	Yes	F:5	TTP
3	28/M	11.9	180	50	2 U PSA	2	F: 75	No	No	F:2	ITP
4	32/F	11.7	115	50	2 U PSA	4	F:200 S:50 T:20	No	No	F:2	ITP
5	22/F	11.9	100	70	2 U PSA	3	F:80 S:40	No	No	F:2	ITP
6	31/F	12.1	125	75	2 U PSA	3	F:90 S:30	No	No	F:2	ITP
7	28/F	13.4	60	50	2 U PSA	2	F:70	No	No	F:2	ITP
8	57/M	12	65	50	2 U PSA	2	F:75 S:20	No	No	F:2	ITP
9	47/F	11.8	75	40	2 U PSA	2	F:100 S:40	No	No	F:2	ITP
10	22/M	12.7	55	50	2 U PSA	2	F:50 S:20	No	No	F:2	ITP

blood loss, pain scores on day 1 and 3, hospital stay length, daily drainage levels, and drain removal times of the cases are shown in Table 2,3,4,5 respectively. Splenectomy indication was idiopathic thrombocytopenic purpura in all cases. In one case, we were forced to conversion to open surgery due to hemorrhage in the splenic artery as a result of failure to fire the stapler. Spleen sizes varied between 11.7-15cm. Blood loss occurred between 50-200cc. While shortest operation length was 60 minutes, longest one was 180 minutes in the splenectomy group. No wound infection was observed in the abdomen postoperatively and there was perfect cosmetic appearance . In 43 years old female there was a 5 cm left lobe tumor located peripherically between segment 2 and 3. In this case liver parenchyma resection was performed with laparoscopic Habib probe of radiofrequency energy. Whole operation lasted 2 hours. Patient was discharged on the 3 rd postoperative day without nay complication. Pathology result revealed hepatic adenoma with clean hepatic tissue margins. Similar case of 49 years of female left hepatic hemangioma (6 cm) was also treated with the same technique. Pancreatectomy case was 59 years old female who underwent left nephrectomy 11 years ago for the treatment renal cell cancer. In her follow-up two suspicious pancreatic lesions determined. After a successful SILS subtotal pancretosplenectomy with clean tumor free margins, histopathology confirmed the two foci of renal cell cancer metastasis. Operating time was 330 minutes. In postopeartive period low volume pancreatic fistula ceased after 20 days with the close follow up of drain

Table 2. **Demographic characteristics, surgical datum and diagnoses of the other cases**

	A/S	LO	BL	Transfusion	LS	C	COA	VAS	Diagnoses
1	59/F	330	100	No	7	Pancreatic fistula 20cc/day	No	F.2	*Pancreatic metastases
2	49/F	150	30	No	2	No	No	F:2	*Liver hemangioma
3	44/F	120	50	No	4	No	No	F:2	*Liver mass (adenoma)

Abbreviatios: A/S: Age and sex, **SS**: Spleen size (cm), **LO**: Length of the operation (minutes), **BL:** Blood loss (cc), **PSA:** Platelet suspension was prepared by method of apheresis **ES :** Erythrocyte suspension **LS**: Length of the stay (day), **D**: Drain volume(cc), **F:**First day,**C**: Complications, **COA**: Conversion to open approach, **VAS**: Visual Analog Scale.

* **To our knowledge first cases in the literature**

that was placed during the surgical intervention. To our knowledge, subtotal pancreatectomy together with splenectomy and left irregular lateral segment hepatic resections are the first cases that were performed with SILS technique in the literature.

DISCUSSION

The introduction of laparoscopy in the early 1990s leaded a new era in the surgical treatment of human diseases. Evolution of minimally invasive techniques has furthered an impulsion in the surgical community to reduce the invasiveness of laparoscopic surgery. Although SILS practice is relatively new, it has already been applied in plenty of surgical procedures by keen on surgeons. Many procedures such as cholecystectomy, adrenalectomy, laparoscopic total extraperitoneal inguinal hernia repair, right hemicolectomy, left hemicolectomy, rectum operations, sleeve gastrectomy, gastrojejunostomy, and nephrectomy have been performed through single incision and reported to the world literature.[8,9,10,11] Although as the solid organs, nephrectomy, prostatectomy and adrenalectomy previously performed with SILS tecnniques, to our knowledge, first SILS splenectomy, pancreatectomy and liver resection are performed in our clinic in the world.[6]

As clinical experience with SILS increases, there are two inevitable questions encountered: First, does SILS compromise on current standards of surgical care? Second, are real benefits of SILS restricted to only improved cosmesis, or are there additional advantages with respect to convalescence and postoperative recovery period? Raman's findings in single incision nephrectomy cases underscore that, in the hands of an experienced laparoscopic surgeon, SILS nephrectomy is equally efficacious to conventional laparoscopic nephrectomy without compromising on surgical or postoperative outcomes. Interestingly, despite this series representing their initial SILS experience, they noted no differences in any operative variables compared to conventional laparoscopy. Anecdotally, they observed no increased difficulty in their cases compared to radical nephrectomy, although they presume that there may be future cases in which dense retroperitoneal inflammatory reaction may prove a challenging obstacle.[6,12]

Since the first laparoscopic splenectomy by Delaitre in 1991 and technique widened its range including massive splenomegaly cases.[13] Regarding minimally invasive surgeries, operations performed with three trocars have been thought to be the best practice that could ever be achieved. Together with our laparoscopic splenectomy experience, use of SILS on solid organs such as in nephrectomy gave us the inspiration that we could employ this method in splenectomy. Consequently, we performed the technique and reported the first SILS splenectomy cases in the world.[4] Single incision laparoscopy presents several advantages over

standard laparoscopy. It is certain that although SILS requires articulated instruments, it is a harder practice compared with the standard laparoscopic techniques. However, we are at the start point of a new route and have to learn many things. We believe that, by the time practices will be easier and the technological advances will increase the comfort of surgeons in this technique. In our SILS splenectomy series, highest length of operation was 180 minutes in the first case, whereas the operation length in our last case was 60 minutes.

Many studies have recently reported on laparoscopic liver resection, although its development has been slow compared to laparoscopy in other fields. The indications for the location of laparoscopic liver resection have previously been limited to easily accessible lesions. endoscopy, high definition imaging and various kinds of equipment for parenchyma transaction such as radiofrequency, bipolar vessel sealing systems have been introduced for clinical use. .[14] Although some reports declaring hepatic tumors located in the difficult localizations like right lobe posterior segment, major left lateral segment resections are performed laparoscopically. We describe here the technical considerations for performing laparoscopic liver resection, with SILS technique. In two cases of left lateral segment benign lesions, we performed single port liver resection without any complication successfully.

In conclusion, we believe SILS is as beneficial as conventional laparoscopic surgery regarding the major advantages of laparoscopy. Although SILS provides a better cosmetic outcome, in order to reveal the main advantages of SILS, more prospective, and randomized studies, are required.

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