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Laparoscopic Splenectomy Using LigaSure

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ABSTRACT

Background: Laparoscopic splenectomy (LS) has become the standard approach for most splenectomy cases. Bleeding is the main complication and cause for conversion. We present our experience with the LigaSure and discuss its advantage as a vessel sealing system in achieving safe vascular control.

Method: Over a 3-year period, we performed 12 consecutive LS using LigaSure at a single center. A literature review of all the patients who had undergone laparoscopic splenectomy with of the LigaSure to achieve vascular control at the hilum was carried out, assessing its advantages and outcome.

Results: Twelve LS were performed. Eleven of these patients had ITP, and one patient had sickle cell disease. The mean blood loss was 70mL (range, 50 to 460), and operating time was 126 minutes (range, 110 to 240). Two postoperative complications occurred: portal vein thrombosis in one case and subphrenic collection in the other. The literature review revealed 8 studies with 231 cases in which the LigaSure was used to perform laparoscopic splenectomy. A significant reduction in operating time (average 102 minutes) and intraabdominal blood loss (66mL) was observed with the LigaSure compared with endostaplers.

Conclusion: The use of LigaSure and the semilateral position results in a gain of time and safety in addition to low intraoperative bleeding, need for transfusion, minimal complications and a low conversion rate.

Key Words: Laparoscopic splenectomy, LigaSure, Bleeding.

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INTRODUCTION

Laparoscopic splenectomy (LS) was first performed in 1992 and has since gained popularity, particularly for hematological disorders of the spleen in adult and pediatric patients.[1–4] LS is feasible, effective, and safe with low morbidity rates and has become a rational alternative to open splenectomy.[4–6] The advantages of shorter postoperative hospital stay (3.6 versus 7.2 days) and lower complication rates for the laparoscopic approach (15.5%) over open splenectomy (26.6%) have been shown in a meta-analysis.[6] LS was associated with significantly fewer pulmonary, wound, and infectious complications.[6] The concern however was longer operating time and increased risk of intraoperative bleeding due to technical difficulties in securing vascular control at the splenic hilum. With the advent of vessel sealing systems like LigaSure (Valley Lab, Boulder, CO), the dissection and vascular control of the hilum became easier, leading to a decrease in operative time and blood loss during LS.[1–3] We evaluated 12 LS performed using the LigaSure, without using any laparoscopic suture or endoscopic stapler and assessed the outcome in terms of operating time, blood loss, and complications. The literature was reviewed to look at the present evidence on the advantages and outcomes with the LigaSure as a vessel-sealing system in LS.

MATERIALS AND METHODS

We reviewed all the patients who underwent laparoscopic splenectomy from 2005 to 2008. During this period, we performed 12 laparoscopic splenectomies using LigaSure as the vessel-sealing device. Surgical indications were idiopathic thrombocytopenic purpura in 11 patients and sickle cell disease in 1 patient. There were 7 female and 5 male patients with an age range from 17 years to 56 years (mean, 28). Body mass index ranged from 19 and 29 (mean, 24), and American Society of Anesthesiology (ASA) scores was 1 (n=8) or 11 (n=4). The mean diameter of the spleen was 12cm (range, 9.5 to 16). Preoperative mean thrombocyte count were 28 000/mm^3 (range, 4000 to 125 000) in the patients with idiopathic thrombocytopenic purpura, all of whom failed to respond to medical treatment preoperatively. All patients were immunized against pneumococcal infection at least one month

prior to splenectomy. Blood loss was measured by the amount of blood accumulated in the suction reservoir after excluding the amount of irrigation solution. Operating time was defined as the period between the beginning of the incision and closure of the wounds.

Surgical Technique

Patients were operated on while in the right lateral decubitus position with a flexed operating table. Pneumoperitoneum was performed with a Veress needle from the umbilical position after nasogastric decompression. Pneumoperitoneum was maintained at 12mm Hg. The port positions included a 10-mm port placed at the umbilicus for 30^0 telescopes and a 5-mm trocar at the epigastrium. Through this port, adhesions, if any, of the splenic flexure of the colon were released to place the left lumbar trocar (10mm), which was placed in the lumbar space between the costal margin and the iliac crest. The epigastric port was used for the retraction and elevation of the spleen from caudal to cranial, and the lumbar port was used for dissection, sealing, and cutting of the tissues and vessels. At the beginning of the study, a fourth 5-mm trocar was placed to the posterior axillary line of the left flank. Dissection of the spleen and sealing of the hilar vessels and short gastric vessels were done with the 5-mm and 10-mm LigaSure Atlas vessel-sealing system (Valley Lab, Boulder CO, USA). No laparoscopic clips, sutures, or monopolar-bipolar diathermy were used. After looking for accessory splenic tissues, dissection and sealing of splenic vessels was performed from the lower pole to the upper pole and from lateral to medial. Techniques for opening the gastrosplenic ligament to demonstrate the splenic tent or early ligation of the splenic artery or dissection of the pancreatic tail were not used. Hilar vessels were divided with a 10-mm LigaSure close to the splenic capsule, and short gastric vessels, particularly at the upper pole close to the stomach, were divided with a 5-mm LigaSure, which was particularly useful in narrow spaces, such as that occurring when dividing the gastrosplenic ligament near the upper pole of the spleen. Because of splenic hanging in the lateral decubitus position, gastric retraction medially was unnecessary during short gastric vessel division. This was followed by division of splenorenal and splenophrenic ligaments to completely free the spleen of its attachments. The spleen was then removed through the lumbar trocar with an improvised plastic bag used for delivering pathology specimen after enlarging the incision to 15mm. The spleens were fragmented within the bag with sponge holding forceps and removed through the lumbar trocar site.

RESULTS

The mean weight of the spleen was 160g (range, 120 to 480). There was one ectopic spleen close to the hilum. Mean operative blood loss was 70mL (range 50 to 460), and the mean operative time was 126 minutes (range, 110 to 240). Operative time was reduced after a short learning period. The nasogastric tube was removed on day 1, and oral feeding was begun on day 2, postoperatively. No mortalities and 2 morbidities occurred. One patient was readmitted with a subphrenic collection that was aspirated under ultrasound guidance. The other patient developed portal vein thrombosis and presented with an acute abdomen 9 days after splenectomy. This patient was explored and was found to have a segment of infarcted jejunum that was resected. Following postoperative anticoagulant therapy, the patient made an uneventful recovery. No conversions were necessary. However, one patient required extension of the incision due to difficulty in placing the spleen in the improvised plastic bag. Mean hospital stay was 4 days (range, 3 to 6). The mean postoperative platelet count was 1 800 000 (range 62 000 to 7 800 000). One of the patients with high postoperative platelet count was carefully monitored with color Doppler for any evidence of portal/splenic vein thrombosis and was discharged on oral anticoagulants.

DISCUSSION

LS is considered the gold standard for the treatment of benign hematological disorders of the spleen, particularly for small-sized spleens in adults and pediatric patients.[1–6] Like other laparoscopic procedures, LS offers numerous advantages over open splenectomy, such as less postoperative pain and blood loss, faster recovery, shorter hospital stay, and fewer complications.[5,6] However, it is a technically challenging procedure, and perioperative bleeding is a major concern with LS. In the early era of LS, individual hilar vessels were isolated and controlled using clips or ligatures prior to division. The complex blood supply of the spleen warranted a great number of clip applications. These metal clips were potentially harmful foreign bodies left behind. The use of a surgical stapler to divide the splenic hilum quickens this surgical step. However, the Endo-GIA stapler requires proper positioning of the device for hilar vascular control following accurate dissection with meticulous skeletonization to exclude extraneous tissues, positioning it as close to the spleen and as far as possible from the tail of the pancreas. Prominent splenic vessels, perihilar soft tissue, the close proximity of the tail of the pancreas, and the narrow jaw opening of

currently available staplers may lead to bleeding from the vascular stapler line, because of incomplete hilar transection.[3,5] Pancreatic fistula or clinical pancreatitis are well-documented complications after LS, as a consequence of the tail of the pancreas being retained between the jaws.[2,5,7] The LigaSure vessel-sealing system was developed for both laparoscopic and open procedures as an alternative to suture ligation, hemoclips, staplers, and ultrasonic coagulation for dealing with vessels and soft tissue.[1–3,5] LigaSure applies bipolar electrical energy to vessel walls. Proteins like collagen and elastin within the vessel walls are partially denatured, and the sealing produces a single compact structure that obliterates the lumen of the vessel. The hemostatic seal is characterized at 20 days by extensive fibrosis with minimal inflammation.[8,9] The device can safely seal and divide vessels <7mm in diameter.[1,7–9] The splenic veins however could exceed 7mm in diameter at the hilum. In these situations, by ligating the splenic artery initially over the superior border of the pancreas, the splenic vein would collapse and could be sealed securely with the LigaSure.[1] Seals have been shown to withstand a minimum of 3 times the normal systolic pressure. LigaSure sealing causes low lateral thermal spread (<2mm), and the smoke produced is also low.[8,9] Because grasping, coagulating, and cutting are done at the same time, frequent instrument interchange is unnecessary and thus time is saved.[1–3,10,11]

A review of the literature pertaining to LS performed with use of a vessel-sealing system including the present series revealed 9 studies involving 243 patients.[1–3,11–15] In these studies, the procedure was completed by using vessel-sealing systems as the only means of achieving hemostasis without the use of clips and endostaplers. The common indications included idiopathic thrombocytopenic purpura, which was the most frequent indication (57%), followed by hereditary spherocytosis (15%) and lymphoma (11%) **(Table 1)**. Other indications include thalassaemia, parasitic or nonparasitic cysts, lymphangioma, thrombotic thrombocytopenic purpura, and hemolytic anemia. The average weight of the excised spleen was 243g (range, 80 to 1800), blood loss was 66mL (range, 0 to 875), and the operating time was 102 minutes (range, 30 to 250). Complications were seen in 7.4% (18 patients), the significant among them being 2 cases each (0.82%) of portal vein thrombosis and pancreatic fistula **(Table 1)**. Other complications include port-site bleeding, wound infection, and general complications like deep vein thrombosis and respiratory complications including pneumonia and pleural effusion. Nine patients required conversion for bleeding from the hilum or splenic capsule, in most cases in the initial learning phase.[1–3,14]

The concerns of operating time and the amount of blood loss during LS have been addressed by Aydin et al[1] in their review comparing the use of LigaSure and endostaplers in the transection of the splenic hilum. Comparing 1430 patients who had undergone LS with endostaplers and clips with 144 patients in whom a vessel-sealing system was used, the blood loss of 160mL to 382mL (average, 224) was much higher than 60mL to 80mL (average, 73) when a vessel-sealing system was used.[1]

Although laparoscopic splenectomy has several advantages over open splenectomy, longer operating time has been its main disadvantage. Winslow and Brunt[6] reviewed 2940 patients in 51 studies (2119 laparoscopic and 821 open splenectomies) and found that the operative times were significantly longer in the laparoscopic splenectomy group by over 60 minutes (114 vs 180). This prolonged operative time did not improve with the use of staplers in achieving vascular control of the hilum, as reported by Bell and associates who found no significant improvement in operative time over a 10-year period.[16] The mean operating time for large spleens where endostaplers and clips were used for vascular control in laparoscopic splenectomy was 156 minutes (range 95 to 170).[1] However, a significant improvement in mean operating time of 103 minutes (range, 71 to 125) was observed when a vessel-sealing system was used to achieve vascular control.[1] The reported operative time was usually <2 hours, which was comparable to the results of open splenectomy,[1] and this was substantiated by observations made in the literature review **(Table 1)**. This was partly achieved by the fact that vessel-sealing systems perform dissection, coagulation, and cutting with the same instrument, leading to less instrument changing. Change of instrument may lead to the risk of losing vision of the surgical area, which is of outmost importance in the event of bleeding. Using a multifunctional instrument like LigaSure enables rapid intervention in such an event to stop bleeding and to decrease time consumption and blood loss.[1–5] The comfort and satisfaction rate of the surgeon is further enhanced, because cutting of all the adhesions surrounding the spleen, and coagulation of vessels of the splenic hilum (splenic artery and vein) and gastrosplenic vessels can be achieved with a single instrument.

The LigaSure vessel-sealing system thus offers some advantages compared with other instruments:

(1) it permits easy dissection of the spleen, reducing the risk of damage to the pancreatic tail (the vascular pedicle

Table 1.
Laparoscopic Splenectomy Using LigaSure: Literature Review

Author Year	No. of Patients (Male: Female)	Age [Mean y (Range)]	Indication Splenectomy[a]	Surgery Duration [Mean Min (Range)]	Mean Spleen Weight [g (Range)]	Blood Loss [Mean mL (Range)]	Conversions [n (%)]	Complications [n (%)][a]	Mortality	Hospital Stay [Mean d (Range)]
Present Series 2010	12 (5:7)	28 (17–56)	ITP-11	126 (110–240)	160 (120–480)	70 (50–460)	Nil	2 (16%)	Nil	4 (3–6)
								PVT-1		
			SCD-1					Subc-1		
Misawa T[2] 2009	30 (16:12)	47 (20–78)	ITP-14	143 (90–180)	319.4 (80–1065)	21.6 (0–250)	1(3%)	2(6.7%)	Nil	6.5
			PST-5					PF-1		3–14
			Lym-4					Res-1		
			HS-2							
			PH-2							
			Misc-3							
Canda AE[12] 2009	14 (NA)	NA	ITP-6	84.7 (30–190)	247 (147–620)	NA	NIL	2(14%)	Nil	3.1 (2–8)
			AHA-7							
			HS-1							
Aydin C[1] 2008	19 (3:16)	37 (18–67)	ITP-17	107 (45–230)	230 (95–510)	88 (20–400)	2(17.6%)	3(16%)	Nil	4 (3–10)
			Lym-1					PSI-1		
			Misc-1					Res-1		
								POB-1		
Wang GY[13] 2008	32 (4:28)	36 (16–64)	ITP-19	70 (55–130)	NA	200 (50–600)	NIL	NIL	NIL	6 (NA)
			HS-6							
			AHA-3							
			Mis-4							
Romano F[3] 2007	74 (NA)	32.8 (4–80)	ITP-25	137 (55–250)	485 (265–1800)	257 (50–875)	5(4.5%)	5(6.7%)	Nil	4.6 (NA)
			HS-19					PSB-1		
			Lyml-21					PVT-1		
			Thal-4					PSI-1		
			AHA-1					POB		
			TTP-2					Res-1		
			PSL-2							

Table 1 continued on next page.

Table 1. (continued)
Laparoscopic Splenectomy Using LigaSure: Literature Review

Author Year	No. of Patients (Male: Female)	Age [Mean y (Range)]	Indication Splenectomy[a]	Surgery Duration [Mean Min (Range)]	Mean Spleen Weight [g (Range)]	Blood Loss [Mean mL (Range)]	Conversions [n (%)]	Complications [n (%)][a]	Mortality	Hospital Stay [Mean d (Range)]
Barbaros[14] 2007	29 (6:23)	35 (22–48)	ITP-20	71.3 (51–90)	250 (160–340)	85 (62–108)	1(3.4%)	3(10.3%)	Nil	2.86 (1.27–4.45)
			HS-3					PF-1		
			TTP-2					PSI-1		
			Lyml-1					DVT-1		
			Mis-3							
Yuney E[11] 2005	10 (6:4)	36 (16–58)	ITP-10	93 (60–155)	NA	60 (20–100)	NIL	NIL	Nil	4.3 (3–7)
Schaarschmidt [15] 2002	23	9.8 (5.1–16.7)	ITP-17	86 (38–165)	NA	NO	NIL	1(4%)	Nil	NA
			HS-5					POB-1		
			Thal-1							
Total	243	31 (5–80)	ITP-139(57%)	102 (30–250)	243 (80–1800)	66 (0–875)	9 (3.7%)	18(7.4%)	Nil	4.42 (1.27–14)
			HS-36(15%)					PVT-2 (0.82%)		
			Lyml- 27(11%)					PF-2 (0.82%)		

[a]ITP=idiopathic thrombocytopenic purpura, SCD=sickle cell disease, LymL=Lymphoma and leukemia, HS=hereditary spherocytosis, PH=portal hypertension, Misc=miscellaneous, AHA= autoimmune hemolytic anemia, Thal= thalassemia, TTP=thrombotic thrombocytopenic purpura, PSL=primary splenic lesions, PVT=portal vein thrombosis, SubC=subphrenic collection, PF=pancreatic fistula, ResC=respiratory complication, PSI=port-site infection, PSB=port-site bleeding, POB=postoperative intraabdominal bleeding, NA=Not available.

at the hilum can be sealed staying as far as possible from the pancreas);

(2) it ensures minimal sticking, charring, and lateral thermal spread (<2mm);

(3) it prevents electric hazards;

(4) it reduces frequent instrument interchange, because grasping, coagulability, and cutting are done at the same time, saving time and avoiding accidental capsular tears, which cause troublesome oozing;

(5) in overweight patients with fatty tissues, it is feasible to seal lower polar vessels without perfect dissection or isolation, which can cause unnecessary bleeding;

(6) it may be a cost-effective alternative for achieving hemostasis;

(7) it is easy to use;

(8) no foreign material, such as clips, stapler, or sutures, are left behind making it an attractive strategy in laparoscopy surgery.[1–5,11–15]

CONCLUSION

We believe that a vessel-sealing system like LigaSure is safe for vascular control in LS and can provide less blood loss. This technique reduces operating time in LS and removes the disadvantage of a longer operating period in LS over the open splenectomy with acceptable complication and conversion rates. The ease and multifunction of LigaSure in sealing vessels <7mm and cutting of tissue without the need to change instruments enhances the surgeon's comfort and satisfaction level.

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