Comparision of Hem-o-lok polymeric clip and tri-staple in laparoscopic splenectomy

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Murat Derebey*, Gokhan Selcuk Ozbalci*, Savas Yuruker*, Ismail Alper Tarim*, Ufuk Karabacak**, Can Akgun***, Vahit Mutlu*, Mahmut Basoglu*

**Department of General Surgery, Ondokuz Mayis University Faculty of Medicine, Samsun, Turkey*
***Department of Surgical Oncology, Cumhuriyet University, Faculty of Medicine, Sivas, Turkey*
****Department of General Surgery, Sirnak State Hospital, Sirnak, Turkey*

Comparision of Hem-o-lok polymeric clip and tri-staple in laparoscopic splenectomy.

AIM: *This study aimed to compare the hem-o-lok polymeric clip (HC) and tri-staple (TS) methods used in dividing the splenic hilum in terms of results, and to reveal their superiority to each other.*
MATERIAL AND METHODS: *Medical records of patients undergoing elective laparoscopic splenectomy at the Ondokuz Mayis University Faculty of Medicine General Surgery Clinic between March 2011 and March 2020 were retrospectively analyzed. Forty-two laparoscopic splenectomy cases performed using hem-o-lok polymeric clip (HC) or tri-staple (TS) were included in this study. Demographic features, primary diagnoses, splenic size, intraoperative data and postoperative complications, as well as the clip and stapler prices used in the surgery were analyzed.*
RESULTS: *The mean operative time was significantly longer for HC group than TS group (116.7 min vs. 87.6 min, $p<0.05$). The mean cost of surgical instruments used to divide the splenic hilum was significantly lower for HC group than TS group (34.1 usd vs. 165.4 usd, $p<0.05$). There was no postoperative mortality, with a morbidity rate 6 (26.1%) for TS group and 4 (21.1%) for HC group ($p>0.05$). No significant difference existed in the complication rates.*
CONCLUSIONS: *In the HC group, the operation time was longer, but the surgical cost was significantly lower. There was no significant difference when comparing other perioperative results. Although both techniques can be applied safely, we would like to emphasize that hemostasis is the most important factor for good results.*

KEY WORDS: Hem-o-lok polymeric clip, Laparoscopic splenectomy, Tri-staple

Introduction

Since its first description by Delaitre and Maignien in 1991, laparoscopic splenectomy (LS) has become the surgical procedure of choice for splenectomy [1]. Nowadays laparoscopic splenectomy is emerging as the gold standard for treatment of hematological disorders of the spleen in adult and pediatric patients because of its feasibility, safety, less postoperative pain, shorter length of hospital stay, decreased postoperative morbidity rates when compared to open splenectomy [2,3]. The reported conversion to open splenectomy is between 2% and 10% in major series. Splenomegaly or uncontrolled bleeding are reported as the main causes for conversion [4,5].
Various laparoscopic techniques have been reported for splenectomy with the advancement in technology. Clips, endoscopic vascular stapler or vessel sealing system have been used for the transection of the splenic hilum. Each of these techniques has its own advantages and disadvantages [6,7]. Vascular structures should be carefully dissected free of surrounding tissue before the clip is applied. This technique which may entail a risk of bleeding can be time consuming until experience is gained. Staplers may lead to pancreatic injury, arteriovenous fistula (AVF) formation, splen-ic-portal vein thrombosis or

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Correspondence to: Murat Derebey, M.D., Ondokuz Mayis University Faculty of Medicine, Department of General Surgery, 55139 Atakum, Samsun, Turkey (e-mail: mderebey@gmail.com)

bleeding from the splenic hilum or capsule because of incomplete hilar transection [8,9].

In this study, we aimed to compare laparoscopic splenectomies which were performed using hem-o-lok polymeric clip (Hem-o-lock, Weck Closure Systems, Research Triangle Park, NC, USA) or tri-staple (Covidien Endo GIA Reinforced Reload with Tri-Staple Technology, Covidien Europa, Dublin, Ireland), and to evaluate them in terms of superiority to each other.

Material and Methods

Medical records of patients undergoing elective laparoscopic splenectomy at the Ondokuz Mayis University Faculty of Medicine General Surgery Clinic between March 2011 and March 2020 were retrospectively analyzed. Fourty-two laparoscopic splenectomy cases performed using hem-o-lok polymeric clip (HC) or tri-staple (TS) were included in this study. Since the data were analyzed retrospectively, no choice was made for which patient and which technique to use. Data on the patients demographic features, primary diagnoses, additional surgery, splenic size, surgical outcomes, postoperative morbidity and mortality were evaluated. Drain withdrawal time, lenght of hospital stay were examined. For the surgical cost, the clip and stapler prices used in the surgery were compared. Two patients required conversion to an open approach due to bleeding were included in the study. All patients were vaccinated against pneumococcal, meningococcal, and haemophilus influenzae infections at least 2 weeks before surgery. Enoxoparin sodium was administered to all patients during the postoperative period for 10 days (4000 IU/day, subcutaneously). Doppler ultrasonography or computed tomography was only performed in patients who had clinical findings (abdominal pain, distension, diarrhea, nausea, fever, leukocytosis) that indicated portal vein thrombosis in the postoperative period.

Surgical technique

Patients were operated in the right lateral decubitis position (45°) with the left side up and flank cushion was placed under the right side. The stomach was decompressed with a nasogastric tube and a urinary catheter was inserted. Pneumoperitoneum was performed with a Veress needle or an open acces technique from the left side of umblicus and a 10-mm-trocar was placed for insertion of a 30° angled telescope to explore the abdomen. The intra-abdominal pressure was achieved by CO_2 insufflation to 14-15 mm Hg. A 5-mm-trocar was placed into the mid-epigastrium near the left side of costal margin. The last and third 12-mm-trocar was inserted in the left upper quadrant at the crossing of mid-clavicular line. Three trocars were generally used, and a fourth trocar was placed if necessary. LigaSure ™ 5-mm Blunt Type Laparoscopic Instrument (Valleylab, Boulder, CO, USA) was used in all surgeries. Accessory spleens were routinely searched for at the time of operation. The spleen was placed into a specimen retrieval bag and removed en-bloc or after the morcellation. A negative pressure drain was placed routinely to the left subphrenic area.

Hem-O-Lok Polymeric Clip Method

The first step was the dissection of the short gastric vessels and gastrosplenic ligament. The splenic artery was dissected immediately proximal to its bifurcation on the pancreatic tail. Two hem-o-lok polymeric clips were placed on the splenic artery and early divided. The second step was the approach to lower pole of spleen. Splenocolic ligament and lower pole vessels were divided with Ligasure. Dissection of the splenic hilum was performed close to the splenic parenchyma from inferior to superior and from anterior to posterior. The splenic ven carefully was identified, clipped, and divided. Splenectomy was completed by releasing the splenorenal and splenophrenic ligaments. An average of four or five hem-o-lok polymeric clips were used during the operation.

Tri-Staple Method

The first step was the dissection of the lower pole of spleen. Splenocolic ligament and lower pole vessels were divided with Ligasure. The second step was the dissection of the short gastric vessels and gastrosplenic ligament. Splenorenal and splenophrenic ligaments attached to the splenic tissue were divided with Ligasure. A safety area was performed between the spleen and pancreas to allow placement of the tri-staple. Splenic hilum was suspended with a grasper and transected with tri-staple loaded with 60 mm vascular cartridges (Covidien EGIA60AVM Articulating Staple Loading Unit Endo GIA 60 MM Titanium Staples, Covidien Europa, Dublin, Ireland). During surgery, one or two tri-staple were used depending on the length of the splenic hilus.

Statical Analysis

SPSS (Statistical Package for Social Sciences) for Windows 15.0 program was used for statistical analysis. In the evaluation of the study data, besides the descriptive statistical methods (mean, standard deviation), in the comparison of qualitative data; Nonparametric chi-square test and Pearson's chi-squared test were used. The p-value <0.05 was considered significant. Independent Sample T-test was applied in the analysis of the significance of the difference between the averages obtained.

Results

The most common indication for LS was idiopathic thrombocytopenic purpura (ITP) in each group. There was no statistical difference between the indications (p>0.05) (Table I).The mean splenic size was 120 mm (74-196) for TS group and 139.7 mm (76-203) for HC group (p>0.05). The mean operative time was significantly longer for HC group than TS group (116.7 min vs. 87.6 min, p<0.05). The intraoperative blood loss was 147.8 ml (40-400) for TS group and was 132.4 ml (70-600) for HC group (p>0.05) (Table I).

Laparotomy was performed in 1 patient (4.3%) in the TS group due to uncontrolled bleeding from the staple line, and in 1 (5.3%) patient in the HC group due to bleeding from the splenic hilum during the dissection (Table I). The mean drain withdrawal time was 3.6 days (2-7) in the TS group and 3.8 [2-10] in the HC group, with no significant difference (p>0.05).There was no statistical difference between groups for lenght of hospital stay (5.2 days for TS group vs. 5.6 days for HC group, p>0.05). The mean cost of surgical instruments used to divide the splenic hilum was significantly lower for HC group than TS group (34.1 usd vs. 165.4 usd, p<0.05). There was no postoperative mortality, with a morbidity rate 6 (26.1%) for TS group and 4 (21.1%) for HC group (p>0.05) (Table I).

In the TS group, there were 2 (8.7%) cases of port site infection. In the HC group, there were 3 (15.8%) cases of infection, two cases intraabdominal abscess and one case port site infection (Table II). Reoperation was required in 1 (5.3%) patient in the HC group because of postoperative uncontrolled intraabdominal bleeding (Table II). In the TS group, 1 (4.3%) patient underwent a second laparoscopic surgery three months after the operation because of hypersplenism due to accessory spleen. No significant difference existed in the complication rates. Complications and their management were listed in the table III.

TABLE I - *Patients characteristics, indications, intra- and postoperative data.*

	Tri-staple(n=23)	Hem-o-lok polymeric clip (n=19)	p
Number of patients	23 (54.8%)	19 (45.2%)	0.644
Sex			
Male	7 (30.4%)	7 (36.8%)	0.455
Female	16 (69.6%)	12 (63.2%)	
Age, years	38.2±13.4 (18-59)	43.2±17.7 (18-69)	0.305
Primary disease			
ITP B	17 (74%)	9 (47.3%)	0.348
Hereditary spherocytosis	2 (8.7%)	4 (21.1%)	
Autoimmune hemolytic anemia.	1 (4.3%)	3 (15.8%)	
Lymphoma	2 (8.7%)	1 (5.3%)	
Other	1 (4.3%)	2 (10.5%)	
Concomitant cholecystectomy	2 (8.7%)	1 (5.3%)	0.702
Splenic size, cm	120±29.4 (74-196)	139.7±35.1 (76-203)	0.054
Operation time, min	87.6±42.7 (40-220)	116.7±41.5 (65-245)	0.032
Intraoperative blood loss, ml	147.8±121.7 (40-400)	132.4±134.8 (70-600)	0.698
Conversion rate	1 (4.3%)	1 (5.3%)	0.890
Type of specimen exctraction			
En-bloc	4 (17.4%)	10 (52.6%)	0.052
Morselation	18 (78.3%)	8 (42.1%)	
Laparotomy	1 (4.3%)	1 (5.3%)	
Drain withdrawal time, day	3.6±1.3 (2-7)	3.8±2.1 (2-10)	0.721
Length of hospital stay, day	5.2±1.3 (3-8)	5.5±2.3 (3-11)	0.562
Surgical material cost, usd	165.4±59.7 (126-253)	34.1±7.6 (22-44)	<0,001
Morbidity	6 (26.1%)	4 (21.1%)	0.496

ITP idiopathic thrombocytopenic purpura.

TABLE II - *Distribution of postoperative complications.*

Postoperative complications	Tri-staple (n=23)	Hem-o-lok polymeric clip (n=19)	p
Infection	2(8.7%)	3(15.8%)	0.480
Thromboembolism	1(4.3%)	2(10.5%)	0.439
Reoperation	1(4.3%)	1(5.3%)	0.890
Intraabdominal bleeding	2(8.7%)	2(10.5%)	0.841
Pancreatic fistula	0	1(5.3%)	0.265
Pleural effusion	1(4.3%)	2(10.5%)	0.439

TABLE III - *Complication and their management.*

No.	Technique	Complication	Management
1	tri-staple	postoperative intraabdominal bleeding	blood transfusion
2	tri-staple	port site infection	antibiotics
3	tri-staple	postoperative hypersplenism	laparoscopic excision of accessory spleen
4	tri-staple	pleural effusion	pleurocan drainage
5	tri-staple	intraoperative uncontrolled bleeding, postoperative intraabdominal bleeding	conversion,blood transfusion
6	tri-staple	port site infection portal vein thrombosis	antibiotics,enoxaparin sodium
7	hem-o-lok	portal vein thrombosis	enoxaparin sodium
8	hem-o-lok	postoperative intraabdominal bleeding,intraabdominal abscesspleural effusion,portal vein thrombosis	blood transfusion,percutaneous drainage, pleurocan drainage, enoxaparin sodium
9	hem-o-lok	port site infection	antibiotics
10	hem-o-lok	intraoperative uncontrolled bleeding, postoperative intraabdominal bleeding,intraabdominal abscess, pancreatic fistula	conversion, reoperation, splenic artery was ligated, near the celiac root, percutaneous drainage and antibiotics

Discussion

LS has been accepted as the standard approach for most hematological diseases that require removal of the spleen and is now accepted for various spleen disorders [10]. It is reported that laparoscopic approach causes less morbidity, requires shorter hospitalization and patients can return to normal activities in the early period [11,12]. Targarona and colleagues have been proponents of the use of LS for all cases regardless of the size of spleen [13,14]. On the other hand, The European Association for Endoscopic Surgery (EAES) supports the use of LS for splenomegaly, defined as spleen size of up to 15 cm in maximal diameter or spleen weight of up to 1000 g, but does not recommend its use in larger spleens due to higher complication, morbidity, and conversion rates [15,16].

Most of the conversions are related to uncontrolled bleeding from hilar vessels or capsular injury, due to the hypervascular structure and fragile tissue of the spleen [17,18]. However, the vessels in the splenic hilum are intricate and variable. It may be difficult to stop the bleeding once vessels are injured [19]. Splenic hilum vessel control is the most fundamental step in LS. The surgical indication for the patient who underwent open surgery due to uncontrolled bleeding during the vascular dissection of the splenic hilum in the HC group was ITP and the spleen size was 135 mm. Regardless of the spleen size, bleeding was encountered during dissection. In the other group, the patient underwent open surgery due to bleeding from the stapler line, the diagnosis was lymphoma and the spleen size was 181 mm. Due to splenomegaly, hilar vascular structures were enlarged and there was difficulty in placing staple in the splenic hilum. Single tri-staple was not sufficient to cut the splenic hilum and the second one was required. Meanwhile, bleeding occurred. Pancreatic injury, AVF formation and portal or splenic vein thrombosis are other complications that may be concerned with the technique used to control the splenic hilum during the laparoscopic procedure [20].

Various methods have been developed, including clips, sutures, ultrasonic coagulation, as well as both monopolar and bipolar coagulation to achieve hemostasis and control the splenic pedicle [21]. At first, individual hilar vessels were isolated and controlled with clips or ligature prior to division but with the advancement in laparoscopic field, nowadays other technical approaches such as vasculary stapler or vessel sealing system have gained a distinct consideration for transection of the splenic pedicle [10,20]. Dissection of the splenic pedicle and isolation of the splenic vessels is essential for placing the clips. This approach can take time and requires experience in laparoscopic surgery. Nevertheless bleeding may occur during the dissection [9]. The clips are easily inserted, but can be displaced by movement. Various types of surgical clips have been described in LS to ligate the splenic vessels. Using hem-o-lok clips can reduce to the clip movement in the vasculary structure.

Currently, stapler is widely used for vascular isolation and en block transection of the splenic pedicle in laparoscopic splenectomy. Stapler can be easily applied with normal spleens, but it is hard in case of splenomegaly because of difficulty in manipulating large organ. Surgical

staplers require accurate placement to work as they should. The necessary hilar dissection should be performed for the en block resection with the stapler of the splenic hilum and sufficient spacing between the distal end of the tail of the pancreas and the splenic hilum should be provided by cutting the splenocolic, gastrocolic and splenophrenic ligament. Stapler should be positioned as close to the spleen as possible before firing [22,23]. After firing the stapler, waiting up to 10–15 seconds can allow the tissue to be squeezed together which helps to prevent bleeding from the stapler lines. Bleeding may occur from the stapler line because of incomplete hilar dissection, thick perihyler adipose tissue and enlarged splenic vascular structures [21]. However, pancreatic injury, pancreatic fistula, or pancreatitis may develop as a result of improper placement of the stapler due to incomplete dissection between the pancreatic tail and splenic hilum [6,24]. The incidence of pancreatic injury during LS has been reported to occur up to 15% [25]. Postoperative pancreatic fistula occured in one patient in the HC group which was treated with postoperative percutaneous drainage and antibiotics. It was the patient who underwent open surgery due to intropeative bleeding, and was operated for the second time due to recurrent postoperative intraabdominal bleeding. In the second operation, splenic artery was dissected over the pancreas and ligated near the celiac root. We do not know whether pancreatic injury occured during this dissection or in the first surgery.

Another rare condition that we may encounter depending on using stapler is the development of AVF. En bloc ligation of the splenic pedicle without separating the splenic artery from the vein seems to be an important causative factor for creating a connection between the splenic artery and vein. However, there is no inreased risk of AVF in individual dissection and clipping of all branches of the splenic artery and vein [9,26]. We have not encountered AVF during the this study period. Thromboembolic complications frequently occur after splenectomy. Longer operative time was found to be positively associated with the development of thrombosis [27]. In our study, portal vein thrombus was observed in 3 (7.2%) patients and there was no statistically significant difference between the groups.

In the analysis of our data, intraoperative and postoperative results were similar, except for the operation time and the cost of surgical instruments used to divide the splenic hilum. The operation time was significantly longer in the HC group. However, we found that the cost of surgical instruments used to divide the splenic hilum was significantly lower in the HC group. There were no significant differences in terms of intraoperative blood loss, conversion rate, drain withdrawal time, length of hospital stay, and postoperative complications. In our study, other complications developed in patients complicated by intraoperative or postoperative bleeding. We would like to emphasize that hemostasis is the most important factor to decrease peroperative morbidity.

The limitations of our study were associated with the disadvantages caused by the retrospective design. Although the data were collected in a 10-year period, the sample size was small. We could not reach all of the splenic weight data extracted by morselation. Therefore, we could not include the splenic weight in this study. Another limitation was that imaging was performed only in patients with suspected clinic for portal vein thrombosis in the postoperative period. All of the patients were not routinely examined for portal vein thrombosis. These situations may have affected the results of our study.

Conclusions

In our study, the laparoscopic splenectomies performed using hem-o-lok polymeric clip and tri-staple were compared in terms of results. Their superiority to each other was not determined except for the operation time and surgical cost. In the HC group, the operation time was longer, but the cost was significantly lower. Although both techniques can be applied safely, we would like to emphasize that hemostasis is the most important factor for good results.

Riassunto

Studio finalizzato a confrontare l'impiego di clip polimerica hem-o-lok (HC) con il tri-stapler (TS) utilizzati nella sezione-emostasi dell'ilo splenico in termini di risultati e di valutare la loro eventuale reciproca superiorità. Sono state analizzate retrospettivamente le cartelle cliniche dei pazienti sottoposti di elezione a splenectomia laparoscopica presso la Clinica di Chirurgia Generale della Facoltà di Medicina dell'Università di Ondokuz Mayis tra marzo 2011 e marzo 2020. Sono stati inclusi in questo studio quarantadue casi di splenectomia laparoscopica eseguiti con clip polimerica hem-o-lok (HC) o tri-stapler (TS), analizzando le caratteristiche demografiche, le diagnosi preoperatore, le dimensioni spleniche, i dati intraoperatori e le complicanze postoperatorie, nonché i prezzi di clip e pinzatrice utilizzati nella chirurgia.

RISULTATI: il tempo operativo medio è stato significativamente più lungo per il gruppo HC rispetto al gruppo TS (116,7 min vs. 87,6 min, p <0,05). Il costo medio degli strumenti chirurgici utilizzati per dividere l'ilo splenico risulta significativamente inferiore per il gruppo HC rispetto al gruppo TS (34,1 usd vs. 165,4 usd, p <0,05). Non si è riscontrata mortalità postoperatoria, con un tasso di morbilità 6 (26,1%) per il gruppo TS e 4 (21,1%) per il gruppo HC (p> 0,05). Nessuna differenza significativa è stata rilevata nel tasso delle complicanze.

CONCLUSIONI: Nel gruppo HC, il tempo di operazione

è stato più lungo, ma il costo chirurgico è stato significativamente più basso. Non ci sono state differenze significative nel confronto con altri risultati perioperatori. Sebbene entrambe le tecniche possano essere applicate in modo sicuro, vorremmo sottolineare che l'emostasi è il fattore più importante per ottenere buoni risultati.

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