RESEARCH ARTICLE

Safe stapleless laparoscopic splenectomy; use of Hem-o-Lok to control the splenic hilum

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Abstract

Objective: To evaluate Hem-o-Lok polymer clips' feasibility, safety and cost-effectiveness in controlling the splenic pedicle during paediatric laparoscopic splenectomy.

Method: The prospective study was conducted from May 2019 to December 2021 at Kafrelsheikh University Hospital, Egypt, and comprised children of either gender aged <18 years who had benign haematological diseases and were indicated for laparoscopic splenectomy. During the procedure, Hem-o-Lok clips were used for controlling the splenic pedicle. Patients were encouraged to ambulate the same day, and the drain was removed 24hours postoperatively. The cases were followed up for three months postoperatively.

Results: Of the 23 subjects, 11(47.8%) were boys and 12(52.2%) were girls. The overall mean age was 8.74±3.44 years (range: 4-15 years). There were 6(26%) cases of spherocytosis, 1(4.3%) immune thrombocytopenic purpura and 16(69.6%) with thalassemia major. The mean operative time was 93.43±29.87 minutes (range: 65-180 minutes). There was no conversion to open splenectomy and no mortality. There were 2(8.7%) cases of minor and 1(4.3%) of major intraoperative bleeding. All the 3(100%) cases were controlled laparoscopically. No postoperative bleeding occurred and no cases required postoperative blood transfusion.

Conclusion: Controlling both the splenic artery and vein using Hem-o-Lok clips was found to be feasible, safe and cost-effective.

Keywords: Purpura, Thrombocytopenic, Idiopathic, Spleen, Splenic artery, Thalassemia, Laparoscopy, Polymers.

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Introduction

Splenectomy, whether open or laparoscopic, highlights the role of the spleen in benign haematological diseases in children. Idiopathic thrombocytopenic purpura (ITP), Hereditary spherocytosis, Thalassemia major, myelofibrosis, myeloproliferative diseases, and sickle-cell anaemia are among the benign haematological diseases that most frequently indicate laparoscopic splenectomy (LS).[1] Splenectomy was performed only through an open approach until 1991 when the first LS for an adult patient was done[2], followed soon after in 1992 by another study.[3] The first LS in children was done in 1993.[4] The last decade has witnessed the revolution of LS for the treatment of patients with benign haematological disorders.[2-6] Since then, LS has gained popularity and is currently the procedure of choice for splenectomy in children.[7] Despite the primary concerns of a prolonged operative time and intraoperative bleeding, LS has become superior to open splenectomy as it guarantees a shorter hospital stay, low complications and cosmetically better results.[8, 9] Numerous methods, including clips, ligatures, ultrasonic shears as harmonic, ligasure and endovascular staplers, are employed to manage splenic vascularity in order to shorten the surgical time and decrease intraoperative complications.[10] The Hem-o-Lok clip was introduced in 1963 as a metallic clip which was initially used for the control of the renal pedicle during nephrectomy. After several upgrades came the version of non-absorbable polymer in 1999, which has a lock engagement feature that provides good security against slippage. The Hem-o-Lok has been tried in only a few studies in paediatric LS.[5, 6, 9, 10-12]

The current study was planned to evaluate Hem-o-Lok polymer clips' feasibility, safety and cost-effectiveness in controlling the splenic pedicle during paediatric LS.

Patients and Methods

The prospective study was conducted from May 2019 to December 2021 at Kafrelsheikh University Hospital, Egypt, after approval from the institutional ethics review committee, and comprised children of either gender aged <18 years who had benign haematological diseases and were indicated for laparoscopic splenectomy.

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Children underwent upper abdominal surgical operations, or complaining from either malignant haematological diseases or splenic cysts and children with severe cardiac or respiratory compromises were excluded from the current study.

The sample size was not calculated. Non-probability convenient sampling technique was adopted and all the patients who were admitted to our hospital during the study period and met the inclusion criteria were included in the study. A written informed consent was obtained from all the patients' parents after full explanation of benefits and risks.

Diagnosis was confirmed at the paediatric haematology unit. All patients received hemophillus influenza B, pneumococcal vaccine and meningococcal vaccine at least 2 weeks before surgery. Abdominal examination was done for confirmation of the level of enlargement of the spleen in relation to the costal margin and umbilicus. Laboratory investigations were performed for blood elements and liver functions. Before surgery, haemoglobin (Hb) was corrected to a minimum of 9g/dl and platelets to 50,000/cmm. Ultrasound examination was done for all patients to measure the splenic span, presence or absence of gall bladder stones, and the presence of accessory spleens.

A flexible operating table with the head of the table and the left side raised and a flank cushion put under the left side were used to position all patients in the 45-degree right-lateral position. A 10mm port was placed at the umbilicus for a 30-degree telescope, a 5mm port was used as the left working port at the midline halfway between the umbilicus and xiphisternum, and a left lumbar 10mm port was used as the right working port and was positioned in accordance with the splenic lower pole. A fourth 5mm subxiphoid trocar was inserted as an assistant and as the liver retractor. The table was tilted to the left side to place the patient in a neutral posture before the trocars were inserted. After trocar insertion, the table was returned to the neutral position so that the patient was back to the right lateral decubitus position. Pneumoperitoneum was maintained at 10-15mmHg according to the age of the patient. After exploring the abdomen and looking for accessory spleens, dissection and sealing of phrenicocolic ligament was done by the use of either LigaSure or Harmonic scalpel, followed by a few lower splenic polar vessels in continuity. Short gastric vessels were then sealed and divided until the lineo-phrenic ligament was reached. Dissection of the hilum started with the opening of the anterior lineorenal ligament. Careful dissection was carried out slowly, using vessel sealing devices, monopolar hook diathermy and a Maryland forcep to skeletonise the artery and the vein. The artery was controlled first, followed by the vein. Two Hem-o-Lock clips were applied proximally and another clip was applied distally on either structure, and scissors was used to cut the structures separately in between the clips. This was followed by the division of the posterior layer of lineorenal and the remaining part of splenophrenic ligaments to completely free the spleen of its attachments. The spleen was then extracted either by the use of a hand-made endobag from the umbilical port site after enlarging the linea alba, or through a Pfannestiel incision. The pedicle was carefully examined for any bleeding, and any blood found was irrigated and aspirated with saline, and a drain was placed at the splenic bed. Intraabdominal gas was deflated, ports were removed, and wounds were stitched up (Figure).

After the operation, splenic tissue was taken and sent for histological analysis. The nasogastric (NG) tube was removed at the end of the operation. Oral feeding was offered 6-8 hours postoperatively for cases whose spleen was extracted by an endobag, or after the return of peristalsis in patients who had a Pfannestiel incision. Complete blood count (CBC) was done 6 hours postoperatively, and if there was no need for blood transfusion, the urinary catheter was removed and adequate analgesia was provided. Patients were encouraged to ambulate later the same day, and the drain was removed 24hours postoperatively.

Results

Of the 23 subjects, 11(47.8%) were boys and 12(52.2%) were girls. The overall mean age was 8.74±3.44 years (range: 4-15 years) (Table 1). There were 6(26%) cases of spherocytosis, 1(4.3%) ITP and 16(69.6%) with thalassemia major. The mean operative time was 93.43±29.87 minutes (range: 65-180 minutes). There were 2(8.7%) cases of minor and 1(4.3%) of major intraoperative bleeding. None of them were related to the use of Hem-o-Lok clips. Of them 1(4.3%) patient had an injury to lower polar vessel which was controlled by titanium clips followed by controlling of the hilum by Hem-o-Lok clips. The patient had intraoperative blood transfusion. The other 2(8.7%) patients had negligible blood loss from short gastric vessels and from a small pancreatic branch. Both were controlled by energy devices. There was no conversion to open splenectomy and no mortality.

In 17(73.9%) cases, spleen was extracted by a handmade endobag and the rest were extracted through a Pfannestiel incision. No postoperative bleeding occurred and no cases required postoperative blood transfusion. The mean hospital stay was 1.2±0.717days (range: 1-4 days) (Table 2).

Table-1: Patient's characteristics (n=23).

	n (%)
Age (year):	
Mean ± SD	8.74 ± 3.44
Range (Years)	4 – 15
Gender:	
Female	12 (52.2)
Male	11 (47.8)
Weight	
Mean ± SD	33.87 ± 12.05
Range Kilograms)	15 – 55
Spleen span:	
Mean ± SD	17.039 ± 1.267
Range (Cm)	14.5 – 19.0

SD: Standard deviation.

Table-2: Intraoperative and postoperative data (n=23).

	n (%)
Conversion to open:	
No	0 (0)
Intraoperative Bleeding:	
Yes	3 (13.1)
Operative time:	
Mean ± SD	93.34±29.87
Range (Minutes)	107 – 180
Method of spleen extraction:	
Endobag	17 (73.9)
Pfannenstiel	6 (26.1)
Hospital Stay:	
Mean± SD	1.2±0.74days
Range (Days)	1-4 days

Discussion

Over the last 15-20 years, LS has become the preferred method for splenectomy in children.

According to a study done in the early 1990s, surgical clips or endo-gastrointestinal staplers were typically used to control the splenic hilum. Subsequently, new surgical tools evolved as supporting devices that can seal blood vessels with supraphysiologic burst pressures equal to those obtained with surgical clips or ligatures.[11] The Hem-o-Lok closure system has been designed to be easy to handle because of its constitutional features. Its bosses are designed to retain clips in the jaws of the applier. It has teeth to interface with the vessel and prevent its spillage, has a hinge curve to afford more flexibility in clip placement, its locking mechanism makes it secure to tissues, and it is designed from a polymer which is inert, non-conductive and radiolucent so it does not interfere with computed tomography (CT), magnetic resonance imaging (MRI) or conventional X-ray.[12]

Splenic hilum control is the most critical step during LS. The current study used Hem-o-Lok clips for selective control of the main splenic pedicle. Earlier studies used it to control splenic hilum,[5, 12-14] while others utilised Hem-o-Lok clips and endostaplers to control splenic pedicle, and found that the clips were less costly compared to the staplers.[13, 15]

Wassem Al-Meflih et al. used LigaSure to control splenic pedicle, and showed full control with no postoperative bleeding.[15] Khairallah et al. also used LigaSure to control the splenic pedicle.[10] P. de Lagausie et al. used intra-corporeal sutures to control the pedicle between two ligature 2.0 or 3.0 absorbable sutures.[20] Mohamed Hassan et al. used an endostapler to control the splenic pedicle.[9]

Intraoperative bleeding is a major concern with LS due to the complex splenic blood supply and the difficulty of dissection associated with the fragility of the parenchyma. The current study had 2 minor incidences of bleeding; one from the short gastric vessels and the other during dissection of the hilum from a small pancreatic branch. There was also one significant bleeding from a lower polar

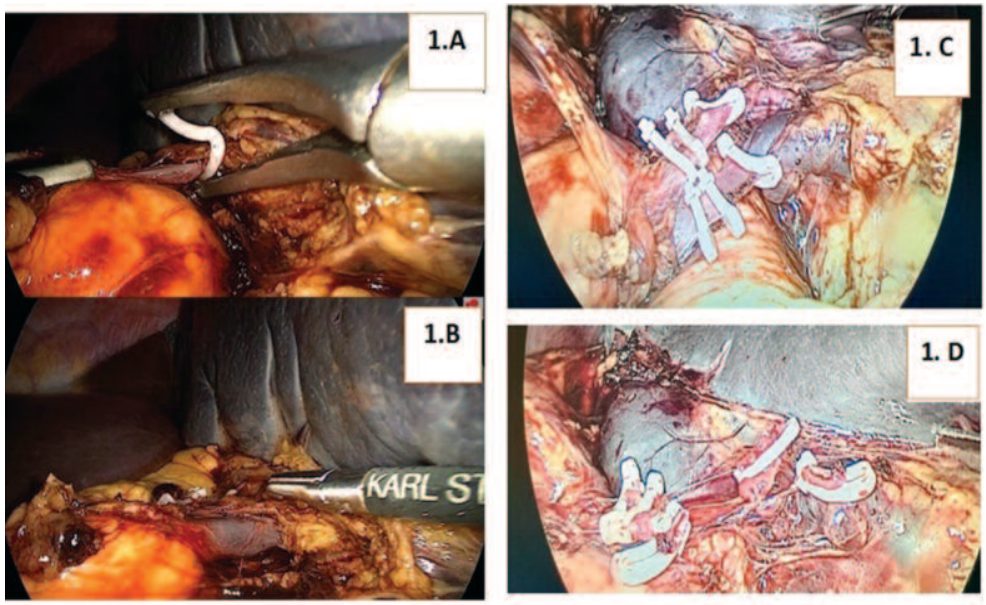

Figure: A. Application of Hem-o-Lok clip on splenic artery. B. Clipped splenic artery and vein before clipping after full skeletonization. C: Laparoscopic view after the application of clips on both splenic artery and vein after full skeletonization and dissection. D: View after cutting by laparoscopic scissor between the clips after clipping each of them separately

vessel. All were successfully controlled laparoscopically, and they were not related to the use of Hem-o-Lok clips. Fadipe et al. and Haffenden et al. reported no case of intraoperative bleeding.[5, 6] Mohamed Hassan et al. reported one case of intraoperative bleeding due to incomplete closure of endostapler which was managed by a sealing device.[9] Romano et al. reported 8 cases of intraoperative bleeding; 5 of them were due to hilar bleeding, and the other 3 were from incorrect use of a sealing device.[13] Faisal Qureshi et al. had 12 cases of intraoperative bleeding which hindered the procedure, and there were converted to open surgery.[14, 15]

Bleeding is the most common cause of conversion to conventional surgery during LS.[11] Reported conversion rates are usually between 5% and 10%.[11] In the current study, there no conversion. Other studies have also reported similar findings.[5,6,16] Romano et al. reported 7.9% conversion rate.[13] Ji B et al.[14] reported 1.9% and Faisal Qureshi et al. 14.8%.[25] Mohamed Hassan et al. reported 8.3% conversion cases.[9]

Regarding intraoperative blood transfusion, there was 1(3.1%) case in the current study. Other studies have reported 6.25%[8] and 3.4%.[14]

In the current study, the mean operative time was 93.34 min, which was close to 90 min reported earlier.[22] Others have reported 178 minutes which may be attributed to the learning curve.[5] Murat Derebay et al. and Ahmet Turkelougou et al. reported 116 and 120 mins, respectively, in Hem-o-Lok groups, and 90 and 115 mins, respectively, in the stapler group.[23,24] This may be attributed to the fact that they operated on a larger splenic span more than 20cm which might have prolonged the duration of extraction. Faisal Qureshi et al. reported 201 mins, which could be due to cases of concomitant LS and laparoscopic cholecystectomy.[25] A study reported the mean operative time of 180 mins using endostapler[9], while the mean operative time was 115.4 min in the Hem-o-Lok group and 100.6 min in the ligaSure group in another study.[16]

The current study used a homemade endobag for extraction of the spleen through the umbilical port in 17 cases, while Pfannsteiel incision was used in 6 cases. The use of an endobag has the advantage of avoiding a surgical incision with its associated pain, negative cosmetic effects, delay of oral feeding, prolonged hospital stay and possible incision complications. This homemade endobag is cost-effective, but has some difficulties of folding of its edges while putting the specimen inside it. Fadipe et al. who used the same technique removed the spleen after morcelation within a retrieval bag in all cases through the umbilical port after the extension of umbilical fascia in midline in a similar way to the current technique.[5] Romano et al. removed the specimen after morcelation within the retrieval bag or via a 5-6cm Pfannestil incision with a huge spleen or when a specimen was required for histopathological examination.[13] The commercial endobags were more expensive compared to the handmade endobag used in the current study. Faisal Qureshi et al. also used a handmade endobag for spleen extraction.[25]

In the current study, no postoperative complications were found, in a study, one case developed postoperative ileus and another underwent laparotomy for unexplained postoperative pain.[5] Nada et al.[7] reported no perioperative mortality or postoperative complications. Ji B. et al. followed up the patients for 3 months, showing no occurrence of major complications.[14] There were also no postoperative complications in other studies as well.[6,18]

No patients in the current study needed postoperative blood transfusion, indicating good preoperative correction of blood elements, and intraoperative correction when needed. Several studies have reported similar findings.[13,15,17,21]

In the current study, the mean hospital stay was 1.2 days. The was no case of postoperative vomiting despite the fact that no preoperative or postoperative anti-emetics. Fadipe et al.[5] used dexamethasone, oxycodone and ondansetron as preoperative antiemetics to avoid vomiting postoperatively, and reported a mean hospital stay of 2 days. Others have reported mean hospital stay ranging from 1.5 days to 3.5 days.[20-24]

Conclusion

Using Hem-o-Lok clips in controlling splenic pedicle during LS in children with benign haematological diseases was found to be feasible, safe and cost-effective.

Limitation: The sample size was not calculated which could have influenced the power of the study.

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Conflict of Interest: None.

Source of Funding: None.

References

1. Wu Y, Liao L, Lin F. The diagnostic protocol for hereditary spherocytosis-2021 update. J Clin Lab Anal 2021;35:e24034. doi: 10.1002/jcla.24034.
2. Delaitre B, Maignien B. Splenectomy by the laparoscopic approach. Report of a case. Presse Med 1991;20:2263.
3. Carroll BJ, Phillips EH, Semel CJ, Fallas M, Morgenstern L. Laparoscopic splenectomy. Surg Endosc 1992;6:183-5. doi: 10.1007/BF02210877.
4. Tulman S, Holcomb GW, Karamanoukian HL, Reynhout J. Pediatric

laparoscopic splenectomy. J Pediatr Surg 1993;28:689-92. doi: 10.1016/0022-3468(93)90033-h.

5. Fadipe A, Wilkinson D, Peters R, Doherty C, Lansdale N. Laparoscopic splenectomy: how minimal can we make it? J Ped Endosc Surg 2022;4:9-12. Doi: 10.1007/s42804-021-00125-6.
6. Haffenden V, Peters RT, Wilkinson D, Lansdale N. Hem-o-Lok polymer clips for major vascular control in paediatric minimally invasive surgery. J Ped Endosc Surg 2021;3:101-5. Doi: 10.1007/s42804-021-00094-w.
7. Nada A, Samadoni A, Aboulhassan M, Mohsen A. Stapless laparoscopic splenectomy using clips and ligasure TM is safe, even in massive splenomegaly. Ann Pediatr Surg 2021;5:247-53.
8. Nafady HA, Rashad AM, Sayed M. Laparoscopic Staple-less Splenectomy: feasibility and benefits. EJMR2020;1:83-94. DOI: 10.21608/ejmr.2020.91110.
9. Hassan ME, Al Ali K. Massive splenomegaly in children: laparoscopic versus open splenectomy. JSLS 2014;18:e2014.00245. doi: 10.4293/JSLS.2014.00245.
10. Khirallah MG, Eldessoky NE, Elbatarny AM, Elsawaf ME. Laparoscopic splenectomy in children with benign hematological diseases: Leaving nothing behind policy. J Indian Assoc Pediatr Surg 2016;21:14-8. doi: 10.4103/0971-9261.164636.
11. Holcomb GW, Murphy JP. In: Holcomb GW, Murphy JP, Peter SD St, eds. Holcomb and Ashcraft's paediatric surgery, 7th ed. Amsterdam, Netherlands: Elsevier Inc, 2020; pp 616-19.
12. Modi P, Rizvi SJ, Gupta R. Use of Hem-o-lok Clips for Vascular Control During Retroperitoneoscopic Nephrectomy in Children. J Endourol 2021;35:739-42. doi: 10.1089/end.2008.0508.
13. Gelmini R, Romano F, Quaranta N, Caprotti R, Tazzioli G, Colombo G, et al. Sutureless and stapleless laparoscopic splenectomy using radiofrequency: LigaSure device. Surg Endosc 2006;20:991-4. doi: 10.1007/s00464-005-0470-5.
14. Ji B, Liu Y, Zhang P, Wang Y, Wang G. A two-step control of secondary splenic pedicles using ligasure during laparoscopic splenectomy. Int J Med Sci 2012;9:743-7. doi: 10.7150/ijms.4862.
15. Fathi A, Elmoatasembellah M, Senbel A, Shahatto F, Eldamshety O, Shetiwy M, et al. Safety and Efficacy of Using Staplers and Vessel Sealing Devices for Laparoscopic Splenectomy: A Randomized Controlled Trial. Surg Innov 2021;28:303-8. doi: 10.1177/1553350620953023.
16. Shabahang H, Maddah G, Tavassoli A, Jangjoo A, Alvandipour M, Abdollahi A, et al. Laparoscopic splenectomy: ligasure or clip ligation? Surg Laparosc Endosc Percutan Tech 2012;22:136-8. doi: 10.1097/SLE.0b013e318246d9a4.
17. Sánchez-Margallo FM, Sánchez-Margallo JA. Ergonomics in Laparoscopic Surgery. In: Malik A, eds. Laparoscopic Surgery. London, UK: IntechOpen Ltd, 2017; pp 105-23. Doi: 10.5772/66170
18. Fujioka S, Yoshida K, Okamoto T, Yanaga K. Stapleless laparoscopic splenectomy using harmonic scalpel by 2-step sealing. Int Surg 2013;98:385-7. doi: 10.9738/INTSURG-D-13-00035.1.
19. Al-Meflh W, Karadshah S, Khasawneh G, Qurah AA, Abddullah B, Al Raymoony A, et al. Laparoscopic Splenectomy in Children: Safety of Ligasure Usage. Med Arch 2020;74:131-3. doi: 10.5455/medarh.2020.74.131-133.
20. de Lagausie P, Bonnard A, Benkerrou M, Rorlich P, de Ribier A, Aigrain Y. Pediatric laparoscopic splenectomy: benefits of the anterior approach. Surg Endosc 2004;18:80-2. doi: 10.1007/s00464-003-9048-2.
21. Morshed G, El-Gaabary T. New technique for laparoscopic partial splenectomy to decrease blood loss. Int Surg J 2018;5:983-6. DOI: 10.18203/2349-2902.isj20180816.
22. Poillucci G, Frangella F, Liberatore P, Angelis RD. Hem-o-lok clips are safe and efficacious for laparoscopic cholecystectomy: Preliminary results of a single center experience. Japanese J Gastroenterol Res 2021;1:1020. Doi: 10.52768/jjgastro/1020.
23. Derebey M, Ozbalci GS, Yuruker S, Tarim IA, Karabacak U, Akgun C, et al. Comparision of Hem-o-lok polymeric clip and tri-staple in laparoscopic splenectomy. Ann Ital Chir 2021;92:64-9.
24. Türkoğlu A, Oğuz A, Yaman G, Gül M, Ülger BV. Laparoscopic splenectomy: clip ligation or en-bloc stapling? Turk J Surg 2019;35:273-7. doi: 10.5578/turkjsurg.4276.
25. Qureshi FG, Ergun O, Sandulache VC, Nadler EP, Ford HR, Hackam DJ, et al. Laparoscopic splenectomy in children. JSLS 2005;9:389-92.