Safety and efficacy of laparoscopic splenectomy in hematologic diseases with massive splenomegaly

Hany M. El-Barbary[a], Mohamed A.M. El-Menoufy[b]

[a]Department of General Surgery, Faculty of Medicine, Ain Shams University, Cairo, [b]Department of Hematology, Medical Research Institute, Alexandria University, Alexandria, Egypt

Correspondence to Hany M. El-Barbary, FRCS, FACS, Mouwasat Hospital Qatif Eastern province, KSA, Postal code 31911, PO Box: 1444; Tel: 851222; Mobile: 00966530808343; fax: 8552244;
e-mail: drhelbarbary69@yahoo.com

Received 20 December 2016
Accepted 26 December 2016

The Egyptian Journal of Surgery
2017, 36:181–188

Splenomegaly and massive splenomegaly are common clinical findings in hematological diseases especially in inherited hemoglobin disorders (sickle cell disease and thalassemia) and hematologic malignancies. Laparoscopic splenectomy (LS) is the gold standard management of most splenic pathologies in which medical therapy fails to control the symptoms or complications. However, splenomegaly could be a challenging task for a laparoscopic removal. In this study, the authors explored the feasibility of LS in patients with splenomegaly and massive splenomegaly using a totally laparoscopic approach. This is a prospective case series of 18 patients (4–27 years old) who were operated from January 2014 till April 2016 with splenomegaly because of sickle cell disease, thalassemia, or both in a secondary-level hospital, Qatif, Eastern Province, KSA. A total of eight patients had hypersplenism, and 10 patients had very big spleens with abdominal pain and pressure symptoms. Male : female ratio was 3 : 1. The operative time was significantly prolonged in massive splenomegaly, mainly because of extraction time. One case was converted to open because of intraoperative bleeding. The operated maximum spleen size was 23 cm in longitudinal axis. Median hospital stay was 2.5 day. There was no overwhelming postsplenectomy sepsis. There were no mortalities. Although massive splenomegaly was associated with increased rates of open conversion, LS in splenomegaly is feasible and safe in experienced hands.

Keywords:
laparoscopy, splenectomy, splenomegaly

Egyptian J Surgery 36:181–188

1110-1121

Background

Sickle cell disease (SCD) and thalassemia are a group of inherited blood disorders resulting from abnormal synthesis of hemoglobin. SCD results from synthesis of abnormal hemoglobin (HbS), and its course is characterized by long-term hemolytic anemia and episodes of pain (vaso-occlusive or painful crises) associated with or without tissue damage [1], whereas thalassemias result from deficient hemoglobin synthesis because of reduced or absent synthesis of one or more of the globin chains. Skeletal deformities, hemolytic anemia, splenomegaly, and tissue damage because of iron overload are the main characteristic features. Thalassemia can coexist with SCD, with hemoglobin Sβ thalassemia being the most common form [2].

Splenomegaly is usually associated with increased workload in long-term hemolytic anemias, abnormal red blood cells being destroyed in the spleen, which suggests that it is a response to hyperfunction. Splenomegaly is one of the four cardinal signs of hypersplenism, which include peripheral blood cytopenia(s), a compensatory proliferative response in the bone marrow, and the potential for correction of these abnormalities by splenectomy. Splenomegaly and hypersplenism should not be confused. Each may be found separately or may coexist [3].

Splenectomy is indicated for transfusion-dependent patients with increasing transfusion requirements and increasing iron overload, for relief of pain and pressure symptoms because of massive splenomegaly, which interfere with the patient's quality of life, and for severe leucopenia or thrombocytopenia because of hypersplenism causing clinical problems (e.g. recurrent bacterial infection or bleeding). Indications for laparoscopic splenectomy (LS) are essentially the same as for open splenectomy (OS) [4].

The limitations of LS are either physiologic limitations, such as those who cannot tolerate operation, or have noncorrectable severe bleeding dyscrasias, or spleen size; large spleens decrease the likelihood of successful laparoscopic removal. Adding to this is the risk and expense of laparoscopy to cases that are likely to be converted to open, as it is not an ideal operation for amateur surgeons [5]. The open technique is indicated for spleens that exceed 20 cm in the long axis by computed tomography (CT) scan [6]. The European Association for Endoscopic

 DOI: 10.4103/1110-1121.204534

Surgery guidelines published in 2008 concerning laparoscopic splenectomy in splenomegaly stated that splenomegaly should be defined in metric terms by preoperative imaging, namely CT [7]. From a surgical perspective, splenomegaly is defined by a maximum splenic diameter exceeding 15 cm. Massive splenomegaly in adults was defined as a craniocaudal length of at least 20 cm. In children, spleens measuring fourfold larger than normal for age were considered massive [8]. For splenomegaly (but not massive splenomegaly), LS still is safe and preferable to OS in experienced hands [7].

The aim of this study was to explored the safety and feasibility of laparoscopic splenectomy in patients with hematologic diseases with splenomegaly and massive splenomegaly using a totally laparoscopic approach.

Patients and methods

This is a prospective case series of 18 patients with splenomegaly and massive splenomegaly who were operated upon from January 2014 till April 2016, with splenomegaly due to sickle cell anemia, thalassemia, or both, in a secondary-level hospital, Qatif, eastern province, KSA.

A multidisciplinary team was responsible about referral, management, and follow-up of patients with splenomegaly. This team was composed of one consultant hematologist, an internist, and one consultant surgeon with laparoscopic experience who performed the surgeries. Admitted patients were required to undergo the standard preoperative tests including complete blood count, coagulation profile, liver and kidney function tests, screening for hepatitis, and blood sugar. Hemolytic profiles such as serum bilirubin, lactate dehydrogenase, and reticulocyte count were also included. In addition, special preoperative protocol was followed in all patients undergoing LS and consisted of the following:

(1) Platelet transfusion to increase platelet counts to more than 35 000/μl for patients with severe thrombocytopenia.
(2) Vaccination against meningococcal, pneumococcal, and *Haemophilus influenzae* type B infections was given at least 15 days before surgery in all cases or shortly postoperatively.
(3) In SCD, specific perioperative management was started, including intravenous hydration to decrease the blood viscosity, adequate oxygenation, and intravenous pain killers.
(4) Simple packed red blood cell transfusion to get the hemoglobin levels ~10 g/dl and pack cell volume between 30 and 34 was done.
(5) Exchange transfusion was performed in some selected cases of SCD.
(6) Anticoagulation prophylaxis before surgery by low-molecular-weight heparin subcutaneous injection according to age and body weight.

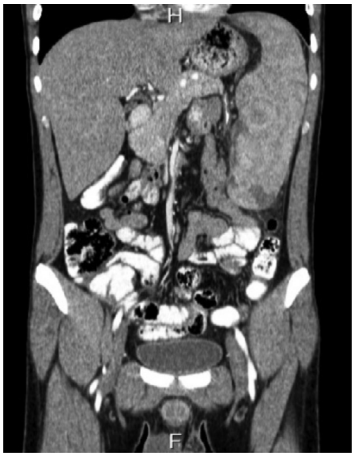
All patient received prophylactic third-generation antibiotics in the form of ceftazidime 1 g intravenously 1 h before skin incision. Preparation for open surgery in case of intraoperative conversion was mandatory. CT of the abdomen to estimate the size of the spleen in centimeter and check for accessory spleens was performed for all patients (Fig. 1).

Preoperative splenic artery embolization was not done. Informed consent was taken from all patients who agreed for surgery. There was approval from the hospital's ethical committee after reviewing professional privileges of all participating staff.

Surgical approach

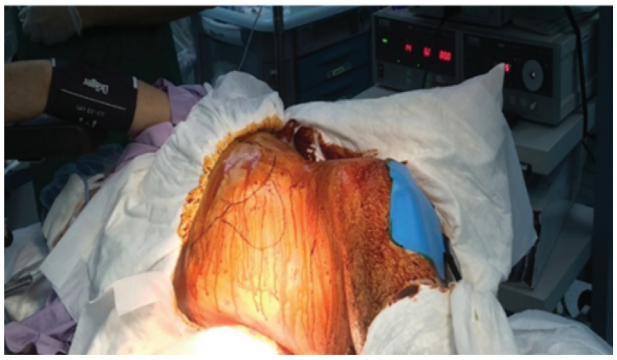
The modified lateral approach, using an inferior to superior and medial to lateral dissection, was used in all cases. The operating table was slightly bent at the waist. After general anesthesia, the patient is draped in the right lateral decubitus, with left arm on arm rest above the head and a pillow behind the back so the trunk will be at 45° backward tilt. This would prevent the spleen from falling down by gravity as we free the lower pole (Fig. 2). The surgeon, the assistant, and the camera operator were positioned on the patient's right side, with the video monitors above and lateral to patient's left shoulder. Open access technique using

Figure 1



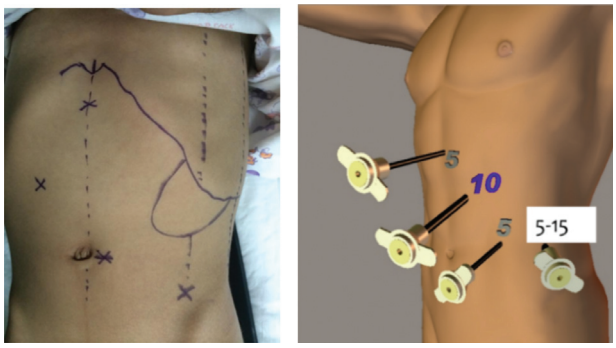
Abdominopelvic computed tomography of one of the patient with massive splenomegaly.

Figure 2



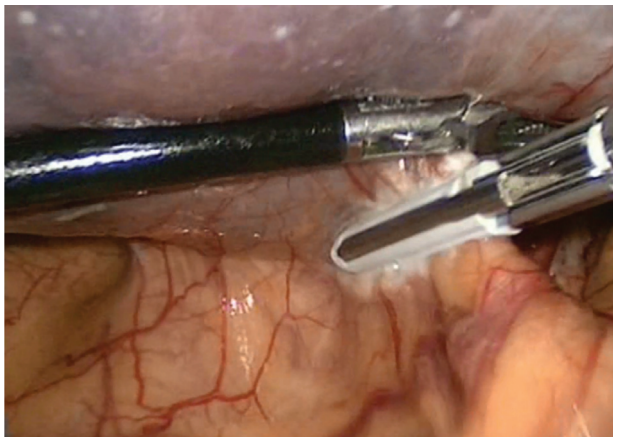
Patient positions on the operating table.

Figure 3



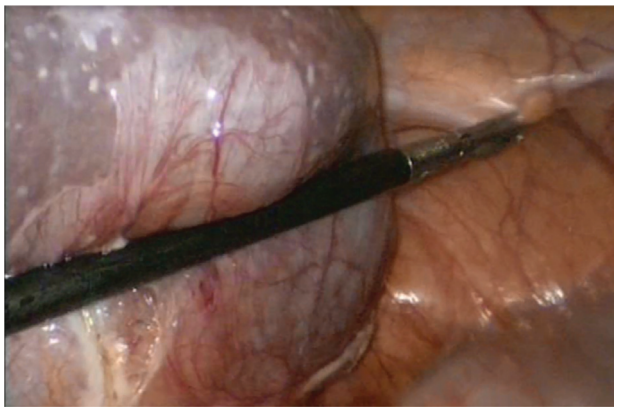
Trocar placements.

Figure 4



Freeing the lower splenic pole.

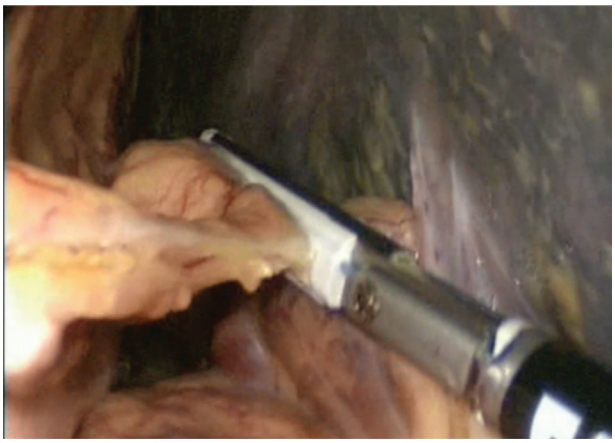
Figure 5



Anchoring and elevating the lower splenic pole.

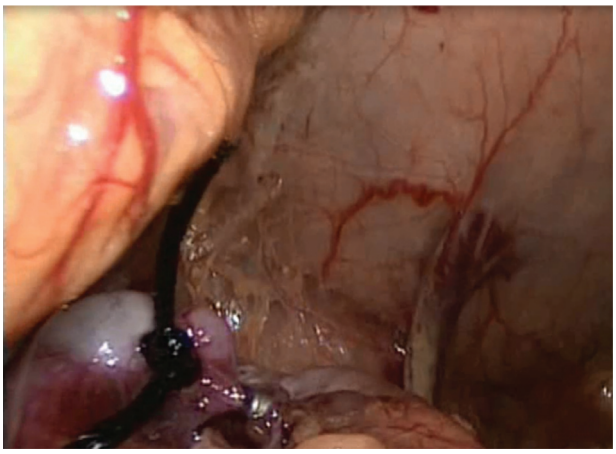
Hasson-likecannula was used for pneumoperitoneum. The first trocar was placed 2–5 cm medial to the lowest palpable edge of the spleen. An oblique viewing 30° 10-mm rod lens was used. Three other trocars were placed in an arc above and below the optic trocar. One 5-mm trocar was placed in the epigastrium to retract the spleen, another 5–10 mm working trocar was placed in the anterior axillary line or right hypochondrium according to spleen size. In the left lower flank, another working 5–15 mm trocar was placed in the middle or posterior axillary line to accommodate the endostapler (Fig. 3). The lower pole was first freed from the peritoneal attachments including the phrenicocolic ligament so that it could be lifted by the grasper in the epigastric port, and the grasper was held in place by anchoring it to the lateral thoracic wall (Figs 4 and 5). The next step was to free the gastrosplenic ligament with division of the short gastric vessels using Ligasure (Ligasure 5 mm blunt tip 37 cm laparoscopic instrument; Valleylab Inc., Boulder, Colorado, USA) (Fig. 6). The splenic artery was usually easy to find along its tortious course above the upper border of the pancreas and so it was dissected and ligated in continuity with intracorporeal thick silk suture (Fig. 7). The splenic vein was identified at the hilum along with its tributaries and was isolated from the tail of the pancreas. It was usually dilated, and in the magistral type, it was stapled at the hilum using 60-mm white cartridge vascular load over a roticulating endostapler (Endopath ETS Articulating Endocutters; Ethicon Endo-Surgery; Endo GIA^{TM} Ultra Universal Stapler, Coviden, Mansfield, MA, USA), or individually sealed with Ligasure or placing additional reloads of staples (Fig. 8). The spleen was allowed to fall slightly with gravity medially, and posterior and upper dissection was done till the visualization of the gastric fundus from the diaphragmatic surface of the spleen. The spleen was then flipped on its back to ensure its liberation from all peritoneal attachments. A large retrieval bag was then introduced from the lower flank trocar (Endo-Catch II 15 mm Specimen Pouch; Covidien, Mansfield, Massachusetts, USA), and the spleen was carefully negotiated to fit into the bag, and the purse-string was pulled to close the sac. The lower

Figure 6



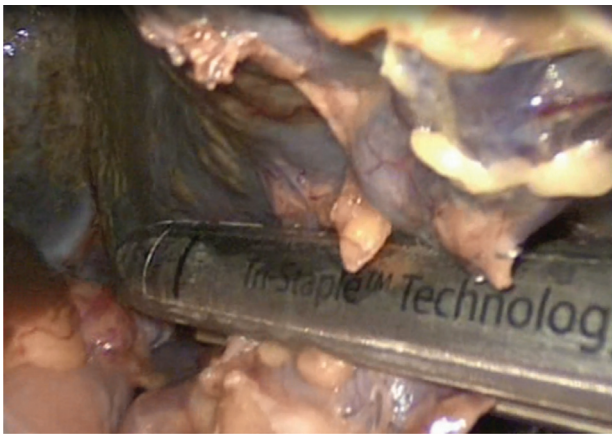
Medial dissection of the gastrosplenic ligament by Ligasure.

Figure 7



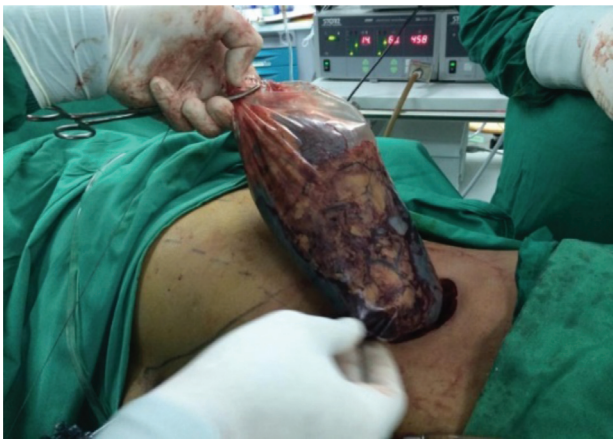
Ligation of the splenic artery in continuity (safety ligature).

Figure 8



Division of hilar vessels with endostapler using vascular load.

Figure 9



Extraction of a large spleen in retrieval bag (Endocatch II).

flank trocar was removed, and the trocar incision was enlarged to ~10 cm to extract the spleen intact (Fig. 9). Secondary pneumoperitoneum was initiated, and accessory spleens were looked for; hemostasis was checked, and a suction drain was left in the splenic bed for all patients. Fascial closure of all port site wounds larger than 10 mm was done, and skin was closed with staples (Fig. 10). The extracted spleen was measured, weighed, and sent for histopathological examination (Figs 11 and 12).

Postoperative

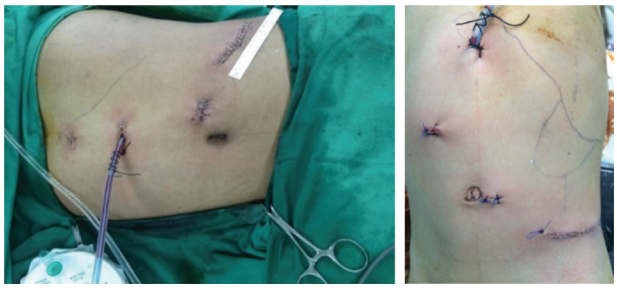
The nasogastric tube was left overnight and the urinary catheter left till the patient was able to ambulate freely. The suction drain removed if the drain was producing less than 50 ml/day, postoperatively. Prophylactic antibiotics were stopped 1 day postoperatively. The patient was kept in 'nothing through the mouth' condition and was well hydrated, and antithrombotic drugs were discontinued as the patient began to ambulate. Oral feeding was usually resumed after 48 h.

Data collection

The collected data included age, sex; American Society of Anesthesiologists class; clinical diagnosis and indication for LS; comorbid disease; diagnostic investigations including an abdominopelvic CT with double contrast to estimate spleen size, locate accessory spleens, or any associated pathologies (e.g. gall bladder stones); extracted spleen weight and size; duration of the procedure; blood transfusion; hospital stay; follow-up; readmission; and complications.

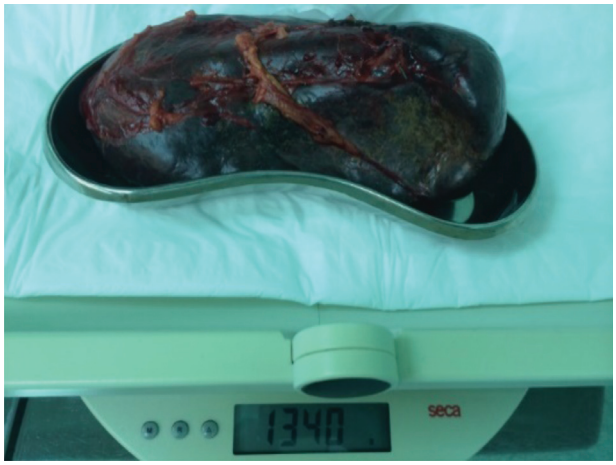
Results were tabulated and statistically studied using SPSS (SPSS for Windows, version 16.0 Chicago, SPSS Inc.), v.16 software. χ^2-test, Mann–Whitney test, or student t-test was used as appropriate. Numerical variables were presented as mean and SD,

Figure 10



Skin incisions for spleen extraction.

Figure 12



Another supermassive spleen (23 cm in length).

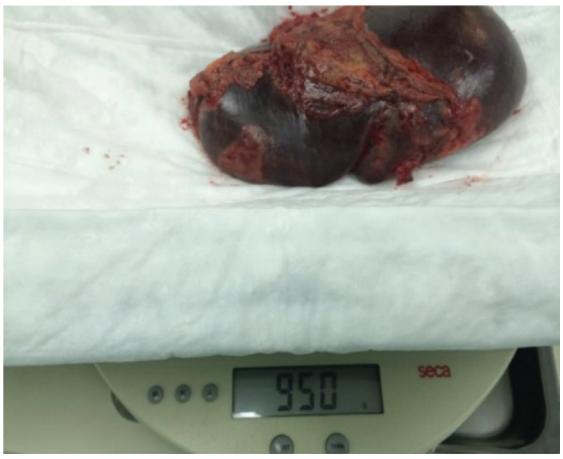
whereas categorical variables were presented as frequency and percentage. Any difference with *P* less than 0.05 was considered statistically significant.

Results

We performed LS on 18 patients (4–27 years old) who were operated from January 2014 till April 2016 with splenomegaly because of SCD, thalassemia, or both in a secondary-level hospital, Qatif, eastern province, KSA. Table 1 presents the clinical characteristics of our patients.

Surgery was indicated in 10 patients who had hypersplenism and in 10 patients who had very big spleens with abdominal pain and pressure symptoms. Male : female ratio was 3 : 1. Most patients were young adults who were 20–40 years of age. SCD was the cause of splenomegaly in nine patients and massive splenomegaly in two patients. Thalassemia was the cause of splenomegaly in one patient and massive splenomegaly in three patients; all patients (three) with sickle cell β-thalassemia (HbS-β thal disease) were having massive splenomegaly. Table 2 shows intraoperative events and complications.

Figure 11



One of the laparoscopically removed spleens.

Operative (OR) time was significantly prolonged in massive splenomegaly, mainly because of extraction time. There was one case of conversion to open procedure because of intraoperative bleeding. The operations were totally laparoscopic in all patients except in one patient with massive splenomegaly who was converted to open because of hilar bleeding. The hilum was secured with 2–3 fires of stapler using vascular loads. Maximum spleen size retrieved was 23 cm in longitudinal axis. Spleen weight ranged from 450 g in splenomegaly to 1340 g in massive splenomegaly. No morcellation was used except partial division of the spleen in one case to fit in the retrieval bag. No autotransfusion was done. Two patients had intraoperative blood transfusion because of intraoperative bleeding. One patient in the splenomegaly group had bleeding from the short gastric vessels because of very short gastrosplenic ligament near the upper splenic pole. This was controlled by clips on both sides. One patient with massive splenomegaly had to be converted to open for control of hemorrhage from the torn splenic vein because of a stapler malfunction. The incision had to be placed higher in that particular patient. Suture ligature using Prolene 5/0 was used to control the bleeder under direct vision and manual digital compression by the assistant surgeon. Two patients with SCD had splenomegaly and concomitant cholelithiasis who underwent laparoscopic cholecystectomy in the start of the procedure. The patients were placed first supine then turned to the right lateral position as described above. The OR time of the first procedure was excluded from the study. All patients with hypersplenism had their blood indices returned to normal after 3–4 months. Three patients were placed on low-dose aspirin (81 mg once daily) for thrombocytosis for 3 months till platelet count became reduced to less than 500 000/μl.

Table 1 Clinical criteria of patients with splenomegaly who had laparoscopic splenectomy

Clinical criteria	Splenomegaly (*n*=10)	Massive splenomegaly (*n*=8)	*P* value
Age (years)			
<20	3	0	0.235
20–40	5	6	
>40	2	2	
Males	7	6	0.769
Females	3	2	
ASA I	3	4	0.512
ASA II	6	4	
ASA III	1	0	
Comorbidity	2	2	0.751
SCD	9	2	0.013
Thalassemia	1	3	0.275
SCD β-thalassemia	0	3	0.069
Hypersplenism	5	5	0.664
Splenic diameter (cm)			
<20	10	0	<0.001
≥20 (massive)	0	8	

ASA, American Society of Anesthesiologists; SCD, sickle cell disease.

Table 2 Intraoperative events and complications of the studied patients

Intraoperative criteria	Splenomegaly (*n*=10)	Massive splenomegaly (*n*=8)	*P* value	Remarks
Operative time (min)	120–155 (135±10)	160–210 (183±14)	<0.001	–
Intraoperative blood loss>500 ml	1	1	0.557	–
Safety ligature of splenic artery	6	8	0.145	–
Concomitant surgery	2	0	0.557	Cholecystectomy
Intraoperative hemorrhage	1	1	0.557	Short gastric, splenic vein
Blood transfusion	3	2	0.769	–
Open conversion	0	1	0.908	–
Extraction incision (cm)	6–10	8–12	0.001	–
Spleen weight (g)	450–1040 (780±160)	1100–1340 (1200±143)	<0.001	–

Table 3 Postoperative complications and hospital stay

Postoperative criteria	Splenomegaly (*n*=10)	Massive splenomegaly (*n*=8)	*P* value
Days of hospital stay (mean±SD)	2±0.67	4±1.77	0.004
Duration of wound drain (days) (mean ±SD)	2±0.67	3±0.93	0.017
Pancreatic injury	–	–	NA
Postoperative Transfusion	0	2	0.356
Wound infection	–	1	0.908
Catheter-related infections	1	0	0.908
OPSI	–	–	NA

NA, not available; OPSI, overwhelming postsplenectomy sepsis.

As regards postoperative complications and hospital stay (Table 3), the mean hospital stay was 2 days in splenomegaly and 4 days in massive splenomegaly, which was statistically significant. There was no overwhelming postsplenectomy sepsis. Patients tolerated oral feeding early and were able to ambulate from the second postoperative day, and there were no mortalities in our series. There was one patient with mild wound seroma and delayed healing, who was managed in OPD with repeated aspiration and prophylactic antibiotics. Patients were followed up in outpatient clinics weekly for the first month and then monthly for the next 6 month.

Discussion

Splenomegaly and massive splenomegaly are common clinical findings in hematological diseases, especially in the inherited hemoglobin disorders (SCD and thalassemias) and hematologic malignancies [8].

The normal healthy spleen weighs 100–250 g. A spleen exceeding the length of 15 cm in longitudinal axis is considered splenomegaly, and massive splenomegaly or 'giant spleen' has a long axis exceeding 20 cm as estimated by abdominal CT scan [7].

In contrast, massive splenomegaly could be defined as a spleen that grows to a size crossing the midline or reaches the left lower quadrant of the abdomen or

enters the pelvis [9]. A massive spleen usually exceeds 500–1000 g [10].

The physiologic or splenic size limitations are not absolute, but there are no clear recommendations [5]. However, for splenomegaly, LS still is safe and preferable to OS in experienced hands. Massive splenomegaly, on the contrary, poses a challenging technical difficulty [7].

In this study, the authors explored the safety and feasibility of LS in patients with splenomegaly and massive splenomegaly because of SCD and thalassemia using a totally laparoscopic approach. This was a prospective case series of 18 patients with splenomegaly and massive splenomegaly reviewed retrospectively, who were operated upon from January 2014 till April 2016 with splenomegaly because of SCD, thalassemia, or both in a secondary-level hospital, Qatif, eastern province, KSA. This area is known for widespread hematological diseases namely SCD.

Our study showed that splenomegaly and massive splenomegaly can occur in children and young adults with SCD and thalassemia or both, although we did not have pediatric patients with massive splenomegaly. The youngest of our patients was 8-year-old boy who experienced SCD and hypersplenism with repeated blood transfusions together with multiple gall bladder stones; both procedures were done in the same setting. Of the eight adult patients with massive splenomegaly, six were the result of thalassemia and SCD-thalassemia, as massive splenomegaly is usually associated with thalassemia disease rather than SCD [11].

In children, splenectomy is usually delayed till the age of 5–6 years [10], which was the case in all our pediatric patients.

There was statistically significant longer OR time in the massive splenomegaly group, partially attributed to technical reasons and the need to perform safety ligature in all cases to shrink the spleen to facilitate the extraction. The extraction time needed to place the spleen in the retrieval bag and taking it out was also significantly longer. Another factor was the open conversion, although it happened in one case with no statistical significance. On the contrary, there was a decrease in operative time at the end of our series to ~25% as we proceeded with the learning curve.

Literature shows that open conversion in LS for massive splenomegaly is between 18 and 60% [7]; however in our study, only one open conversion occurred in massive splenomegaly group (12%) which is less than the reported percentage in the literature and was attributed to instrument failure (stapler malfunction). We always used vascular reload in a single-use disposable stapler. We here emphasize the need to be well prepared to perform such demanding procedure by having all necessary instrumentation and to be prepared as well with blood products and to convert to open at any time for the safety of the patients. There was statistically significant difference in the length of extraction incision in the massive splenectomy group, which is self-explanatory, but in all cases it was cosmetically accepted by the patient, and in one patient, there was a mild postoperative wound seroma, which was conservatively managed by aspiration and frequent dressings and antibiotic prophylaxis.

On the contrary, there was statistically significant differences in hospital stay in the massive splenectomy group, which can be explained by the need of postoperative blood transfusion in two patients, opioid analgesics to control the pain, which could only be given in the hospital, and the duration of wound drains, where most patients preferred to be removed before going home especially in pediatric patients. This matches the results of Tesler *et al.* [12] and Owera *et al.* [13]. Overall, there were statistically insignificant differences in both groups regarding postoperative complications, which is in concordance with other studies in the literature [6,13].

Hand-assisted laparoscopic splenectomy (HALS) is a valid approach. It should be considered to avoid conversion to open surgery. For massive splenomegaly, HALS is recommended as a primary procedure because it shortens operative time and minimizes intraoperative blood loss. This technique requires a special port and uses an incision placed at the site of spleen extraction to place the hand-port [7]. We did not include any HALS cases in our study, and all procedures were totally laparoscopic.The statement of Grahn *et al.* [5] holds true in our series, he stated that 'the laparoscopic approach should be considered for patients requiring elective splenectomy regardless of spleen size'.

LS is an advanced laparoscopic procedure with a learning curve reflected on the operative time, conversion rate, and the rate of complications. In the European Association for Endoscopic Surgery 2008 recommendations, it was stated that it should be done by an experienced surgeon who have done at least 10–20 cases successfully [7]. This study supports this recommendation, and is a clear

demonstration that elective splenectomy for hematologic patients with splenomegaly or massive splenomegaly is feasible and safe, provided it is done with experience and good preparation.

Conclusion

Despite the possibility of open conversion, totally LS in splenomegaly and massive splenomegaly because of hematologic disease as SCD and thalassemia is feasible and safe in experienced hands.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Rees DC, Williams TN, Gladwin MT. Sickle-cell disease. Lancet 2010; 376:2018–2031.

2 Weatherall DJ. The thalassemias: disorders of globin synthesis. In: Kaushansky K, Lichtman MA, Prchal JT, Levi MM, Press OW, Burns LJ, Caligiuri MA, editors. Williams hematology, 9th ed. New York, , Chicago, London: McGraw Hill Education; 2016. pp. 725–758.

3 Caro J, Nagalla S. Hypersplenism and hyposplenism. In: Kaushansky K, Lichtman MA, Prchal JT, Levi MM, Press OW, Burns LJ, Caligiuri MA, editors. Williams hematology. 9th ed. New York, Chicago, London: McGraw Hill Education; 2016. pp. 863–870.

4 Knauer EM, Ailawadi G, Yahanda A, Obermeyer RJ, Millie MP, Ojeda H, *et al.* 101 laparoscopic splenectomies for the treatment of benign and malignant hematologic disorders. Am J Surg 2003 186:500–504.

5 Grahn SW, Alvarez J III, Kirkwood K. Trends in laparoscopic splenectomy for massive splenomegaly. Arch Surg 2006; 141:755–762.

6 Cavaliere D, Torelli P, Panaro F, Casaccia M, Ghinolfi D, Santori G, *et al.* Outcome of laparoscopic splenectomy for malignant hematologic diseases. Tumori 2004; 90:229–232.

7 Habermalz B, Sauerland S, Deltair B, Gigot JF, Leandros E, Lechner K, *et al.* Laparoscopic splenectomy: the clinical practice guidelines of the European Association for Endoscopic Surgery (EAES). Surg Endosc 2008; 22:821–848.

8 Hassan ME, Al Ali K. Massive splenomegaly in children: laparoscopic versus open splenectomy. JSLS 2014; 18:e2014.00245.

9 Zhu J, Ye H, Wang Y, Zhao T, Zhu Y, Xie Z, *et al.* Laparoscopic versus open pediatric splenectomy for massive splenomegaly. Surg Innov 2011; 18:349–353.

10 Luo E, Leditt L. Massive splenomegaly. In: Perazella M, editor. Resident grand rounds. Turner White Communication, Inc.; 2008. pp. 31–38. www.turner-white.com.

11 Brousse V, Buffet P, Rees D. The spleen and sickle cell disease: the sick (led) spleen. Br J Haematol 2014; 166:165–176.

12 Tesler MD, Savedra MC, Holzemer WL, Wilkie DJ, Ward JA, Paul SM. The word-graphic rating scale as a measure of children's and adolescents' pain intensity. Res Nurs Health 1991; 14:361–371.

13 Owera A, Hamade AM, Bani Hani OI, Ammori BJ. Laparoscopic versus open splenectomy for massive splenomegaly: a comparative study. J Laparoendosc Adv Surg Tech A 2006; 16:241–246.