Laparoscopic versus open splenectomy in children with benign hematological diseases in children: a single-center experience

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Introduction Splenectomy whether open or laparoscopic addresses the role of the spleen in the hematology disorders, particularly that of the cellular sequestration and destruction and antibody production. Laparoscopic splenectomy (LS) has been increasingly used for the removal of spleen in children. However, there are still certain questions as regards the feasibility, economic reflections, appropriate splenic size suitable for LS, vascular control of that organ, and final outcomes related to either procedure.

Patients and methods In the period between May 2007 and March 2017, 70 children with benign hematological diseases underwent splenectomy, either laparoscopic or open. They were divided into group A and group B. Group A included cases who had LS, and group B included cases who had open splenectomy (OS). We performed LS while the child was in the right lateral position. In cases of normal splenic size, we used three ports and four ports in cases of splenomegaly. OS was performed in supine position.

Results A total of 70 children were subjected to splenectomy, of whom 20 were boys and 50 were girls. Thalassemia was present in 36 cases, idiopathic thrombocytopenic purpura in 24 cases, and spherocytosis in 10 cases. Five cases were converted to the traditional approach, and three of them were because of huge splenomegaly and two cases were because of accidental bleeding. In the LS group, small-sized spleens were extracted using retrieval bags, whereas large spleens were extracted through Pfannenstiel incision. OS procedure was performed through midline incision. Cholecystectomy was performed in five cases during the original procedure because of gall bladder stones: three cases in group A and two cases in group B.

Conclusion Although both LS and OS achieved the same goal for the children with benign hematological disease, the advantages of minimal invasive surgery made LS the standard approach for treatment of children with benign hematological diseases. However, the main concern is the high economic burden of LS when compared with OS. *Ann Pediatr Surg* 13:194–198 © 2017 Annals of Pediatric Surgery.

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Introduction

Splenectomy whether open splenectomy (OS) or laparoscopic splenectomy (LS) highlights the role of the spleen in benign hematological diseases in children [1].

As regards anemia, splenectomy is indicated for specific cases of anemia, which include cases of cellular defects (membrane abnormalities, enzyme deficiencies, and hemoglobinopathies) and extracellular defects particularly autoimmune hemolytic anemia [2].

On the other hand, idiopathic thrombocytopenic purpura (ITP) is the most common hematological indication for splenectomy, where the spleen is the source of antiplatelet antibody production, as well as the major site of the platelet–antiplatelet antibody complex destruction by the macrophage-induced phagocytosis [3].

With the introduction of LS during the past years of the past century, it gained popularity [4].

However, there are still certain questions as regards the feasibility, economic reflections, appropriate splenic size suitable for LS, vascular control of that organ, and final outcomes related to either procedure.

Patients and methods

Seventy children with benign hematological diseases (thalassemia, ITP, spherocytosis) underwent splenectomy either open or laparoscopic during the period from May 2007 to December 2016. They were randomly categorized into two groups: group A included cases subjected to LS and group B included cases subjected to conventional OS. Children with severe cardiac or chest troubles were excluded. Informed consent was obtained from parents of every child. Ethical committee approval was obtained according to the requirements of our institution. All children were vaccinated against capsulated organisms at least 2 weeks before splenectomy. Complete laboratory investigations including complete blood picture, renal function tests, liver function tests, virology profiles, and coagulation profiles were performed for all children. Also all children had pelviabdominal ultrasound with special attention to the presence or absence of accessory spleens.

Group A (laparoscopic splenectomy)

Patients in group A were operated in right lateral position with the body of patient at 60° with the operating table.

There was more extension at the waist of the patients. In cases with normal-sized spleens we used three ports: telescopic port 10 mm at the umbilicus, and then two ports 5 mm first at the left midclavicular line just below the costal margin and the second at the epigastric region. In cases of splenomegaly, we used four ports. Telescopic port at the umbilicus was 10 mm, the second port at the midclavicular line at the level of umbilicus, the third one in the epigastric region midway between the xephoid process and the umbilicus, and the forth one in the epigastric region just below the xephoid process. After creation of pneumoperitoneum and port placement, exploration of the abdominal cavity was done. Searching for accessory spleens was done in the greater omentum and at the hilar of the spleen. The procedure started with entrance of lesser sac and then attacking the short gastric vessels using bipolar sealing device (LigaSure; Valleylab Inc., Boulder, Colorado, USA). Dissection was then started at the hilum of the spleen to identify both splenic artery and vein. Small vessels at the lower pole of the spleen were sealed and cut. Securing of the hilar main vessels was performed at this stage. We used bipolar sealing devices (LigaSure) 10 mm. At this point the spleen was still attached with the suspensory ligaments to left kidney and splenic flexure of colon and to the diaphragm. Dissection of spleen from these ligaments was done using bipolar sealing devices (LigaSure). Delivery of small-sized spleens was done within the retrieval bag at the umbilical port after moralization of spleen into small fragments. Extraction of huge spleens was done through Pfannenstiel incision. We inserted tube drains in all cases.

Group B (open splenectomy)

Patients were operated in supine position. Although there are multiple approaches for OS, we chose midline incision for all cases of OS. Through this midline incision, the abdominal cavity was accessed. As in LS, accessory spleens were searched for. Spleen was delivered and lesser sac was entered. Short gastric vessels were cut off using harmonic scalpel. The pedicle of the spleen was secured either with ligature using Vicryl 2/0 or with bipolar sealing device. Then, the spleen was detached from its ligaments and excised. Peritoneal wash was done. Tube drains were used in all cases. The midline incision was closed using Vicryl size 0 in a continuous manner.

Results

Seventy children with benign hematological diseases had splenectomy either LS or OS. Fifty boys and 20 girls were included. In group A ($N=35$), there were 18 cases with thalassemia, 12 cases with ITP, and five cases with spherocytosis. In group B ($N=35$), there were 18 cases with thalassemia, 12 cases with ITP, and five cases with spherocytosis. The mean age in group A was 5.6, 12.4, and 6.7 years in thalassemia, ITP, and spherocytosis, respectively, whereas the mean age in group B was 5.9, 13.5, and 5.3 years in thalassemia, ITP, and spherocytosis, respectively. The mean body weight in thalassemic patients was 18 and 17.5 kg years in group A and group B, respectively. In cases of ITP, the mean body weight was 26.3 and 26.9 kg in group A and group B, respectively. The mean splenic span in cases of thalassemia was 18.8 and 18.5 cm in group A and group B, respectively. The mean span in patients of ITP was 12.5 and 12.7 cm in group A and group B, respectively. In group A three cases had chronic calcular cholecystitis, whereas in group B two cases had gall bladder stones (Table 1).

As regards operative data in group A, the mean operative time in cases with splenomegaly was 80.5 min with SD 5.6 ± 3.4, whereas in cases of normal-sized spleens it was 60 min with SD 4.3 ± 2.4. We used four ports in cases of splenomegaly and three ports in cases of normal-sized spleens. Five cases of splenomegaly were in need for blood transfusion in the form of packed red blood cells. The mean amount of estimated blood loss in cases of splenomegaly in group A was 350 ml with SD 50 ± 10.5, whereas in cases of normal-sized spleens in the same group it was 250 ml with SD 11.12. On the other hand the mean amount of blood loss in cases of splenomegaly in group A was 550 ml with SD 15 ± 20.5, whereas in cases of normal-sized spleens in the same group it was 350 ml with SD 20.12. No visceral injuries occurred in either group. In group A four cases of splenomegaly converted to open conventional approach because of either huge splenic size or accidental bleeding, whereas one case of normal-sized spleen in the same group was converted to open because of accidental bleeding and this happened during early experience with the laparoscopic technique (Table 2).

As regards postoperative data, lung atelectasis occurred in six cases of group A, whereas it occurred in three cases in group B. Patients in group A initiated oral intake much earlier than patients in group B, and this was estimated by 12 ± 2.5 h. Five cases in group A had subphrenic collections. Three of them responded to conservative measures, whereas the other two cases required ultrasound-guided drainage and drain insertion for 7 days.

Table 1 Demographic and preoperative data

	Group A (LS) ($N=35$)	Group B (OS) ($N=35$)
Indications		
Thalassemia	18	18
ITP	12	12
Spherocytosis	5	5
Age (mean) (years)		
Thalassemia	5.6	5.9
ITP	12.4	13.5
Spherocytosis	6.7	5.3
Sex		
Boys	9	11
Girls	26	24
Body weight (mean) (kg)		
Thalassemia	12	11.5
ITP	14.3	16
Spherocytosis	9.4	10.5
Spleen size (mean) (long axis in cm)		
Thalassemia	18.8	18.5
ITP	7.5	7
Spherocytosis	12.5	13.8
Gall bladder stones		
Thalassemia	2	2
Spherocytosis	1	0

ITP, idiopathic thrombocytopenic purpura; LS, laparoscopic splenectomy; OS, open splenectomy.

Table 2 Operative data in group A and group B

	Group A (*N* = 35)		Group B (*N* = 35)		
	Splenomegaly (*n* = 23)	Normal-sized spleen (*n* = 12)	Splenomegaly (*n* = 23)	Normal-sized spleen (*n* = 12)	*P* value
Indications					
Thalassemia	18	–	18	–	
Spherocytosis	5	–	5	–	
ITP	–	12	–	12	
Approach	Four	Three	Midline incision	Midline incision	
Operative time (mean) (min)	80.5	60	120	90	0.005
Number of cases of blood or blood product transfusion					
Thalassemia	2	–	4	–	
Spherocytosis	3	–	2	–	
ITP	–	3	–	6	0.235
Estimated amount of blood loss (mean) (ml)	350	250	550	350	0.005
Visceral injuries	None	None	None	None	–
Conversion to OS	4 cases (3 due to splenomegaly; 1 due to bleeding)	One case (bleeding)	–		
Extraction of spleen	Pfannenstiel incision	Extraction bag	Midline incision	Midline incision	

ITP, idiopathic thrombocytopenic purpura; OS, open splenectomy.

Table 3 Postoperative data

	Group A (*N* = 35)	Group B (*N* = 35)	*P* value
Atelectasis of lungs (number of cases)	6	3	
Start of oral intake (mean) (h)	12 ± 2.5	24 ± 4.3	0.005*
Subphrenic collections (number of cases)	5	2	
Pancreatic involvement			
Serum amylase (mean) (IU/ml)	40 ± 2.4	24 ± 3.9	0.254
Serum lipase (mean) (IU/ml)	44 ± 1.7	30 ± 1.3	0.184
Wound infection	None	None	
Length of hospital stay (mean) (days)	2.1 ± 0.9	3.5 ± 1.2	0.005*
Return to normal activity (mean) (days)	10.3 ± 2.9	16 ± 3.2	
Portal vein thrombosis (number of cases)	2	1	

*Significant.

In group B, two cases only had subphrenic collections that responded to conservative follow-up, and no intervention was required. Pancreatic enzymes (amylase and lipase) showed an increase during the early postoperative periods in both groups, but they were higher in group A. Frank pancreatitis did not develop in any cases of either groups. There is no wound infection in either group. As regards the length of hospital stay, it is much shorter in patients of group A than in patients of group B by about 18 h. Patients in group A returned to their normal activity within 10.3 ± 2.9 days, whereas patients in group B patients returned to their usual activity within 16 ± 3.2 days. The onset of portal vein thrombosis occurred in two cases of group A and in one case only in group B (Table 3).

Discussion

Laparoscopy has been increasingly used for splenectomy in children. It was introduced more than two decades ago by Delaitre in France, Carrol in USA, and Pouline in Canada [5,6].

In our country Egypt, the most common causes of splenectomy in pediatric age group are thalassemia, ITP, and to a lesser extent hereditary spherocytosis.

In our study in cases of splenomegaly due to spherocytosis or thalassemia, the splenic size was not considered an obstacle during LS.

Therefore, cases of splenomegaly were randomly categorized either for open or LS.

In the same context, Wood *et al.* [7] advocates for LS, regardless of the size of spleen, when the surgeon has adequate laparoscopic experience.

The operative time in group A was 80.5 and 60 min in cases of splenomegaly and normal-sized spleens, respectively, whereas in group B it was 120 and 90 min in cases of splenomegaly and normal-sized spleens, respectively.

Fildman *et al.* [8] showed in his study dealing with the comparison between the LS and OS in cases of splenomegaly that the mean operative time for LS was 135 min, but he operated on spleens more than 20 cm. The operative time of the cases of OS was 70 min [8].

Pugliese *et al.* [9] had operated LS for spleens with a mean diameter of 13 cm, and the average operative time for the operation was 110 min, whereas for splenic diameters of average 15 cm the mean operative time was 135 min.

The main concern for that great difference in the operative time between studies was because the main patient groups among different studies were adults.

Children undergoing LS showed fewer incidences for blood or blood product transfusion than those of OS. This may be explained by the tamponade effect of the trocar at the edges of the wound in laparoscopic operations, and also the use of LigaSure reduces the intraoperative bleeding.

We agree with Vecchio *et al.* [10], who showed in their work that LS in cases of ITP only one-third of their patients needed platelets transfusion during the operation while the open group needed platelets transfusion for all patients. They explained this by the fact that minimal invasive surgery was associated with less extent of tissue trauma [10].

The estimated amount of blood loss during LS in our study was much smaller than that in OS, and this may seem to be the main explanation for the decreased need for blood or blood product transfusion.

We agreed with Qureshi *et al.* [11] who showed that the average amount of estimated blood loss in cases of OS was 200 ml, and this amount increased with the increase in the size of the spleen.

However, according to the study of Pugliese *et al.* [9], the estimated amount of blood loss was 160 ml and it showed that the amount increased with the increase in the size of spleen.

During our study, the main intraoperative complication was vascular injury of the pedicle, which led to conversion from LS to OS in two cases, whereas the other cause for conversion was splenomegaly.

Also Bedirli *et al.* [12] showed that intraoperative hemorrhage was one of the main complications and a cause for conversion. It was mainly due to laceration of the hilar or short gastric vessels, the splenic capsule, or parenchyma. This was increased by the increase in the size of the spleen [12].

In the study of Khirallah *et al.* [13], they proved that the use of bipolar sealing devices during LS reduced the estimated amount of blood loss. They reported a mean amount of 230 ml with conversion of two cases to OS [13].

In both groups, there were no injuries of adjacent structures during either procedures.

The conversion rate in group A to conventional OS was 14%. There were three cases owing to huge spleen sizes during our early period of study and two cases owing to bleeding.

Bedirli *et al.* [12] showed that intraoperative bleeding was one of the principle complications and a cause for conversion. It was mainly due to injury of the hilar or short gastric vessels, the splenic capsule, or parenchyma. This was increased in cases of splenomegaly [12].

Patients in group A started early ambulation from bed and started walking around the ward within the first 6–10 h, whereas patients in group B started walking after 12–18 h.

Rosen *et al.* [14] showed that patients subjected to LS had early ambulation than patients with open approach.

As regards the initiation of oral feeding, patients of group A started oral intake 12 ± 2.5 h postoperatively, and the amount was increased as the child tolerated. On the other hand, patients of group B showed evident delay in the initiation of the oral feeding for 24 ± 4.3 h postoperatively.

On the other hand, Fildman *et al.* [8] recommended to start oral feeding with fluids after recovery of patients who quickly progressed as tolerated after LS.

Baccarani *et al.* [15] documented that the mean time to start the oral feeding was 24–48 h in patients subjected to LS and this time was nearly doubled in patients subjected to OS.

The main problem we had faced in patients of group A was the high incidence of lung atelectasis when compared with the patients of group B. This was related to the pneumoperitoneum that increased the intra-abdominal pressure and compressed the bases of both lungs. We overcame this problem by immediate respiratory exercises following recovery from anesthesia.

We documented a state of elevated amylase and lipase in patients of group A when compared with patients of group B, but we did not record any case of pancreatitis in both groups.

Chand *et al.* [16] reported that the incidence of pancreatic injury during LS was 15% and this was characterized by isolated hyperamylasemia, peripancreatic fluid collections, and pancreatic abscess. This was mainly attributed to the use of stapling devices across the hilum during the procedure. In addition, they showed that splenomegaly was associated with an increased risk of injury of adjacent structures [16].

As we did not use staplers to control the pedicle, we assumed that the splenic size together with the manipulation of the hilum with our instruments during dissection, especially if the tail of pancreas was adherent to it, might play a role in this state of elevated pancreatic enzymes.

The length of hospital stay among patients of group A was much shorter than that among patients of group B by about 1.5 days.

We agreed with the main conclusion of Qureshi *et al.* [11] who showed in their study that the average time for hospital stay was about 48 h in the maximum period, whereas that for OS was 4 days.

On long-term follow-up, we had two cases of portal vein thrombosis in patients of group A and one case in patients of group B. These cases were suffering from ITP, and platelet count was above 800×10^3/ml in the postoperative period. Therefore, we started giving antiplatelet drugs such as Aspocid 150 mg once daily to decrease platelet aggregation.

In the same context, Romano *et al.* [17] documented an incidence of portal and splenic vein thrombosis ranging from 0.7 to 14% after splenectomy. This could reach 80% in elevated-risk patients [17].

In conclusion, although both LS and OS achieved the same goal for the children with benign hematological disease, the advantages of minimal invasive surgery made LS the standard approach for treatment of children with benign hematological diseases. However, the main concern is the high economic burden of LS when compared with OS.

Conflicts of interest

There are no conflicts of interest.

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