# Outcomes of laparoscopic splenectomy in benign hematologic and splenic diseases in children

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**Objective**
The aim of this study is to evaluate the safety and efficacy of laparoscopic splenectomy (LS) in the management of benign hematologic and splenic diseases in children.
**Patients and methods**
Thirty-eight patients, with the mean age of 10.4±4.3 years, underwent LS between May 2010 and November 2014; out of them, 92.1% suffered from benign hematologic diseases and 7.9% suffered from benign splenic diseases. The indication of splenectomy was different according to the underlying disease.
**Results**
The rate of conversion to open surgery was 5.2% and to hand-assisted procedure was 7.8%. The mean operative time was 148.4±26.7?min and the mean duration of hospital stay was 4.5±1.6 days. Five (13.1%) patients had accessory spleen diagnosed and removed successfully and one patient was diagnosed with missed accessory spleen. Postoperative complications were observed in five (13.1%) patients, which are wound infection (one patient), incisional hernia (one patient), upper respiratory tract infection (two patients), and missed accessory spleen (one patient). No mortality was reported in the study.
**Conclusion**
LS is well tolerated and effective in the management of benign hematologic and splenic diseases. It has many advantages over open surgery and should be the standard option in the surgical treatment of such cases.

**Keywords:**
benign, hematological disease, laparoscopic splenectomy

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## Introduction

The spleen, once thought to be a nonessential organ, has important functions in bacterial clearance, antibody formation, phagocytosis, and hematopoiesis. Apart from trauma, surgical intervention in children is mainly limited to hematologic diseases that affect the function of the spleen and to other uncommon benign lesions [1].

Improvements in surgical techniques have reduced perioperative complications and mortality. Preventive measures (new protein conjugate vaccines, antibiotic prophylaxis, and increased vigilance) are thought to greatly reduce the risk of overwhelming postsplenectomy infection, although their implementation is inconsistent [2].

Hematological disorders are the main indication for splenectomy in childhood. Idiopathic thrombocytopenic purpura (ITP), hereditary spherocytosis (HS), sickle cell anemia, and autoimmune hemolytic anemia make up the majority of cases. Immune thrombocytopenic purpura is the most frequent cause of splenectomy. Indications of splenectomy in HS include recurrent hemolytic crisis, severe aplastic crisis, significant splenomegaly, cholelithiasis, and developmental delay. Total splenectomy increases the risk of infection in these cases, and partial splenectomy may be an alternative option [3–5].

The benign indications include splenic cyst, abscess, hemangioma, lymphangioma, and splenic vein thrombosis.

Splenectomy was performed exclusively via an open approach until 1991, when Delaitre and Maignien performed the first laparoscopic splenectomy (LS) in an adult patient. Tulman and colleagues in 1993, performed the first LS in children. Since then, this technique has been gaining popularity due to accumulated experience and technological advances [6].

Some surgeons perform splenic artery embolization before splenectomy to control intraoperative bleeding that may be caused by unexpected capsular tears [7]. Others insert a Steiner electromechanical morcellator to extract cores of splenic tissue until complete splenectomy in cases of massively enlarged spleens to avoid large incisions to remove the spleen [8]. An alternative procedure for such cases is the hand-assisted LS.

Many aspects have been proposed as major advantages of LS in adults, such as less surgical trauma and intraoperative blood loss, early-hospital discharge, rapid return to normal activities, and better cosmetics [9].

## Patients and methods

After approval of the Study Ethical Committee and obtained parents' written consent, the current study was conducted on 38 patients, which included 21 women and 17 men with a mean age of 7 years (range: 3.5–18 years) and different benign disorders, underwent LS in Pediatric Surgery Departments, El-Iman Hospital, Riyadh, KSA and El-Minia University Hospital, El-Minia, Egypt between May 2010 and November 2014.

The indications of splenectomy were different according to the underlying disease. It was recurrent thrombocytopenia in patients with ITP, aplastic crisis and anemia in HS, acute sequestration crisis and hypersplenism in sickle cell disease, recurrent sequestrations and severe anemia in thalassemia major (Cooley's disease), failure of medical treatment and severe anemia in autoimmune hemolytic anemia, and lastly, the fear of impending rupture and abdominal pain in cases of hemangioma and splenic cysts.

Preoperative workup included history taking, physical examination, routine blood tests, chest radiograph, electrocardiography, and abdominal ultrasonography for measurement of the maximum interpole diameter of the spleen and detection of cholelithiasis. The diagnosis and indications for splenectomy were established by the Department of Hematology in patients with hemolytic diseases. All patients received pneumococcal and meningococcal vaccines.

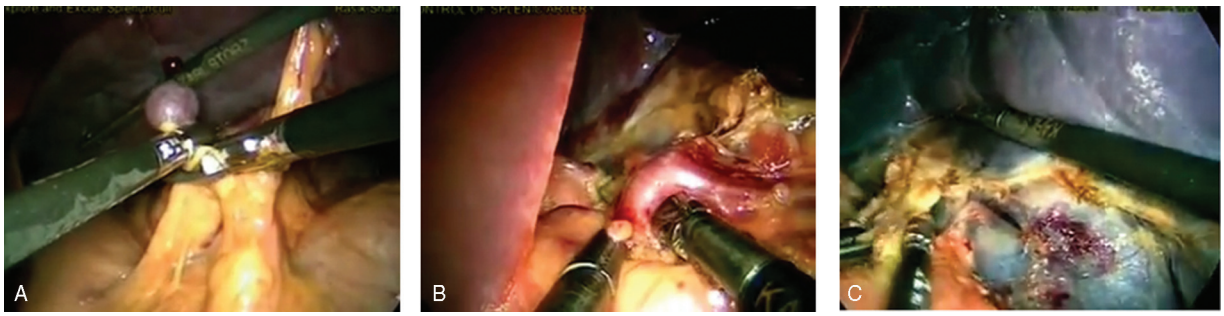
The data obtained and studied included the age, sex, indication for splenectomy, presence of gall stones, surgical time, length of hospital stay, intraoperative, and postoperative complications. Children with malignant lesions were excluded from the study. Patients with hemoglobin below 10 g/dl received packed red blood cells until hemoglobin was between 10 and 12 g/dl.

### Operative procedure

The operation was performed under general anesthesia with the patient in the right lateral decubitus position.

The laparoscopic technique involves inserting a 10-mm trocar in the umbilicus by the open technique. After creating the pneumoperitoneum, a 10-mm trocar is introduced in the left iliac fossa and two 5-mm trocars are placed, one subxiphoid and the other in the left anterior axillary line, below the rib cage. When cholecystectomy is performed, one more 5-mm trocar is employed in the right flank. The procedure begins with the opening of the gastrocolic ligament and extends along the entire gastric curvature and involves the short vessels. This maneuver exposes the pancreatic tail and splenic artery, which is ligated. Next, the splenorenal and splenocolic ligaments are sectioned. Finally, the hilar vessels are sectioned after ligation with clips. Once completely freed, the spleen is placed into a plastic bag, crumbled into fragments, and then eased out of the abdomen through the 10 mm port in the left lower quadrant (Fig. 1).

**Figure 1**




Operative procedure: (a) during excision of accessory spleen, (b) dissection of splenic artery before clipping, and (c) dissection and division of splenic ligaments.

At the beginning and at the end of the operation, a carful and methodical search was done to exclude accessory spleens in patients with hematologic diseases.

For all the patients operated on due to hematological diseases, postoperative ultrasound color Doppler examinations were done to detect any possibility of splenoportal thrombosis.

## Results

A total of 38 patients underwent LS, 17 men and 21 women and their age ranged between 3.5 and 18 years, were included in the study. The indications of splenectomy were different according to the underlying disease. Fourteen (36.8%) patients were suffering from ITP, seven (18.4%) patients had sickle cell disease, six (15.7%) patients had Cooley's disease, five (13.1%) patients had HS, three (7.8%) patients had autoimmune hemolytic anemia, two (5.2%) patients had hemangioma, and one (2.6%) patient had splenic cyst. The mean operative time was 148.4±26.7 min and the mean hospital stay was 4.5±1.6 days (Tables 1 and 2 and Figs 2–4).

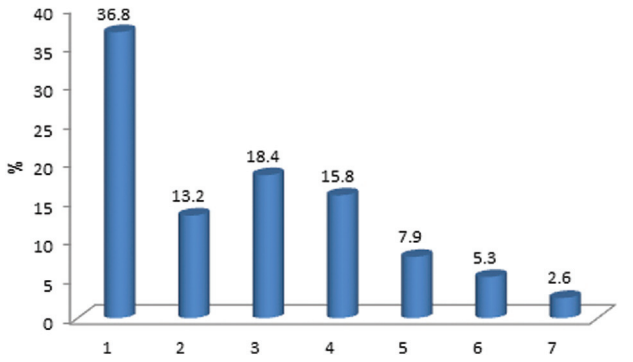
**Table 1 Demographic data**

| Characteristics | Benign (*N*=38) |
|---|---|
| Sex [*n* (%)] | |
| Male | 17 (44.7) |
| Female | 21 (55.3) |
| Age (mean±SD) (years) | 10.4±4.3 |
| Duration of operation (mean±SD) (min) | 148.4±26.7 |
| Hospital stay (mean±SD) (days) | 4.5±1.6 |

**Table 2 Indication and frequency of splenectomy**

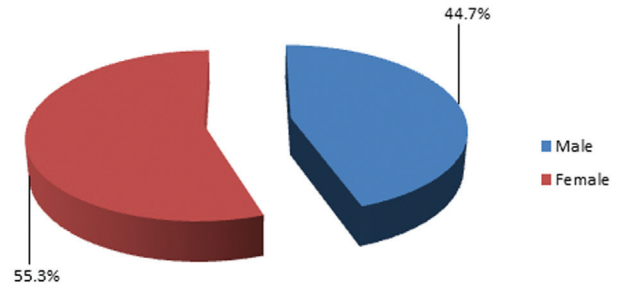
| Diseases | Indication | *n* (%) |
|---|---|---|
| Idiopathic thrombocytopenic purpura | Recurrent thrombocytopenia | 14 (36.8) |
| Hereditary spherocytosis | Aplastic crisis and anemia | 5 (13.2) |
| Sickle cell disease | Acute sequestration crisis and hypersplenism | 7 (18.4) |
| Cooley's disease | Recurrent sequestrations and severe anemia | 6 (15.8) |
| Autoimmune hemolytic anemia | Failure of medical treatment and severe anemia | 3 (7.9) |
| Hemangioma | Abdominal pain and fear of rupture | 2 (5.3) |
| Splenic cyst | Abdominal pain and fear of rupture | 1 (2.6) |
| Total | | 38 (100) |

**Figure 2**



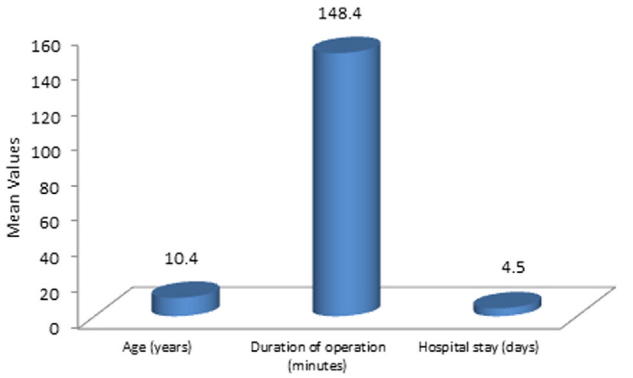

Sex distributions.

**Figure 3**




Mean values for demographic data.

**Figure 4**




Percentage of type of disease.

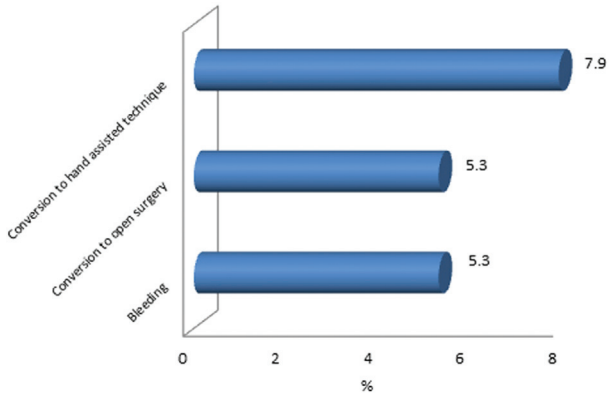
Two (5.2%) patients with cholelithiasis were subjected to laparoscopic cholecystectomy in the same time. Five (13.1%) patients had accessory spleen at the splenic hilum, successfully removed by carful dissection.

A hand-assisted technique was used in three (7.8%) patients to retrieve the spleen due to massive splenectomy (interpolar diameter ≥20 cm). Two of them had Cooley's disease and one had autoimmune

**Table 3 Intraoperative complication**

| Characteristics | *N*=38 [*n* (%)] |
|---|---|
| Bleeding | 2 (5.3) |
| Conversion to open surgery | 2 (5.3) |
| Conversion to hand-assisted technique | 3 (7.9) |

**Figure 5**




Percentage of intraoperative complications.

hemolytic anemia. Intraoperative bleeding happened in two (5.2%) patients converted to open surgery. One had hemangioma and the other had ITP (Table 3 and Fig. 5).

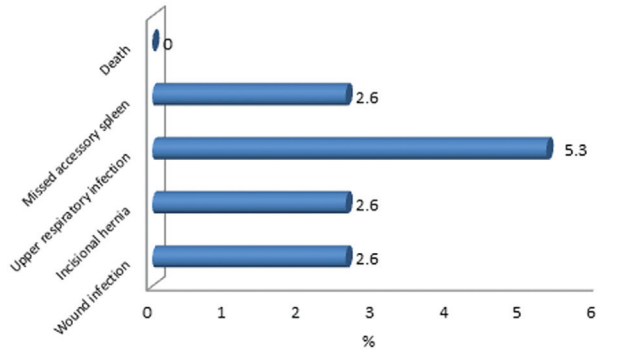
All patients started to receive soft diet on the second postoperative day. Postoperative complications were observed in five (13.1%) patients. One patient had postoperative incisional hernia after hand-assisted procedure, one patient had wound infection, two patients had acute upper respiratory tract infection treated by antibiotics, and one patient had missed accessory spleen. No postoperative mortality (Table 4 and Fig. 6) was reported in the study.

The mean follow-up was 12 months for patients with hematologic diseases and 6 months for the other three patients with hemangioma and splenic cysts. Patients with ITP, spherocytosis, and autoimmune hemolytic anemia became free. Patients with β-thalassemia improved certainly with a delay in the interval between transfusions.

**Table 4 Postoperative complication**

| Characteristics | *N*=38 [*n* (%)] |
|---|---|
| Wound infection | 1 (2.6) |
| Incisional hernia | 1 (2.6) |
| Upper respiratory infection | 2 (5.3) |
| Missed accessory spleen | 1 (2.6) |
| Death | 0 (0) |

**Figure 6**




Percentage of postoperative complications.

## Discussion

For nearly a century, splenectomy has been used in the treatment of hematologic disorders. Classically, performed by open surgery starting in 1991, they began to be performed laparoscopically, initially in adults and since 1993, in children [10].

LS is a procedure of high complexity, whose technical difficulty is directly related to the presence of adhesions to the other organs and relative size of the spleen [11].

Spleen size is considered as the single most important condition affecting the conversion rate, operative time, and complication rate in LS [12]. Some authors consider massive splenomegaly as a relative contraindication to LS [13]. Standardization of the technique, increasing experience, and technical innovations have shown that an enlarged spleen can be managed successfully by laparoscopy [14].

In the present study, two (5.2%) cases converted to open surgery due to intraoperative bleeding, three (7.8%) cases converted to hand-assisted technique due to massive splenomegaly, and 33 (86.8%) cases completed purely laparoscopically. Gianfranco *et al.* [14] reported a conversion rate of 5.3% in a study for LS in the management of benign and malignant hematologic diseases.

Maurício *et al.* [11] reported a conversion rate of 6% in a study of LS in hematologic disorders in the global literature, the conversion rate range between 2 and 18% [15–21].

The identification and removal of accessory spleens is an important issue, as missing them may allow the condition for which the splenectomy is done, and therefore, may persist recurrence of symptoms later. In the current study,

the incidence of accessory spleens was 13.1% and that of the missed accessory spleen was 2.6%, detected postoperatively. Maurício *et al.* [11] detected accessory spleens in 12% of their study patients, whereas in other series, this rate varied from 4 to 28% [17–25].

In the current study, the operative time ranged between 105 and 190 min. The size of the spleen and the absence or presence of adhesions were the two important factors affecting the duration of operation. The duration of hospital stay ranged between 2 and 7 days depending on the presence or absence of complications. A review of the literature reveals that these two variables, surgical time and duration of the hospitalization, represent the most conflicting results when analyzing the open approach versus the laparoscopic technique [1].

In a study performed by Rogulski *et al.* [26], the operative time for total LS was 190–360 min and the duration of hospitalization was 8–13 days. However, Gianfranco *et al.* [14] reported an operative time range of 60–240 min and hospital stay range of 2–11 days for patients with benign hematologic disease, who underwent LS. Maurício *et al.* [11], reported an average operative time of 160 min and a mean hospital stay time of 48 h.

The main postoperative complications in the current study included wound infection (2.6%), incisional hernia (2.6%), and acute upper respiratory tract infection (5.2%). Postoperative splenoportal thrombosis was not reported in the study.

## Conclusion

LS is well tolerated and effective in the management of benign splenic disorders in children. The long duration of LS is offset by a low postoperative morbidity, a short-hospital stay and a quick return to normal activities.

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Nil.

#### Conflicts of interest

There are no conflicts of interest.

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