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ORIGINAL ARTICLE

Laparoscopic versus Open Splenectomy in the Management of Hematological Diseases

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ABSTRACT

Background: Splenectomy traditionally was by open method, which required a big incision in the abdominal wall, long hospital stay and disfiguring scar. With time, the benefits of laparoscopic splenectomy (LS) over open splenectomy (OS) included shorter hospital stay, quick return to work, and wound complications and better cosmetic results.

Methods: This is prospective randomized comparative study included patients when splenectomy is indicated due to hematological diseases who presented to Surgery Department of Zagazig University Hospitals during the period from September 2016 to May 2019.

Results: The mean age of patients was 22.17 ± 3.35, and 66.7% of them were female. .Pathology included 8 patients with (ITP), 5 thalassemia, 4 hereditary spherocytosis, 7 (AIHA). Mean operative time was 120.33± 23.14 minutes in the (LS) group vs 109.58 ± 18.12 min in the (OS) group. The (LS) group had a significantly shorter hospital stay compared to OS group (1.91± 0.79 day vs 3.83 ± 0.83 day). LS group was associated with less blood loss and blood transfusion during surgery, less complications and better outcome. Wound complication occur in 1 patient in the (LS) group vs 3 patient in the OS group.One patient in the (LS) group had intraoperative bleeding so, converted to open surgery due to difficult control.

Conclusion: Lap splenectomy is considered to be an emerging 'gold standard' procedure for all elective splenectomy in patients with hematological diseases. Rapid advances in technology advanced laparoscopic instruments, endoscopic vascular stapler and ligature aid the surgeons in removing even large spleens laparscopically.

Keywords: Hematological disorders, Splenectomy, Laparoscope, Stay.

INTRODUCTION

Splenomegaly occurs in a large number of hereditary diseases, some relatively prevalent and others, rare to ultra-rare. Because physicians are often unfamiliar with the less common disorders, patients may suffer because of diagnostic delay or diagnostic error and may undergo invasive, non-innocuous procedures that are potentially avoidable if the correct diagnosis was suspected [1].

Laparoscopic splenectomy (LS) is a technically challenging procedure and this can be handled by learning and practicing the proper technique. The instruments used should be up-to-date and properly maintained so that the procedure is smooth without complications [2].

Surgical complications of laparoscopic splenectomy are similar to those for the "open" procedure. Complications are divided as early and late. Early complications include bleeding, pneumonia, left pleural effusions, atelectasis, and injury to other organs as colon, small bowel and stomach. Late complications include subphrenic abscess, splenic or portal vein thrombosis, recurrence of the original disease as a result of accessory spleens and overwhelming post-splenectomy sepsis [2].

METHODS

This is prospective randomized comparative study included patients who are candidate for

splenectomy when splenectomy is indicated due to hematological diseases who presented to Surgery Department of Zagazig University Hospitals during the period from September 2016 to May 2019.

Inclusion Criteria includes Age 10-50 years, both sexes, patients with hypersplenism due to hematological diseases, patient acceptance, and size of spleen up to 20 cm. We excluded Age < 10 > 50.We excluded , Patients with hypersplenism due to another cause rather than hematological diseases, splenomegaly due to portal hypertension, traumatic splenectomy, re-operations because of accessory spleen, current pregnancy and patient refusal.

All patients were asked about history suggesting hematological diseases as, hematological crises and anemia. History suggestive for hypersplenism, symptoms suggesting thrombocytopenia (easy bruisability, appearance of petichae), anemia (easy fatigability, history of frequent blood transfusion) and leucopenia (repeated infections). Physical Examination searching for pallor, jaundice and peticteal hemorrhage also abdominal examination for detection of splenomegaly and hypersplenism. Laboratory tests included complete blood count, kidney and liver function tests, viral markers, bone marrow aspirate and bleeding profile to aid in the assessment of patient fitness for surgery. Radiological examinations is pelvic-abdominal US for size of the spleen.

Written informed consent was obtained from all participants and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans**.**

a. Operative technique: **Open splenectomy:**

The procedure is done under general anesthesia with endotracheal intubation.1 gm of 3rd generation cephalosporin is given IV at the induction of anesthesia. The patients lie supine on the operating table. The usual steps of draping and preparation of the abdomen for laparotomy was performed.

Exploration of the abdomen was done carefully. The splenophrenic and linorenal ligaments of the spleen were divided. The splenocolic ligament was divided releasing the colon from the lower pole of the spleen.

Division of the peritoneum over the splenic hilum was done from the lower pole to the upper pole. The short gastric vessels were controlled carefully. Ligation of the splenic vessels at the hilum was done. Careful ligation of the splenic vessels at the hilum was done in order to avoid injury of the tail of the pancreas.

Any peritoneal attachments were divided and the spleen was removed. Hemostasis was then secured carefully by using pad rolled toward the midline to permit visualization of the site of the divided short gastric vessels at greater curvature of the stomach.

b. **laparoscopic splenectomy** (according to Laparoscopic splenectomy in lateral approach)

The procedure is done under general anesthesia with endotracheal intubation. Antibiotic was given at the induction of anesthesia. The patients were placed in the right lateral decubitus position. The abdomen is prepared and draped in the standard way.

The laparoscopic set is placed on the left side of the patient; the surgeon stands on the right side of the patient. Also the cameraman stands on the right side of the patient. This allows the surgeon; laparoscopic set and the spleen are on the same line to get better orientation. We use the splenic ligaments to act as a natural traction by tilting the patient 15° reverse trendelenburg position, while gravity act as natural counter retraction.

A pneumoperitoneum is created and maintained at 13 to 15 mmHg using carbon dioxide. The 1st 10 mm port is inserted along the mid-clavicular line above the patient's umbilicus, and to be used for the camera. The 2nd 10 mm port is inserted along the anterior axillary line above the patient's anterior superior iliac spine. 5 mm trocar is inserted in left subcostal or subxiphoidly. We can add Additional 5 mm trocar below the twelfth rib between the mid to post axillary lines.

Placement of the additional trocars in the abdomen should be done in triangular fashion. The abdomen is carefully explored for accessory spleens. This step is very critical especially in our cases of splenomegaly with hematological diseases to avoid the recurrence of the original disease.

The dissection proceeds in five stages: division of the short gastric vessels, division of the splenocolic ligament, and ligation of the inferior polar vessels, hilar control, and division of the phrenic attachments of the spleen. The control of the short gastric vessels was done using the harmonic scalpel.

Dissection proceeds toward the lienorenal ligament while the spleen remains suspended from the posterior layer of lienorenal ligament. The inferior polar branches are divided using large polymer clips figure (1). Segmental devascularization changes the color of the spleen from brown to blue and allows the surgeon to

follow the progress of the procedure. After devascularization of the inferior pole of the spleen, the vascular pattern of the hilar structures was exposed. The pedicle formed by the artery and vein enters the hilum as a compact bundle and is transected en bloc with application of intracorperal suture using vicryl 0 and application of large polymer clips on each of the artery and vein figure (2). Once excised, the spleen is placed in a durable rips top nylon sack

In our cases, the extraction was done through trocar site after widening the trocar site and fragments the specimen using Babcock forceps figure (3). Tube drain in the splenic bed was left. Closure of the port sites using absorbable sutures and Steris trips.

Post-operative follow-up:

Clinical evaluation of all patients for any complications was recorded. Any Wound complications as wound dehiscence and burst abdomen. Postoperative laboratory investigations: CBC, length of hospital stay was recorded. Conversion rate to open surgery social, physical and psychological states of the patient were recorded. Follow up of the patients every week for one month after discharge in the outpatient clinic then every month for one year after the operation.

Statistical analysis

The collected data were analyzed by computer using Statistical Package of Social Services version 24 (SPSS), Data were represented in tables, Continuous Quantitative variables e.g. age were expressed as the mean ± SD & median (range), and categorical qualitative variables were expressed as absolute frequencies (number) & relative frequencies (percentage).

Suitable statistical tests of significance were used after checked for normality. Categorical data were cross tabulated and analyzed by the Chi-square test; Continuous data were evaluated by Mann Whitney test. The results were considered statistically significant when the significant probability was less than 0.05 ($P < 0.05$). P-value < 0.001 was considered highly statistically significant (HS), and P-value ≥ 0.05 was considered statistically insignificant (NS).

RESULTS

This is prospective randomized comparative study including 24 patients with splenomegaly with hematological diseases who presented to Surgery Department of Zagazig University. Patients were divided into two groups (lap and open).

The mean age of patients was 22.17 ± 3.35, and 33.3% of them were male. .Pathology included 8 patients with idiopathic thrombocytopenic purpura (ITP), 5 thalassemia, 4 hereditary spherocytosis, 7 autoimmune hemolytic anemia (AIHA). Table (1) shows that there was no significant difference between both groups regarding duration of surgery as it was 120.33± 23.14 versus 109.58 ± 18.12 min among laparoscopic splenectomy and open splenectomy group respectively.

There was highly statistically significant difference between both groups regarding hospital discharge where length of stay was statistically longer among open splenectomy than laparoscopic splenectomy it ranged from 3-5 days vs 1-3 days respectively table(4). LS group was associated with less blood loss and blood transfusion during surgery, less complications and better outcome. Chest complications occurred in 1 patient in the OS group. Wound complication occurred in 1 patient in the (LS) group vs 3 patient in the OS group table (2).

One patient in the Lap group had intraoperative bleeding so, converted to open surgery due to difficult control. There is no mortality within 30-day post-operative in both groups. Only one case in the (LS) group was readmitted and re-operated for wound complication (evacuation of a seroma).

Table (3) are showing that there was no significant difference between platelet level pre and postoperative among the studied laparoscopic splenectomy, but there was highly statistically significant difference among open splenectomy group where platelet level statistically increased after operation.

Tables and figures

Table 1. Duration of surgery between the studied groups.

Item	Laparoscopic Splenectomy group (N=12)	Open Splenectomy group (N=12)	MWT	P-value
Duration of surgery (min)				
• Mean ± SD	120.33± 23.14	109.58 ± 18.12	54.00	0.297 (NS)
• Median (Range)	117.5(90-160)	107.5(80-140)		

Mann Whitney U test. $P < 0.05$ is significant. NS: Not significant.

Table2. Complications (splenectomy outcome) among the studied groups.

Item	Laparoscopic Splenectomy group (N=12)		Open Splenectomy group (N=12)		χ^2	P-value
	No.	%	No.	%		
Complication						
Non specific						
• Cardiac complications	0	0.0	0	0.0	----	---
• Chest complication	0	0.0	1	8.3	Fisher's	1.000
Specific						
• Bleeding	1	8.3	0	0.0	Fisher's	1.000
• Fever	0	0.0	0	0.0	----	---
• Wound complication	1	8.3	3	25.0	Fisher's	0.590
• Subphrenic collection	0	0.0	0	0.0	----	----
• Portal Venus thrombosis	0	0.0	1	8.3	Fisher's	1.000
• OPSI	0	0.0	0	0.0	----	---
• Conversion to open	1	8.3	0	0.0	Fisher's	1.000

OPSI: overwhelming post-operative infection. P < 0.05 is significant. NS: Not significant.

Table 3. Platelet count pre and postoperative between the studied groups.

Platelet level x10^3	Preoperative	Postoperative	test	P-value
Laparoscopic Splenectomy				
• Mean ± SD	167.25± 49.8	201.6± 53.9	-1.609	0.104 (NS)
• Median (Range)	165.5(97-250)	201.5(120-280)		
Open Splenectomy				
• Mean ± SD	172.42± 41.8	232.17 ± 43.9	-3.059	0.002* (HS)
• Median (Range)	159(115-250)	224.5(150-300)		

Wilcoxon Signed Ranks Test. P < 0.05 is significant. NS: Not significant.

Table 4. Hospital discharge between the studied groups.

Item	Laparoscopic Splenectomy group (N=12)	Open Splenectomy group (N=12)	MWT	P-value
Hospital discharge (day)				
• Mean ± SD	1.91± 0.79	3.83 ± 0.83	7.500	0.000* (HS)
• Median (Range)	2(1-3)	4(3-5)		

Mann Whitney U test. *P < 0.05 is significant. NS: Not significant. HS: highly significant.

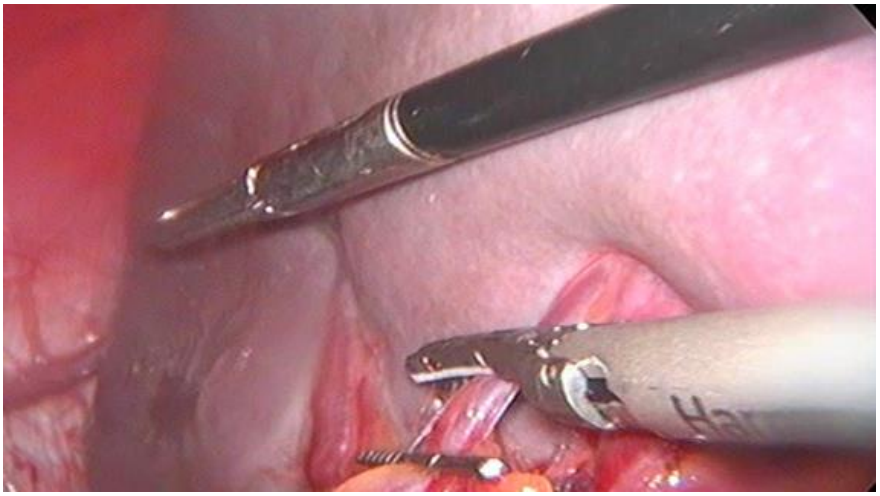

Figure1. Photograph shows division of branch of splenic artery.

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Volume 28, Issue 4, July 2022(672-678)

Figure2. Photograph shows clipping of splenic vein.

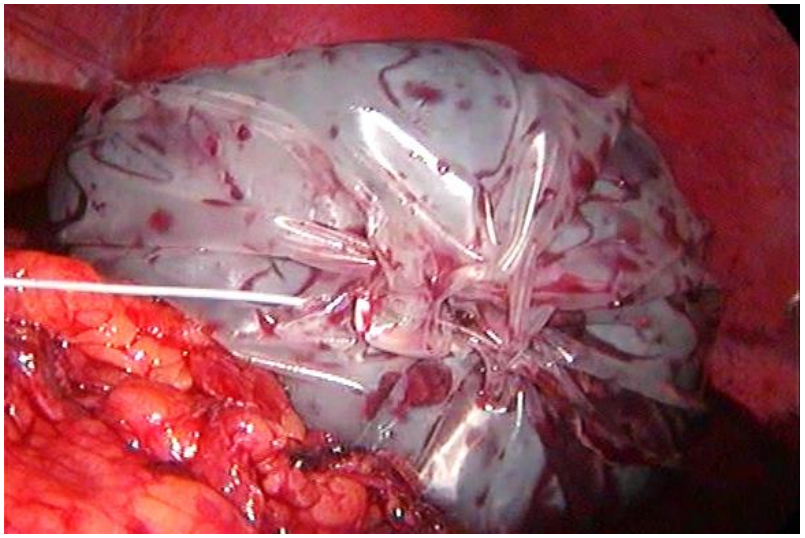

Figure3. Photograph shows placement of the spleen in the retrieval bag.

DISCUSSION

The first splenectomy was performed by Andirano Zaccarello in 1549 in a young woman for hypersplenism, who survived for 6 years afterwards. Up to 1991, open splenectomy was the traditional surgical approach for spleen removal for various reasons. With the development of minimally invasive surgical procedures, LS has gradually increased, since it was first reported by Delaitre and Maignien in 1991.The advantages of the laparoscopic approach compared to the open (conventional) surgery are mainly related to small incision, less postoperative pain and shorter recovery period [3]

In the meta-analysis and systematic review of studies comparing laparoscopic and open splenectomy with 922 patients over a 20-y period, 55% of the splenectomies were performed laparoscopically [4]. Although in multi-institutional contemporary cohort study [5]. With a similar number of patients, the majority of splenectomies (91%) were performed laparoscopically with a conversion rate of less than 1%.

Demographic data in our hospitals show that age of group I was ranging from 16-27 years old with mean 22.17 ± 3.35 years old and 33.3% of them were male while age in group II was 22 ± 4.28 years old, ranged from 14-28 years old, there is no significant difference between both groups regarding age and sex.

In our study, we have four types of hematological disease associated with splenomegaly as ITP (33.3% in both groups), AIHA (33.3% in group 1 vs 25% in Group II), Thalassemia (β type) (16.7% vs 25% in Group II) and Hereditary spherocytosis (16.7 in both groups). There is no statistically significant difference between both groups regarding hematological disease.

In a study made by Sapucahy and his colleagues [6], idiopathic thrombocytopenic purpura was the most common entity in both groups (17/30 in the laparoscopic group vs. 17/28 in the open group), followed by familial spherocytosis, haemolytic anemia, myelodysplasia and lymphoma.

In our study, we found preoperatively that the

platelets levels was varying in both groups ranging from (97-250 × 10^3/mm^3 with mean of 167.25± 49.8 in group1) vs (115-250 × 10^3/mm^3 with mean of 172.42± 41.8 in the open group). There is no statistically significant difference between both groups in pre-operative platelet count, and preoperative corticosteroid dose.

In study of Golash and his colleagues [7] Preoperative splenic diameter (cm) was 14 in the (LS) group while in study of Patle and his colleagues [8] Preoperative splenic diameter (cm) was 18.4 in the (LS) group.

In our study, we found that duration of surgery was varying in both groups ranging from (90-160 min with mean of 120.33± 23.14 in group 1) vs (80-140 min with mean of 109.58 ± 18.12 in the open group). The duration of surgery was slightly longer in the (LS) group than open but with no significant difference between both groups table (1).

In study of Utria and his colleagues, the mean operating time was 120 (90-159) min in the lap group vs 133 (80-182) min in the open group, which is similar to the results in our study. Also, in this study 4 cases out of 613 in the lap group was converted to open (0.65%) and 42 cases out of 612 in the lap group were received blood transfusion (6.9%).

In our study, there was no significant difference between both groups regarding pre and post-operative platelet level (the mean was 169.8± 45.07× 10^3/mm^3 preoperatively vs 216.9 ± 50.56 × 10^3/mm^3 postoperatively) table (3).

In study of Hasan Ucmak and his colleagues [9] the mean Post-operative platelet count was 222× 10^3/mm^3 in the (LS) group.

There was highly statistically significant difference between both groups regarding hospital discharge where length of stay was statistically longer among open splenectomy than laparoscopic splenectomy, as it ranged from 3-5 days vs 1-3 days respectively table (4).

In study of Utria and his colleagues, the mean length of stay 2 (1-3) days in the lap group vs 4 (3-5) days in the open group. In our study, there was no significant difference between platelet level pre and postoperative among the studied laparoscopic splenectomy, but there was highly statistically significant difference among open splenectomy group where platelets count statistically increased after operation.

In study of Machado and his colleagues [10] the mean of pre-operative platelet count was 28 × 10^3/mm^3 to be 180 × 10^3/mm^3 what is mean of post-operative platelet count.

In our study, that there was no significant difference between both groups regarding complications in the form of bleeding, cardiac complications, chest infection, , fever, wound complication, subphrenic collection, venous thrombosis and overwhelming post-operative sepsis. we found that only 1 case out of 12 in the lap group had wound complication (8.3%) vs 3 out of 12 cases in the open group had wound complications (25%) and only one case (8%) in the open group had chest complication table (2).

In a study by Yikun Qu and his colleagues [11] 3 cases out of 32 (9.4%) in the lap group had wound complications vs 5 cases out of 41 (12.2%) had wound complications.

In our study, regarding the need for reoperation, only 1 patient among laparoscopic splenectomy group readmitted and re-operated again for wound seroma with no significant difference between both groups.

In study of Utria and his colleagues, 23 cases out of 613 were readmitted (3.8%) and only 2 cases were re-operated (0.3%) in the lap group vs only 1 case out of 60 was readmitted (1.7%) with no reoperation.

CONCLUSION

Lap splenectomy is considered to be an emerging ‘gold standard’ procedure for all elective splenectomies in patients with hematological diseases. Good documentation for all cases of splenomegaly with hematological diseases to have database for retrospective multicentric studies on lap splenectomy. Conversion to open in the lap ceases is not a failure or complication and safety of the patient comes first. The evolution of the technology has allowed though, cases which were considered to be absolute contraindications for performing a minimal invasive procedure to be treated with modified laparoscopic approaches.

- Conflict of Interest: None.
- Financial Disclosures: None.

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