ORIGINAL RESEARCH

A comparative study between laparoscopic splenectomy versus open splenectomy

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ABSTRACT

Background: Initially splenectomy was done by open technique, indications being mainly haematological disorders. With the development in the techniques of laparoscopy, it was also used for haematological disorders mainly chronic ITP. With growing experience and advancement in technology the laparoscopic approach extended to cysts, tumours, storage diseases and even trauma. **Materials and methods:** The study was a randomized comparative study conducted in the department of general surgery of Sawai Man Singh Hospital, Jaipur from june 2011 to june 2012. Total 25 patients were included in study and randomized prospectively into two groups, group A & group B with 12 cases in group A and 13 cases in group B respectively. The patients in group A underwent laparoscopic splenectomy while group B underwent open splenectomy. **Observations and results:** The Mean age in Group A was 35.41 years while in Group B was 29.53 years. Splenic span of 11-20 cm was found in 33% patients in group A and 46% of patients in Group B. Minimum preoperative platelet count in group A was 7000/µl in a case of I.T.P. and that in group B was 30000/µl. Accessory spleen was detected in 1 of the patient (8%) in Laparoscopic group whereas none of the patient was found to be having accessory spleen in open group. In group-A hilar control was achieved by Endostapler in 83% patients while in 17% patients hilar control was done by Endosuturing using silk sutures. The operative time in Group A was in the range of 90-360 minutes with Mean operating time of 185 minutes ±96 minutes while in Group B operating time was in the range of 75-120 minutes with Mean operating time of 102 minutes ±20 minutes. Mean intra operative blood loss in Group A was 60 ml ±38 ml and found to be less than Group B that is 165 ml±78 ml. Mean drain output was 134ml± 145ml in Group A with range of 50-550ml while in Group B Mean drain output was 342ml±103ml with range of 200-500ml. The difference was statistically significant (p value < 0.05). **Conclusion:** Laparoscopic splenectomy is safe and efficacious for mild to moderate size spleens. The operative time for laparoscopic splenectomy is longer than open splenectomy but after achieving learning curve it can be shortened significantly.

Keywords: Idiopathic thrombocytopenic purpura (I.T.P), Splenectomy, Veress needle insertion [V.N.I], Pneumoperitoneum.

INTRODUCTION

Initially, splenectomy was done by open technique, indications being mainly haematological disorders e.g. Hereditary Spherocytosis (H.S.), Immune/ Idiopathic Thrombocytopenic Purpura (I.T.P.) and Hypersplenism. It was the development in the techniques of laparoscopy ranging from diagnostic to therapeutic procedures which rejuvenated the interest for applying this modality for splenectomy. Laparoscopic approach was used initially for haematological disorders mainly chronic ITP, but with growing experience and advancement in technology the laparoscopic approach was extended to cysts, tumours, storage diseases and even trauma. Several groups have demonstrated the technical feasibility, safety and effectiveness of laparoscopic approach for splenectomy [1,2,3].

The present study was done in our institution to compare laparoscopic splenectomy with open splenectomy.

MATERIALS AND METHODS

This randomized comparative study was conducted in the Department of General Surgery of Sawai Man Singh Hospital, Jaipur in the year 2011. Total duration of study was one year and the candidates for the study were cases undergoing elective open and laparoscopic splenectomy. Total 25 patients were included in study and randomized prospectively into two groups, group A & group B with 12 cases in group A and 13 cases in group B respectively. The

patients in group A underwent laparoscopic splenectomy while group B underwent open splenectomy.

INCLUSION CRITERIA

Patients of more than 15 years age, Patients of either sex, Patient with mild to moderate spleen size (cranio caudal length < 20cm).

EXCLUSION CRITERIA

Massive splenomegaly (cranio caudal length > 20 – 25 cm), Portal hypertension with bleeding diathesis, Splenic trauma, Pregnant females.

GROUP A

OPERATIVE TECHNIQUE OF LAPAROSCOPIC SPLENECTOMY

1. PATIENTS POSITION AND OPERATING ROOM SET-UP:

After induction of general anesthesia and end tracheal intubation, patient was placed in a 60^0-90^0 right lateral deceits position with left arm supported by arm splint and with right lower limb flexed on hip and knee joints. A sand bag was between the legs. The kidney bolster of operating table was raised to increase the gap between left costal margin and left iliac crest. Two video monitors, one on each side of patient's shoulder are placed. Surgeon stands on right side of patient with camera assistant to right of the surgeon. One assistant stands on the left side of the patient helping in retracting the spleen. Scrub nurse with instrument-trolley stands at the foot end of the table.

2. CREATION OF PNEUMOPERITONEUM:

After painting and draping with 10% betadine, carbon dioxide pneumoperitoneum was created using closed technique by Veress needle [V.N.I] in all patients. The carbon dioxide pressure was maintained between 12-15 mm Hg.

3. PORT PLACEMENT AND DIAGNOSTIC LAPAROSCOPY:

Total of four ports were used in all cases. 10mm optical trocar was placed in the left mid axillary line midway between umbilicus and left costal margin. The two working ports were placed around the telescope in triangulated fashion at 90^0 angles, one 12mm working port in left anterior/mid axillary line and 5mm working port in the epigastric region at sub xiphoid level. Another 5 mm retracting port in mid/posterior axillary line was placed. Using 30^0 telescope thorough examination of the peritoneal cavity was done to search accessory spleens, on the splenic hilum, tail of pancreas and omentum, small/large bowel mesentery and in pelvis.

4. MOBILISATION OF SPLEEN:

The exposure to spleen was facilitated by using 15^0 reverse trendelenberg position and elevation of patient's left side achieving "Hanging spleen" from dorsolateral diaphragmatic attachments. Dissection of spleen was carried out in a step wise manner as described below.

a) Division of splenocolic ligament was done. Colon was retracted allowing proper exposure of inferior pole of spleen. Small inferior polar vessels were ligated using surgical clips.
b) Division of posterior layer of lienorenal ligament was done from caudal to cranial direction leaving small diaphragmatic attachment of spleen.
c) The dissection started at medical aspect of inferior pole and progressed in a cephalad direction.
d) Division of gastrosplenic ligament with short gastric vesscls was performed with harmonic device. Thereafter splenic hilum was approached. The peritoneum overlying the splenic vessels was divided using harmonic scalpel.
e) The hilar control was achieved using two methods. First by dissecting splenic artery and vein individually and ligating and dividing them using endo-suturing. Second by dividing the pedicle *"en-masse"* using endo-stapling using white vascular cartridge.
f) Finally the spleen was detached from its diaphragmatic attachments and splenic bed was inspected for homeostasis.
g) The detached spleen was transferred to an endo-bag having purse-string tied at its mouth.

5. EXTRACTION OF THE SPECIMEN:

The drawstring was grasped through 12mm working port and the extraction bag containing the specimen was elevated to the abdominal wall. The 12mm port was removed and the fascial incision at that site was enlarged. The bag was pulled partially through the abdominal wall and the spleen was fragmented through the open end with ring forceps and using finger fracture method. Abdominal drain of twenty gauge was placed in the splenic bed and fixed to abdominal wall. All ports were removed under visions and pneumoperitoneum was deflated. The fascial defect of incision was closed using vicryl no. 1 suture. All port sites were closed with ethilon 3-0 suture. Antiseptic dressings were applied.

GROUP B

OPERATIVE TECHNIQUE OF OPEN SPLENECTOMY

Patient was placed in supine position. After general anesthesia, abdomen was painted from nipple to thigh. A midline vertical incision or left sub costal incision was made extending from subxiphoid to umbilicus. An assistant on each side helps retracting the abdominal wall and left lobe of the liver or self-retaining retractor is used. After opening peritoneum, lesser sac was approached by dividing the gastro colic omentum. The peritoneum over the anterior surface of pancreas was divided and splenic artery over the superior border of pancreas was identified and ligated in continuity. The diaphragmatic adhesions were divided. The posterior layer of lienorenal ligament was divided and spleen

with tail of pancreas was retracted medially. The splenic artery and vein were dissected individually and ligated and divided taking care of tail of pancreas. The short gastric vessels in the gastrosplenic ligament were ligated and divided taking care of gastric fundus. The specimen was removed and splenic bed was thoroughly examined to ensure absolute haemostasis. The 32 gauge abdominal drain was placed in the left sub diaphragmatic space. The abdomen was closed in layers. The skin sutures were applied using ethilon 3-0 sutures. Anti-septic dressing was applied.

INTRA-OPERATIVE DETAILS:

The following intra operative details were recorded in both groups-

1. Position of the patient.
2. Method of creating pneumoperitoneum
3. Number and position of ports/type and size of incision.
4. Operative time.
5. Estimated amount of blood and requirement of blood and blood products.
6. Presence of accessory spleens (Number, Location and size).
7. Associated co morbidities found intra operatively.
8. Intra operative complications:-

- Veress needle injury to spleen, colon, small bowel.
- Injury to pancreatic tail, gastric funds, splenic flexure, diaphragm.
- Vascular injury to splenic vessels, slippage of ligature/clip, haemorrhage.
- Splenic capsular tear.
- Rupture of endobag with spillage of splenic tissue into abdominal cavity.

9. Length of incision.
10. Conversion to open surgery in group-A (laparoscopic splenectomy).

POST OPERATIVE DETAILS:

Patients were shifted to surgical wards/Intensive care unit from the anesthesia recovery room and monitored for hemodynamic stability. Patients received parenteral anti-biotic, analgesic, anti- emetic in the ward.

Following details were recorded:-

1. Mobilization of the Patient.
2. Parenteral analgesic requirement.
3. Abdominal drain output.
4. Removal of Ryle's tube and Foley's catheter.
5. Return of bowel functions.
6. Start of oral feed and resumption of regular diet.
7. Hematological response.
8. Post-operative complications.

- Gastrointestinal- Acute dilation of stomach, ileus, pancreatic fistulas.
- Pulmonary- atelectasis, effusion, pneumonitis, embolism.
- Vascular- deep vein thrombosis.
- Infection- port site/incision/subphrenic collection.
- Wound dehiscence/port site hernia/incisional hernia.
- Overwhelming post splenectomy infections (OPSI).
- Mortality.

9. Length of hospital stay.

FOLLOW UP IN OUTDOOR

Patients were subjected to a follow up for one year and noted for persistent hematological response, Cosmetic aspects, Psychological satisfaction.

OBSERVATIONS AND RESULTS

25 patients of splenectomy were included in the study, 12 in the Group-A (laparoscopic splenectomy) and 13 in Group-B (open splenectomy). For *demographic profile* age and sex were compared in both the groups. The Mean age in Group A was 35.41 years with standard deviation of 16.32 years and range was 16-67 years while in Group B mean age was 29.53 years with standard deviation of 12.73 years and range was 16-55 years. Patient of either sex were included in the study. In Group A, male to female ratio was 5:7 and that in Group B was 6:7. Most of the patients in two groups were having benign haematological disorders. I.T.P. being the commonest in Group-A (67%) and Hypersplenism in Group B (69%). 67% patients out of twelve patients in Group A were having I.T.P. 16.66% patients had splenic cyst and 8.33% patient was having Hypersplenism. In Group-B (open splenectomy) main indication for the surgery was Hypersplenism in 69.23% patients out of thirteen patients. 23.07% patients were having splenic abscess and 7.69% patient was suffering from splenic cyst. Splenic span of 11-20 cm was found in 33% patients in group A and 46% of patients in Group B. 67% patients in Group-A were having normal sized spleen while 54% in group B. 58 % patients in Group A were using steroids either orally of parenterally. 8% of patient required the use of cytotoxic drug (Azathioprin) and I.V. Immunoglobulin in addition to parenteral steroids. In Group B 30% of the patients were using steroids for Hypersplenism. None of the patients required cytotoxic drugs and I.V. Immunoglobulin. Two Patients (16%) of I.T.P. in Group A developed steroid toxicity in the form of hypertension, diabetes and pan gastritis. None of the patients in Group B were having features of toxicity.

Minimum preoperative platelet count in group A was 7000/µl in a case of I.T.P. and that in group B was 3000/µl. 33% patients and 25% patients of Group A required preoperative blood and platelet transfusion respectively while 30% patients and 23% patients required same in Group B respectively. For *Intraoperative findings* both the groups were compared in terms of length and type of incision, detection of accessory spleen, method of hilar control, mean operative time, blood loss, blood and platelet transfusion and intraoperative complications. All

patients of Group-A underwent Laparoscopic surgery using four-port technique as described under the section of material and methods. The 12mm. port incision was extended to deliver the specimen. Mean length of incision was 3.70 centimeter with standard deviation of 0.498 centimeter. 77% midline vertical incision and 33% left subcostal incision were used with mean length of 17.50 cm with standard deviation of 2.25 cm in Group B. Accessory spleen was detected in 1 of the patient (8%) in Laparoscopic group whereas none of the patient was found to be having accessory spleen in open group. The accessory spleen was located at splenic hilum. It was measuring approximately 4 x 4 x 3 cm in size, supplied by one of the branches of splenic artery. In group-A hilar control was achieved by Endostapler (Endolinear cutter ATS flex 45mm; Echelon 60mm.) in 83% patients. Vascular cartridge having white color code was used in all the cases. In rest of the 17% patients hilar control was done by Endosuturing using silk sutures. In Group-B splenic artery and vein were dissected and ligated individually using silk sutures. The operative time in Group A was in the range of 90-360 minutes. The mean operating time was 185 minutes with standard deviation of 96 minutes. Mean operating time for first 6 cases was 250 minutes with standard deviation of 96 minutes and it was reduced to 120 minutes with S.D. of 32 minutes for the nest 6 cases.

In Group B operating time was in the range of 75-120 minutes. Mean operating time was 102 minutes with S.D. of 20 minutes. Mean operating time for first six cases was 105 minutes and that for next 7 cases was 100 minutes. The Operative Time was significantly higher in cases when endosuturing was used for hilar control as compared to endostapling. Major proportion of Operative Time in Group A was required for specimen extraction. Whereas Group B time taken for access a mobilization of spleen mainly contributed to Operative Time.

Mean intra operative blood loss in Group A was 60ml±38ml and found to be less than Group B that is 165ml±78 ml. Blood and platelet were transfused intraoperatively in 17% and 50% patients of group A respectively while same in 38% and 30% patients of group B respectively.

Various intra operative complications were compared between the two groups as shown in **table-1**. In *post-operative period*, all patients of Group A had Ryle's tube out by day1 whereas in Group B Ryle's tube was removed on day3 in 50% of the patients. Catheter was removed in 72% of patients on day1 in Group A while 50% on day3 in Group B. 75% of the patients in Group A could be mobilized on same day of surgery whereas in Group B 77% patients were able to move by day 1. Mean drain output was 134ml± 145ml in Group A with range of 50-550ml while in Group B Mean drain output was 342ml±103ml with range of 200-500ml. The difference was statistically significant **(p value < 0.05)**. Approximately 75% of the patients got their drain removed by day-3 in Group A whereas 50% of patients in Group B required abdominal drain beyond day 4. In Group- A bowel sounds returned post operatively on an average of 14 hours earlier than in Group B. Mean value of return of bowel movement in group A was 27hours±9.8hr while that of group B was 40.8±14.25hours. Feeding was started in 91% patients on day 1 in Group A whereas only 42% patients in Group B were able to take oral feed by day 2. The various post-operative complications were compared between both groups as shown in **table-2**.

Mean length of hospital stay was 4.4 ± 1.78 days in Group A and that in Group B was 8.38 ± 2.18 days. The mortality rate was same in each group. In Group-A one patient (8%) of I.T.P. developed severe post-operative intra abdominal hemorrhage leading to shock. On re-exploration, no bleeding vessel was found rather diffuse peritoneal bleeding was observed. Patient was managed in intensive care unit with single donor platelet transfusion, coagulants, steroids and packed cells but she succumbed on second post-operative day. In Group-B one patient (8%) of splenic abscess developed septicemia, pneumonitis and expired on fifth post-operative day.

In Group-A Mean *follow up period* was 9 months with a range of 4-18 months. In Group-B Mean follow up period was 7 months with a range of 1-18 months. Complication during the period of follow up was found in 17% of patients in Group-A and 15% in Group B.

In Group A two patients required readmissions, one for epistaxis and other for recurrent thrombocytopenia. Patient with epistaxis was investigated and no abnormality was detected. This patient did not experience such complaints thereafter. Second patient who developed recurrent thrombocytopenia was treated by restarting steroids and tapering he dose gradually. Patient used steroids for 2 months post operatively and thereafter had stabilized platelet count. In Group B one patient with incisional hernia and other with severe anemia were re-admitted to hospital during follow up.

DISCUSSION

Common indications for elective splenectomy are benign hematological diseases. I.T.P. the commonest indication for laparoscopic splenectomy in studies by Brunt [4], Flowers [5] and Katkhouda [6]. In our study, I.T.P. and hypersplenism were the common indications. Other indications in our adult patients were splenic cysts, abscesses and lymphoma. Patients of I.T.P. who need splenectomy usually are on toxic doses of steroids or have steroid resistance. In our study most patients with these diseases had steroid resistance.

Detection of accessory spleens is very important preoperatively and during surgery. Failure to remove these can defeat the purpose of surgery in patients with hematological diseases. Incidence of accessory

spleens ranges between 6-39% in various studies. [7,8,9,10,11,12]

The detection rate of accessory spleens in laparoscopic and open splenectomy is highly variable. The difficulty in detection of accessory spleens is attributed to their remote and occult locations, multiplicity and limitations of laparoscopy like lack of tactile sensations, difficulty in organ retraction and exposure of retro-peritoneum. Patient factors like obesity add to the difficulty in detection. No single investigation is useful for pre-operative detection of accessory spleens. In our study, accessory spleens was found intra operatively at hilum only in 8% patient of I.T.P. undergoing laparoscopic splenectomy.

The operative time for laparoscopic splenectomy is significantly longer as compared to open splenectomy in various studies by Brunt [4], Flowers [5], Gigot [13], and Rudowski [14]. The operative time becomes progressively shorter with increasing experience as reported by Emmermann [2], Flower [5], and Tsiotos et al [15]. In comparative study, Brunt et al [4] reported mean operative time of 227 minutes for first 13 cases compared to 176 minutes for the last 13 cases. Katkhouda et al [6] found mean operative time of 161 minutes (range 65-340 min.) for laparoscopic splenectomy. Mean operative time for first 10 cases was 305 minutes and that for last 10 cases was 179 minutes. This variation in operative time is attributed to the learning curve of surgeon, splenic size, perisplenic adhesions and pattern of splenic hilar vasculature and method of its division.

In our study, mean operative time for laparoscopic splenectomy was 185 minutes. For first 6 cases it was 250 minutes and for last 6 cases it got reduced to 120 minutes. Operative time in laparoscopic group is reduced by use of endostapling device [6]. In our study operative time was significantly higher when endosuturing was used for hilar control as compared to endostapling. This difference can be attributed to increased time required for dissecting splenic artery and vein individually for endosuturing. After laparoscopic splenectomy intact specimen is retrieved in an endobag from abdomen via small umbilical incision [6], sub costal incision and pffanensteil incision. Specimen can be removed by 15-20mm incision if it is fragmented by Ring forceps, morcellator or by finger fracture technique. In our study specimen was removed through sub costal tiny incision using a combination of finger fracture technique and ring forceps. The subdivision of operative time in our study revealed that 30% of operative time was taken for extraction of specimen from abdominal cavity.

Intra operative blood loss was same for laparoscopic and open splenectomy as reported by Yee [16] and Yoshida [17]. Brunt [4] reported reduced blood loss in laparoscopic group. In our study mean blood loss was lesser (60ml) in laparoscopic group than open splenectomy group (102ml). This can be attributed to minimal dissection and less tissue handling as compared to open splenectomy. Moreover better visualization of vessels in laparoscopic surgery and meticulous surgical technique reduces the incidence of inadvertent vascular injury and hence intra operative blood loss.

Intra operative blood transfusion is reported in the range of 0-40% by Emmermann [2], Flowers [5], Harold [18], Park [19], Smith [20], Tsiotos [15] and Yee [16]. In a comparative study by Brunt et al (1996)[4] transfusion of packed red blood cells was required in 15% patients who had laparoscopic splenectomy versus 10% who underwent open splenectomy. In our study 38% patients undergoing open splenectomy required blood transfusion compared to 17% who had laparoscopic splenectomy. This difference in transfusion requirements of two groups can be attributed to reduced intra operative blood loss in laparoscopic group.

Conversion to open is reported in the range of 0%-18.5% in various studies of laparoscopic splenectomy by Cadier [21], Flowers [5], Emmermann [2], Poulin [22], Rhodes [23], and Tsiotos [15]. The chief cause for conversion has been severe uncontrolled haemorrhage due to injury to hilar; short gastric, inferior polar vessels and splenic capsular tears. Brunt et al [4] reported that the conversion rate increases in patients with splenomegaly. Katkhouda et al [6] reported that conversion rate gets reduced with learning curve of surgeon. All attempted laparoscopic splenectomies in twelve patients were completed successfully in our study. This can be attributed to meticulous technique in laparoscopic surgery. The difficult dissections were performed patiently using harmonic shears. The intra operative bleeding whenever encountered was managed laparoscopically using pressure by gauge piece, electrocautery, harmonic device an liga-clips in various combinations.

Secondly all patients in our study had splenic size less than 20 centimeter as per the selection criteria of our study. Perisplenic adhesions did not pose much of a problem because none of our patients had undergone prior abdominal surgery.

Total parenteral analgesic requirement is significantly less for patients undergoing laparoscopic splenectomy as compared to those undergoing open splenectomy as shown by Brunt [4], Schlinkert [24], Yee [16] and Yoshida [17]. Postoperative pain is mainly due to somatic trauma as compared to visceral trauma. In laparoscopic surgery, there is minimal trauma and dissection of the abdominal wall. The results of our study are in accordance with world literature.

Return of bowel function achieved earlier in laparoscopic group by Flower [5], Katkhouda [6], Rudowski [14] and Yee [16]. This difference can be

attributed to less bowel handling in laparoscopic group.

In our study the bowel function and oral diet was resumed on an average of 24 hours earlier in the laparoscopic group. Early resumption of oral feed provided better psychological satisfaction. On the other hand duration of parenteral fluid was significantly reduced due to early start of feed in laparoscopic group.

Post-operative complication like wound infection, pneumonitis, pleural effusion and incisional hernia are significantly reduced in laparoscopic splenectomy when compared to open procedure in studies of Brunt [4] and Flowers et al [5]. Our results are in accordance with world literature. Length of hospital stay is reduced in laparoscopic splenectomy as reported by Flowers et al [5]. Brunt et al [4] reported mean length of hospital stay of 2.5 for laparoscopic group than that of 5.8 days for open group. In our study mean hospital stay was 4 days shorter in patients undergoing laparoscopic splenectomy compared to open splenectomy these results are accordance with that of world literature.

CONCLUSION

Laparoscopic splenectomy is safe method for mild to moderate size spleens with I.T.P. being the commonest indication for laparoscopic splenectomy. It gives better cosmetic results with less intra operative blood loss, blood transfusion and postoperative hospital stay.

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