INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 6.078
(Volume 6, Issue 6)
Available online at: https://www.ijariit.com

Laparoscopic splenectomy and contribution of steps towards optimising standard practice

Dr. M. Senthil
avnish1232003@gmail.com
Siva Hospital , Eathamozhi, Tamil Nadu

Dr. T. Siva Kumar
m_senthil_ms@gunamhospital.com
Siva Hospital , Eathamozhi, Tamil Nadu

ABSTRACT

Laparoscopic Splenectomy has established itself as the gold standard for benign hematological conditions requiring surgery. Its role in the management of difficult spleens is expanding. The objectves of this study were to critically evaluate the various parameters in laparoscopic splenectomy in the Institution as compared with international standards and identify areas of improvement and implement changes that are cost effective, evidence based, technically sound and can be accepted into standard practice. Prospective analysis of consecutive patients who underwent laparoscopic splenectomy. Laparoscopic Splenectomy was successfully completed in 35 of 36 patients (97.3%). ITP was the most common indication (61 % of cases). The mean operative time was 205 min for the first 18 cases, 182 min for the last 18. The average blood loss was 83 ml. The average duration of hospital stay was 3.3 days. Complications were minor; there was no procedure related mortality. Accessory spleens were identified in 11%. Four patients underwent a concomitant cholecystectomy. Laparoscopic splenectomy can safely and effectively be performed in a teaching institution. With meticulous technique, standardization of operative steps, patient outcomes can be optimized.

Keywords: *Splenectomy, ITP, Laparoscopic*

1. INTRODUCTION

The spleen has always been a mysterious organ of seemingly occult function as well as a forbidding organ of extreme vulnerability for the surgeon. But on both fronts it has yielded considerable ground. According to Webster's Third New International Dictionary, spleen has come to mean: the seat of emotions and passions; the source of laughter, violent mirth and merriment; a fit of anger, malice or bad temper; a sudden impulse; a proud, courageous, impetous temper; latent malevolence or spite; a feeling of ill will; extreme lowness of spirits described as melancholy or depression. Few organs if any can boast of having such markedly diverse effects, effectively symbolising the naunces and variances that characterise life itself.

1.1 Evolution of Surgery for the spleen

Aristotle, Plato and Galen attributed mysterious functions to the spleen. Vesalius refuted them with his detailed dissections. The understanding of splenic physiology received a boost with Harvey's description of circulation and Malphigi's elucidation of microscopic anatomy. However no particular function could be attributed to the spleen and splenic extirpation became a norm for trauma as there were seemingly no untoward effects of total splenectomy. It was after the classic work of Morris and Bullock on splenectomised rats that the concept of OPSI emerged and stimulated a flurry of research[1].

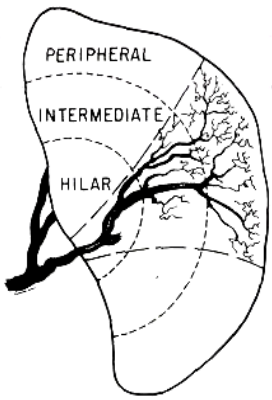

Fig. 1: Vascular regions of the spleen

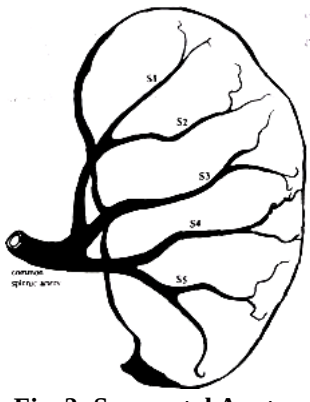

Fig. 2: Segmental Anatomy

Details of the immunological functions of the spleen began to be elucidated and splenic conservation surgery gained strong proponents. Campus Christo from Brazil described the segmental blood supply of the spleen and the feasibility of segmental resections in his report in 1962.Upadhaya correlated the pattern of injury with the need for splenectomy[2].

In the late 1980s, the advent of minimally invasive procedures ushered in a new era in patient management[3]. The first successful laparoscopic splenectomy was reported in 1991 by Deltaire and Maignen[4]. In 1992, Carrol, Philips, Semal, Fellas and Morgenstern of Cedars-Sinai Medical Center reported three cases of successful laparoscopic splenectomy[5]. The same year many teams around the world reported similar cases[6]. Since then laparoscopic splenectomy is fast gaining a strong foothold for management of the many afflictions of the spleen.

Most centers now consider laparoscopic splenectomy (LS) the procedure of choice for patients requiring routine (nonsplenomegaly) splenectomy. LS has undergone significant refinement as surgeons' experience has improved and as procedure-enabling technologies have emerged. The description of a reliable and practical (lateral) approach to LS facilitated adoption of this technique by most experienced laparoscopic surgeons[7]. Minilaparoscopic techniques have come into vogue[8][9]. In advanced centers, laparoscopic splenectomy has evolved from a procedure requiring two experienced laparoscopic surgeons to that performed by supervised senior residents with comparable results[10].

1.2 The role for splenectomy in hematological diseases [11][12][13][14][15][16][17]

Splenectomy for treatment of hematologic disorders has been a well-recognized therapeutic modality since it was initially described for hereditary spherocytosis (HS) in 1910 and for idiopathic thrombocytopenic purpura (ITP) in 1916 Medical treatment of chronic ITP gained favor in the 1950s with the discovery of the role of plasma immune globulins and the response to steroids. Medical management of chronic ITP was later demonstrated to be less effective than surgery, with a long-term remission rate of approximately 25% after glucocorticoid therapy and 66% after splenectomy. The explanation resided in the major effects of splenectomy: removal of the main site of destruction of antibody-sensitized platelets and removal of a major site of antibody synthesis[18]. In ITP, surgery is indicated in patients with refractory symptomatic thrombocytopenia after 4-6 weeks of medical therapy, patients requiring toxic dises of steroids to achieve remission, and patients who relapse following an initial response to stetoid therapy. Surgery is indicated for all patients with hereditary spheroctosis and splenomegaly, for patients with symptoms of severe hemolytic anemia or mild hemolytic anemia and jaundice and concomitant gallstones and for patients with cholelithiasis in siblings[19].

1.3 Advantages of Laparoscopy over Open Splenectomy

These include the well known benefits of lesser post operative pain, ileus, faster return to productive activity, superior cosmesis[20].

1.4 Challenges of the Laparoscopic approach

The procedure is ***technically demanding***[21] and needs to be performed by a surgeon trained in advanced laparoscopic surgeries[22]. Even then there is a steep learning curve[23][24][25] involved. Most complications, difficulties occur in the first 20 to 30 procedures. Another criticism levelled is the ***longer operating time*** required, therefore higher costs. However, the costs are probably offset by the shorter post operative stay. In the best centers, operating times are almost similar to the open approach[26]. The incidence of ***accessory spleens***[27][28][29][30] found during laparoscopy is slightly lesser to that reported at open surgery. This raises concerns about missing splenculi during laparoscopy (especially since the lateral approach has come to be widely adopted) ,possibly leading to relapse of the primary hematological condition for which the surgery was indicated. However in defence of laparoscopy it may be said that most splenculi are located around the hilum, ligaments which are accessible to the magnified scrutiny of the laparoscope most centers are reporting a comparable incidence of splenenculi to that of open surgery long term remiision of disease on follow up studies are satisfactory and approach that of historical open controls

The issue of the massive spleen

How safe and efficacious is laparoscopy in the setting of a large spleen? A large spleen implies longer operating time, increased chances of bleeding, and conversion[31]. With growing experience, spleens upto 20-22 cm in cranio-caudal length have been removed successfully by laparoscopy alone.

Strategies to deal with a massive spleen

i. Hand assisted laparoscpic splenectomy (HALS)[32]

This facilitates tactile feedback, vascular control, delivery of the spleen through a small incision (left subcostal/ Pffannensteil/posterior colpotomy) This strategy is especially helpful in the initial stages of laparoscopic surgical experience when it acts as a bridge between open and minimal access surgery, retaining the many advantages of the latter in terms of operating time, post operative hospital stay .

ii. Preoperative splenic artery embolisation[33][34] Advantages:

- Reduces the size of the spleen and intraoperative bleeding
- A helpful adjunct in the initial stages of surgical expertise

Disadvantages:

- Invasive
- High incidence of perisplenitis which causes patient discomfort, makes dissection difficult
- Needs an expert interventinal radiologist

Most centers do not advocate use of this modality and indications need to be tailored to benefit a particular patient with a massive spleen undergoing sugery at a center with the necessary radiological expertise and the surgical team wishes to extend the benefits of the minimally invasive approach (typically used for spleens between 22-27 cm) No particular spleen size has been defined as an absolute contraindication for laparoscopic extaction[35]. However a size greater than 25-27 cm will be extremely difficult to negotiate [36].[37]

iii. Intraoperative strategy

A large spleen necessitates the conventional anterior approach with port placement inferior than usual to facilitate easy manipulation of instruments

Early hilar vascular control reduces the chance of intraoperative bleeding.[38]

Broadening indications

Laparoscopic splenectomy has come to be accepted as the gold standard for benign hematological conditions requiring elective splenectomy. The indications in malignant conditions, trauma is less clear. There are many reports of successful laparoscopic splenectomies in malignant hematological conditions[39][40] However certain points are noteworthy

- The spleen size, operating time, incidence of complications are more in this sicker population of patients
- The specimen should not be crushed. This will reduce the incidence of port site tumour recurrence/spillage and preserve archtecture for histopathological examination. The spleen is best removed through a small incision using a hand assisted approach.
- If completed successfully by an experienced surgeon in accordance with safe oncological principles, this group of patients will enjoy the benefits of minimally invasive surgery

Application to our setting

Laparoscopic splenectomy has already made inroads into many centers in India. Qualified surgeons and the necessary equipment are at par with their world class counterparts. A team of dedicated hematologists, surgeons, anasthetists contribte towards successful patient outcome. The other important issue will be reduction of costs. Apart from shorter hospitilisation, the only way to cut costs will be development of indigenous equipment whereever feasible for example - retreival bags. Technological advances are indispensible—for instance the ultrasonic activated scalpel/ vascular staples which have improved operating time without compromising patient safety.

2. OPERATIVE DETAILS

Technique

Anterior approach

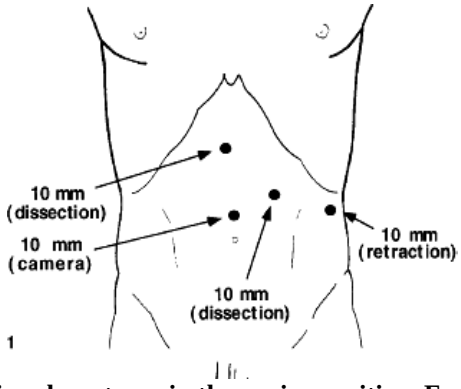

Fig. 3: Trocar placement for laparoscopic splenectomy in the supine position. Four trocars are required. The camera port should bisect the angle between the operating ports and the splenic hilum.

The patient is placed supine, or in the Fowler position if the surgeon prefers to stand between the patient's legs, and a sandbag is then placed below the left hypochondrium and ribcage. After establishing pneumoperitoneum, the laparoscope is inserted in an umbilical port and explorative laparoscopy is performed. Trocars are then inserted in the subxiphoid, midepigastrium, and the left ileac fossa. The scope is introduced through the midepigastric trocar; the subxiphoid area and umbilical ports are used for placement of grasping and dissecting instruments. The table is then placed in a right lateral tilt and reverse Trendelenburg position. After opening the omental pouch and dividing the short gastric vessels with clips or an endovascular stapler, a thorough search for AS begins at the tail of the pancreas and along the greater curvature of the stomach. Several techniques have been proposed for dissection of the splenic hilum. Splenic vessels can be controlled at the main trunk, or a segmental devascularization near the splenic parenchyma can be performed. Once the main vessels have been divided and the pancreas dissected away, the remaining short gastric vessels can be controlled. Splenic flexure is then liberated and the posterior attachments to the spleen are sectioned until the viscera are completely freed. Advocates of this approach point out that the splenic artery can be accessed along the superior border of the pancreas within the lesser sac, thus securing vascular control early in the procedure. Also, when concomitant laparoscopic cholecystectomy is indicated in a patient undergoing LS, no repositioning of the patient between procedures is required.

Lateral approach *[50][51][52][53]*

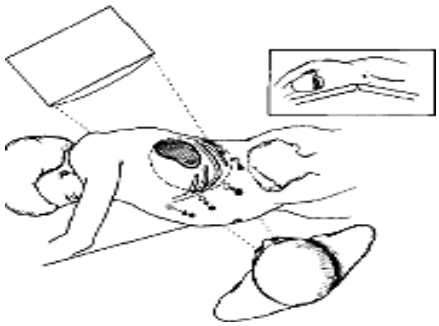

Fig. 4: Patient positioning

[75] Park AE, Brigisson G, Mastrangelo MJ, Marcaccio M,J, Witzke DB. Laparoscopic splenctomy. Outcomes and lessons learned from 200 cases Surgery 2000 Oct; 128(4): 660 –7

After induction of general anesthesia and endotracheal intubation, the patient is placed in a right lateral decubitus position at 60°. The table is broken 20°–30° below level in both the cephalad and caudad position. This maximizes the window of access between the patient's left iliac crest and costal margin. Video monitors are placed on each side of the patient's shoulders. The surgeon stands on the right side of the patient; the camera assistant is on the surgeon's left side and the first assistant is on the left of the patient. The patient is tilted in a 15° reverse Trendelenburg position. This allows the spleen to hang by its diaphragmatic attachments, thus acting as a natural countertraction while gravity retracts the stomach, transverse colon, and greater omentum inferiorly, and places the hilum of the spleen under tension. An open surgical tray is always available should the need for immediate conversion arise.

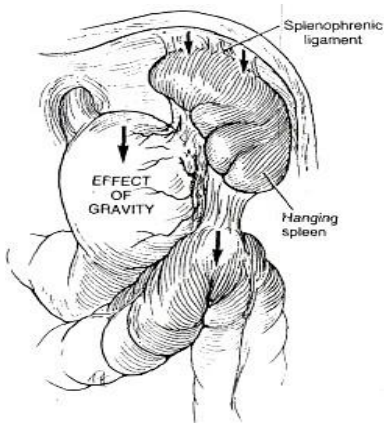

Fig. 5: The hanging spleen

[19] Katkhouda N, Mavor E. Laparoscopic splenectomy. Surg -Clin - North- Am .2000 Aug; 80(4); 1285-97
A carbon dioxide pneumoperitoneum created is maintained at 13 to 15 mmHg. Four 10- to 12-mm trocars are then inserted to allow a bimanual procedure. The position of the first trocar for the 30° telescope attached to a high-performance digital video camera is carefully chosen; low insertion of the trocar will hamper a direct view during dissection. As a rule of thumb, after creation of the pneumoperitoneum, if the distance between the umbilicus and the left costal margin exceeds the width of the hand, the position of this trocar is moved up toward the left costal margin. The next trocars used by the surgeon are placed around the telescope in a triangulated fashion at a 90° angle. A fourth trocar is placed in the anterior axillary line under the left costal margin and is reserved for the instruments of the first assistant. Sometimes added is a fifth subxiphoid trocar to allow retraction of an enlarged spleen or a prominent left hepatic lobe, or if hemorrhage occurs. *

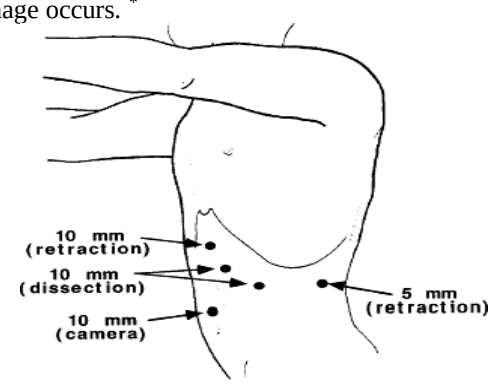

Fig. 6: Trocar placement for splenectomy in the decubitus position. Four or five ports are required. The camera can be moved to different ports as demanded by exposure

Glasgow RE, Sean JM. Laparoscopic Splenectomy. World J. Surg. 1999; (23): 384–388
The abdomen is carefully explored for accessory spleens (AS). This is done before the initiation of the dissection to avoid obscuring the surgical field with blood or irrigant. The stomach is retracted to the right and the gastrosplenic ligament is inspected, then the splenocolic ligament, the greater omentum, and the phrenosplenic ligament. The left side of the mesentery, the mesocolon, and the

pelvis, in the area of the left internal ring in both sexes and around the left adnexa in women, are checked. On opening the gastrosplenic ligament, the splenic pedicle behind the pancreatic tail is inspected. The spleen is also evaluated for notching of the anterior border, which correlates with a distributed vascularization of the hilum, thus predicting the level of difficulty and the type of instruments used for hilar control. The dissection proceeds in five stages: division of the short gastric vessels, division of the splenocolic ligament, ligation of the inferior polar vessels, hilar control, and division of the phrenic attachments of the spleen. The gastrosplenic vessels are divided with four or five applications of the harmonic shears after retracting the gastric fundus. The splenocolic ligament is divided, leaving a bundle of connective tissue on the spleen that will be grasped by the first assistant, avoiding direct manipulation of the spleen and possible capsular fractures. Dissection proceeds medially and superiorly toward the splenorenal ligament while the spleen remains suspended from the diaphragm. The inferior polar branches are divided using clips or the harmonic shears. Segmental devascularization changes the color of the spleen from brown to blue and allows the surgeon to follow the progress of the procedure. Gentle retraction of the mobilized inferior pole of the spleen exposes the hilar groove, and the vascular distribution of the hilum is evaluated. In the distributed mode, each terminal branch is divided between clips. In the magistral mode, the pedicle formed by the artery and vein enters the hilum as a compact bundle and is transected en bloc with a single application of a 3-cm linear laparoscopic stapler. Once the hilum has been controlled, the remaining short gastric vessels at the superior pole of the spleen and the ligamentous phrenic attachments are divided with the harmonic shears, completing the splenic mobilization. A small cuff of avascular splenophrenic ligament is temporarily left in situ. This serves to hold the spleen in its normal anatomic position and will greatly facilitate placing it into a sack for extraction.

Extraction of the specimen[54][55][56][57]

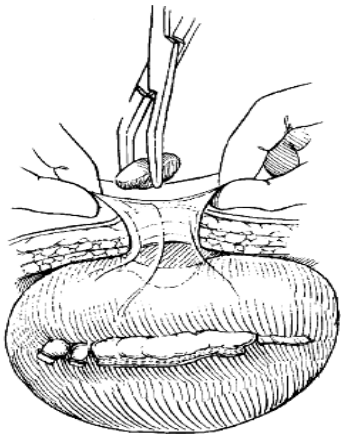

Fig. 7 Extraction of specimen

The left lateral trocar is removed and a puncture-resistant retrieval bag is introduced through this site. The trocar is then replaced. The bag is directed toward the diaphragm and is held open facing the telescope. The patient is placed in a slight Trendelenburg position to facilitate the introduction of the spleen into the bag while grasping the hilar connective tissue. The sack is introduced and unfurled, then manoeuvered over the relatively immobile spleen. The final splenophrenic attachments are then divided and the drawstring on the sack is closed. The neck of the sack is withdrawn through the supraumbilical trocar site. Within the sack, the spleen is orcellated with ring forceps and extracted piecemeal taking great care to insure that the bag is not ruptured is necessary to avoid intraabdominal contamination from splenic material and subsequentsplenosis. Also, during all manipulations, care is taken to avoid spillage of splenic fragments between the sac and the umbilical incision. Once the entire specimen and sack have been removed, a final laparoscopic survey and irrigation are performed..In the event that it is necessary to extract the spleen intact (as in staging for Hodgkin's disease), an accessory incision must be used, which can be made in various locations on the abdomen or through the widening of a trocar incision. A Pfannestiel or umbilical incision can be made as well. The use of a posterior culpotomy has also been suggested as a means by which the specimen may be exrtacted. If a concomitant procedure such as cholecystectomy is to be performed, the patient will need to be rolled supine and to have another (2 mm or 5 mm) port introduced into the right upper quadrant. Drains are placed in the early experience at the surgeon's discretion when it is thought that the pancreatic tail might have been injured. The fascia of all trocar ports is closed. The advantages of lateral approach over anterior approach include improved exposure of and access to the splenic pedicle. Also, the mechanics and sequence of dissection are enhanced and more intuitive to the surgeon using this approach. The tail of the pancreas is more easily identified and, therefore, less likely injured using the lateral approach to LS. A drawback to this approach is the frequent necessity to reposition the patient when concomitant laparoscopic cholecystectomy is to be performed following completion of the LS[58].

The splenic hilum and hemorrhage [59][60][61]

Skeletonizing the vessels allows for clipping smaller vessels but does not afford an advantage when using a linear stapling device. Should significant hemorrhage occur during division of the hilar vessels, a clear understanding of and exposure to the remaining vascular attachments can make the difference between continuing laparoscopically and converting to an open procedure. Thus, before dividing the hilum, the spleen is completely mobilized while retaining a small superior pole splenophrenic attachment. Advances in linear stapling devices have enhanced LS. In general, 2.5-mm vascular loads are sufficient for hemostasis, but 2.0-mm staple loads are used for thin pedicles and skeletonized vessels. A large spleen dictates an approach to the hilum through less than optimal port placement. The tail of the pancreas should be well visualized to avoid inadvertent injury. Hemorrhage is the most common cause for conversion during LS. A judiciously placed grasper can control the hemorrhage, allowing deliberate suctioning and dissection, rather than blind placing of clips that may cause more bleeding or jam subsequent stapler function. An additional port can also make the difference between continuing laparoscopically and converting to laparotomy. Back bleeding from the spleen can be difficult to identify because of vessel retraction into the spleen and additional parenchymal damage from clips placed to

control bleeding. In situations such as this, it is best to progress steadily and expeditiously through the division of the remaining hilum, focusing on control of any bleeding from the proximal side. Since the majority of injuries occur at the apex of the staple lines, additional tension on the hilum will often lift a point of bleeding in line with the next staple load, providing rapid hemostasis with firing. The completeness of the division of the vascular attachments can be demonstrated by manipulating the spleen medially and laterally.

Other LS techniques[62][63]

Hand-assisted LS has been suggested as a means by which LS can be more safely and expeditiously performed. Using this technique the surgeon's left hand (left-handed surgeons may choose to insert their right hand) is completely introduced into the peritoneal cavity. This allows for identification and division of appropriate tissues by palpation under direct laparoscopic visualization. Several authors report good results in initial series where hand-assisted LS was performed. The size of incision required to admit the surgeon's hand may mitigate the advantages of this approach. Mini- laparoscopic splenectomy, is particularly suited to pediatric and slender patients. A hidden umbilical incision can be used for introduction of the endovascular stapling device. This results in improved cosmesis as well as better functional recovery.

Complications of LS [64][65][66]

Independent of any complications inherent to laparoscopic surgery in general (e.g., related to pneumoperitoneum injuries from trocars), LS is associated with several potential perioperative complications that the surgeon should be aware of and be able to treat. The greatest potential problem is hemorrhage, which can be from three sources: a small caliber vessel (short gastric or polar vessels), a larger vessel of the hilum, or the splenic parenchyma. The first type of hemorrhage, though not lifethreatening, can become quite a hindrance to the operation, as rapidly accumulating blood may impair vision. This hemorrhage, however, can also easily be stopped with the use of clips, electrocoagulation, or the ultrasonic dissector. Hemorrhage from a larger vessel may be an indication for immediate conversion to laparotomy. The best means for its prevention is delicate dissection of the artery and vein to prevent rupture of smaller splenic and pancreatic blood vessels. The dissected artery and vein should then be clipped prior to any movement of the spleen. Injury to these vessels can occur simply due to the rigidity of the clamping instruments. Hemorrhage originating in the parenchyma is less dangerous and can be managed by clamping the artery or by applying slight pressure with gauze, as well as by the use of electrocoagulation. Another potential complication of LS is injury to the tail of the pancreas. Proper dissection and placement of the endostapler can avoid this problem. The use of the lateral approach to LS allows the splenic hilum to lengthen, which permits the endostapler to be used without risk of causing harm to the pancreatic tail. A further possible complication of LS is perforation of the diaphragm during dissection of the superior pole of the spleen. A small puncture may be quickly amplified by the presence of pneumoperitoneum, causing a pneumothorax. This can be controlled laparoscopically and by the use of a pleural drain. Other complications reported with LS include deep vein thrombosis, pulmonary embolus, and wound infection. It is interesting to note that there is a remarkably low incidence of deep surgical infection or subphrenic abcess.

Table 1: Postoperative complications observed in a cumulative series of 340 cases of laparoscopic splenectomies performed by the authors (42/340, 12.3%). Patient numbers appear in parentheses

Bleeding complications (15/340, 4.4%)
Intraoperative bleeding (requiring transfusion) (8)
Postoperative bleeding (4)
Abdominal wall hematoma (2)
Hemothorax (1)
Pulmonary complications (12/340, 3.5%)
Atelectasis (2)
Pneumonia and upper respiratory tract infection (5)
Pulmonary embolus (1)
Pneumothorax (3)
Pleural effusion (1)
Septic complications (5/340, 1.5%)
Wound infection (2)
Deep line sepsis (1)
Urinary tract infection (2)
Others (10/340, 2.9%)
Deep venous thrombosis (3)
Gout flare (1)
Myocardial infarction (1)
Vocal cord damage (1)
Postoperative ileus (2)
Hypophyseal insufficiency (1)
Urinary retention (1)

[67][68][69][70][71][72][73][74][75][76]

Long term outcome

85- 90% of the patients with ITP respond to splenectomy with their platelet counts reaching normal levels with in 3 days. There

were no recurrences in patients whose postsurgical platelet count exceeded 160,000 during the first 3 days On long term follow up 65% of patients are in remission with 20-30% requiring medications to sustain their platelet counts. There is no difference between open and laparoscopic splenectomy in terms of long term hematological outcome. Age less than 50 years and a pre-operative count of more than 70,000 predict a high success rate for laparoscopic splenectomy. Accessory spleens are found in around 30% of the patients with recurrences. They can be tackled laparoscopically after a preoperative radionucleotide and CT localization. However even their successful removal does nor gurantee a complete remission. As such the role of accessory spleens in relapse of disease is not well defined.

Pre-operative evaluation

All pateints underwent a thorough clinical examination, pre-anasthetic evaluation, hemoglobin ,platelet count estimation, blood grouping and typing. Patients with hemolytic anemias had an abdominal Ultrasonogram, LFT in additon to evaluate for pigment gallstones.

Spleen size was documented as normal when not palpable, moderately enlarged when palpable anywhere between the costal margin and the umbilicus and massively enlarged when extending beyond the umbilicus. All patients were given Pneumovac 2 weeks prior to surgery. An informed consent was obtained from all patients after explaining the details of surgery, the possibility of conversion, complications.

Intraoperative details

TED stockings were used in all patients. A single dose of Cefuroxime 1.5 gram was used at the time of induction and continued post-operatively. A nasogastric tube was passed in all patients and removed at the end of surgery. A Foley's catheter was used only in cases of massive spleenomegaly.

Equipment used:

- Karl Storz three chip camera
- 45 degree 5mm telescope
- High resolution monitor
- Digital video recorder
- Storz endoscopic thermoflator
- Xenon 300 light source
- Laparomat suction irrigation apparatus
- Ultrasonic activated scalpel and other standard laparoscopic instruments

Fig. 8: Operative equipment

Fig. 9: Instruments

The standard right lateral decubitus position was adopted in all patients.

Port placement was as follows:

- 10 mm left subcostal port in the midclavicular line. Creation of pneumoperitoneum with CO2 upto 14 mm Hg.
- 5mm paramedian, 5mm epigastric ports placed under vision
- 5mm port in the left subcostal area in the anterior axillary line after division of the phrenico-colic ligament. The last port was not used in three cases and dissection was completed with three ports only.
- The ports were placed in accordance with the spleen size, body habitus forming an arc around the left costal margin so that there was no interference in the movements of the various instruments.

A standard sequence of steps was adopted for dissection

1) Division of the phrenicocolic ligament, mobilisation of the lower pole of the spleen
2) Control of the lower polar vessels (doubly clipped and ligated)
3) Division of the short gastric vessels with harmonic scalpel
4) Control of splenic artery between three clips proximally, two distally. Splenic vein similarly tackled
5) Division of the lineorenal and phrenosplenic ligaments
6) Use of a polythene bag to capture the spleen
7) Retreival through the 10mm port after finger fracture
8) Inspection of the splenic bed
9) Placement of a 14 French Romovac suction drain through the left lateral port if only there is oozing
10) 10 mm port site closure with No1 polypropylene; skin closure with 4.0 nylon.

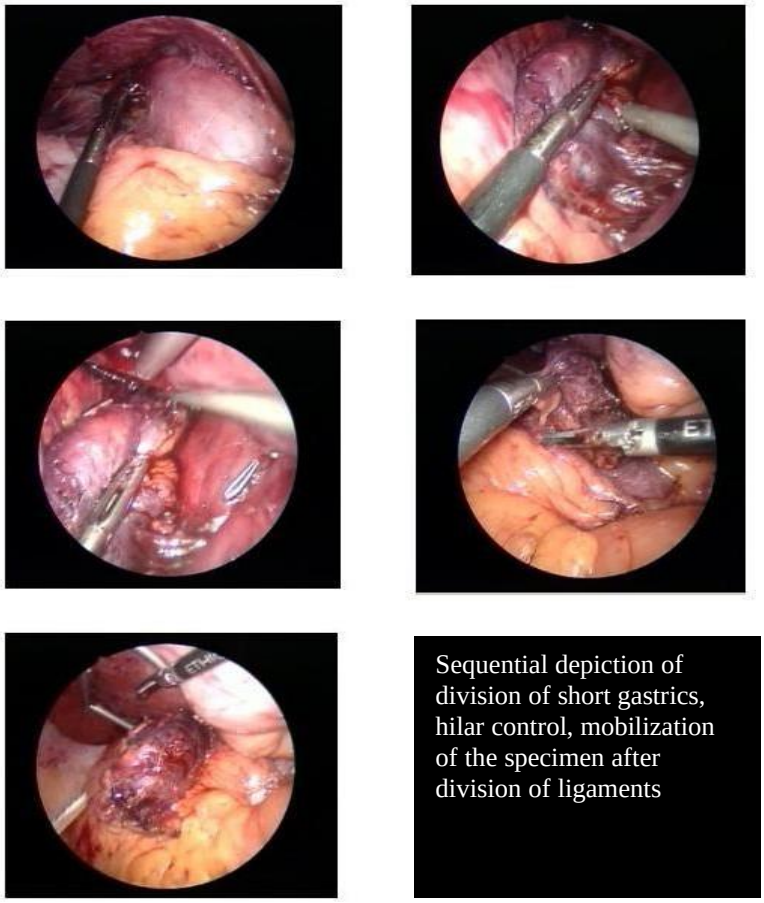

Fig. 10: Photographs of operative steps at Siva Hospital

Accessory spleens were carefully sought for and removed if present at the beginning of surgery. The spleen size, type of arterial supply, operating time, transfusion requirements, intraoperative complications, any special difficulties encountered were recorded.

Post operative Course

All patients were encouraged to take sips of clear fluids by 4-6 hours postoperatively, normal diets the next day. The presence of adhesions or completion of surgery at a late hour necessited resumption of oral feeds after 12 hours. Antibiotics were changed to oral form the next day and continued for 3-5 days. Drains when placed were invariably removed on post operative day2. Patients on perioperative steroids were typically given Injection dexamethasone 4mg iv Q8H on the day of surgery, 2mg iv Q8H for 2 days and switched to oral prednisolone thereafter in consultation with the Hematologist. Most patients were discharged by post operative day3 unless they required admission for comorbid medical conditions or in the unlikely event of complications. Patients were followed up in the surgical OPD with blood counts after one week, sutures removed and advised to folow up in Hematology OPD thereafter.

3. DATA ANALYSIS

ITP patients were compared with the others keeping duration of surgery, blood loss, and tansfusion requirements as the variables.

Complications were were analysed for the variabes of age, gender, first 18 versus last 18 cases, diagnosis, arterial pattern, duration of surgery. The duration of surgery, transfusion requirements, blood loss, complications were compared in normal versus moderate/massive spleens. The T-test was used for parametric variables and the CHI- square test for non-parametric variables. Level of significance for (95% confidence intervals) was set at .05

4. RESULTS

- Total number of cases – 36
- Male to Female ratio - 1:1

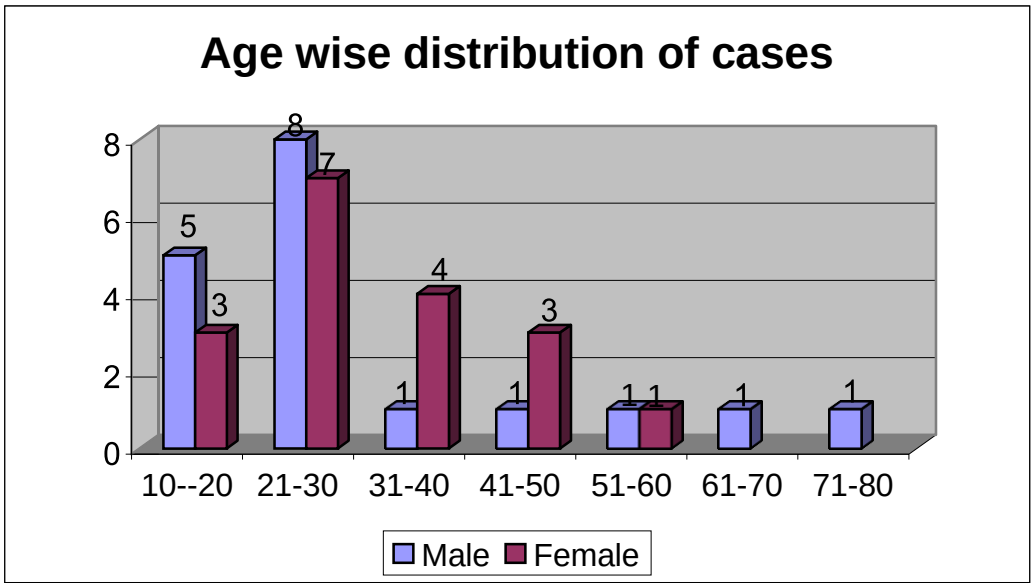

Fig. 11: Age wise distribution of cases

Most of the patients were predominantly in the 10-40 age group

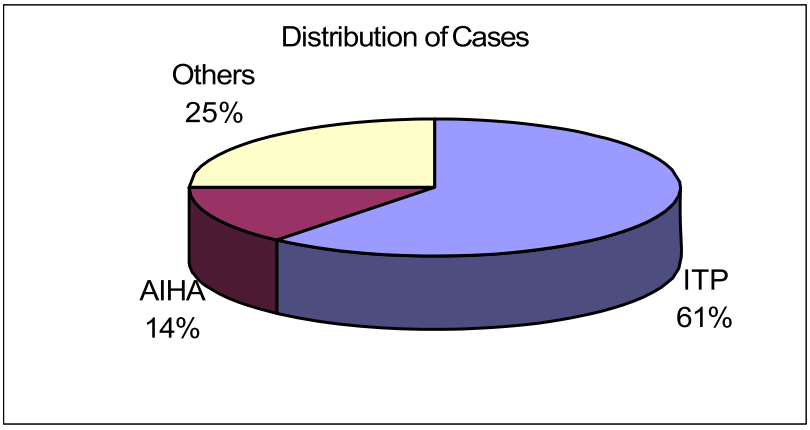

Fig. 12: Type of cases

Table 2: Distribution of cases

Distribution of cases	
Idiopathic thrombocytopenic purpura	22
Autoimmune Hemolytic Anaemia	5
Pyruvate kinase defeciency	1
Congenital non spherocytic hemolytic anemia	1
Kochs	1
Persistent fetal Hb	1
Idiopathic splenic infarct	1
Sickle-Thal trait	1
Sideroblastic anemia	1
Hereditary Spherocytosis	1
Status Laparoscopic Splenectomy? Accessory Spleen	1
Total	**36**

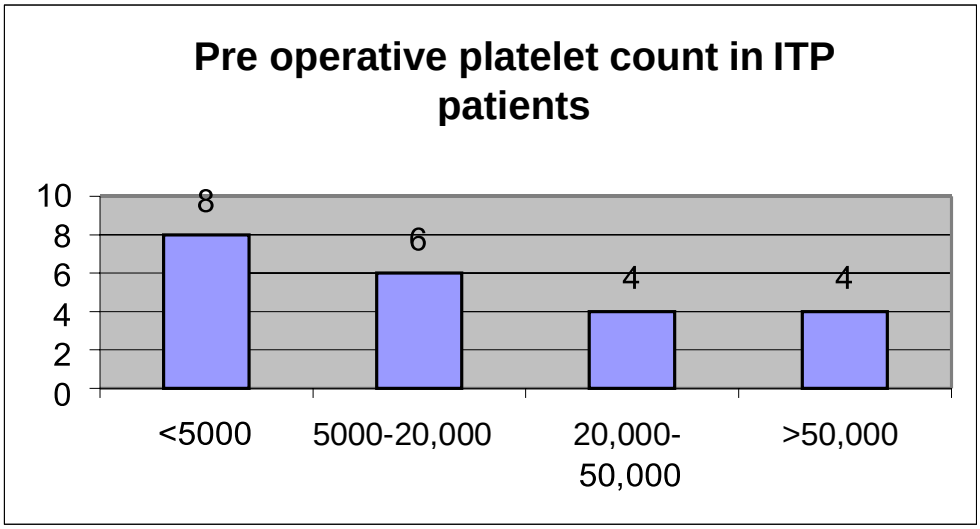

Fig. 13: Pre operative platelet count in ITP patients

It is interesting to note that 14/22 (63.63%) of ITP patients had pre operative platelet counts less than 20,000. However none of these patients required conversion. Patients with counts less than 5000 were given intra operative platelet transfusion.

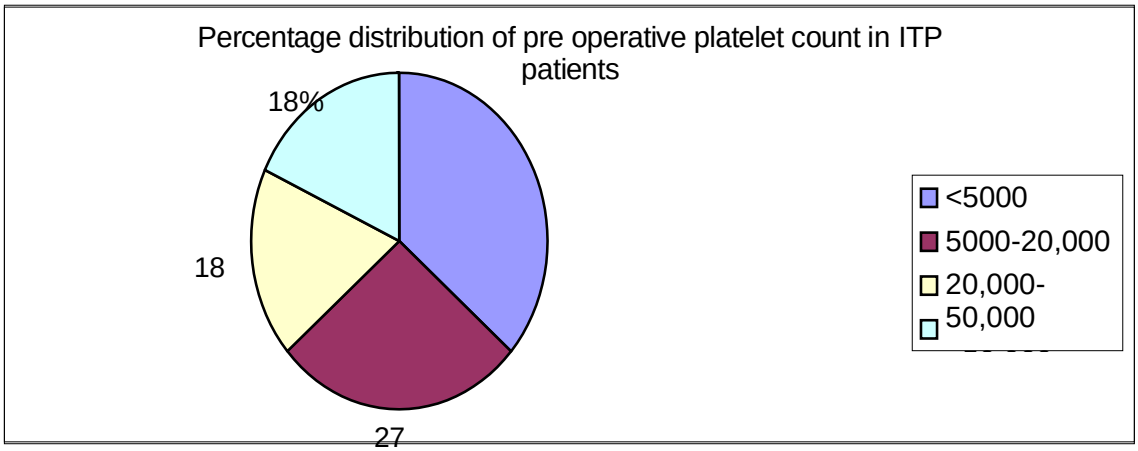

Fig. 14: Percentage distribution of pre operative platelet count in ITP patients

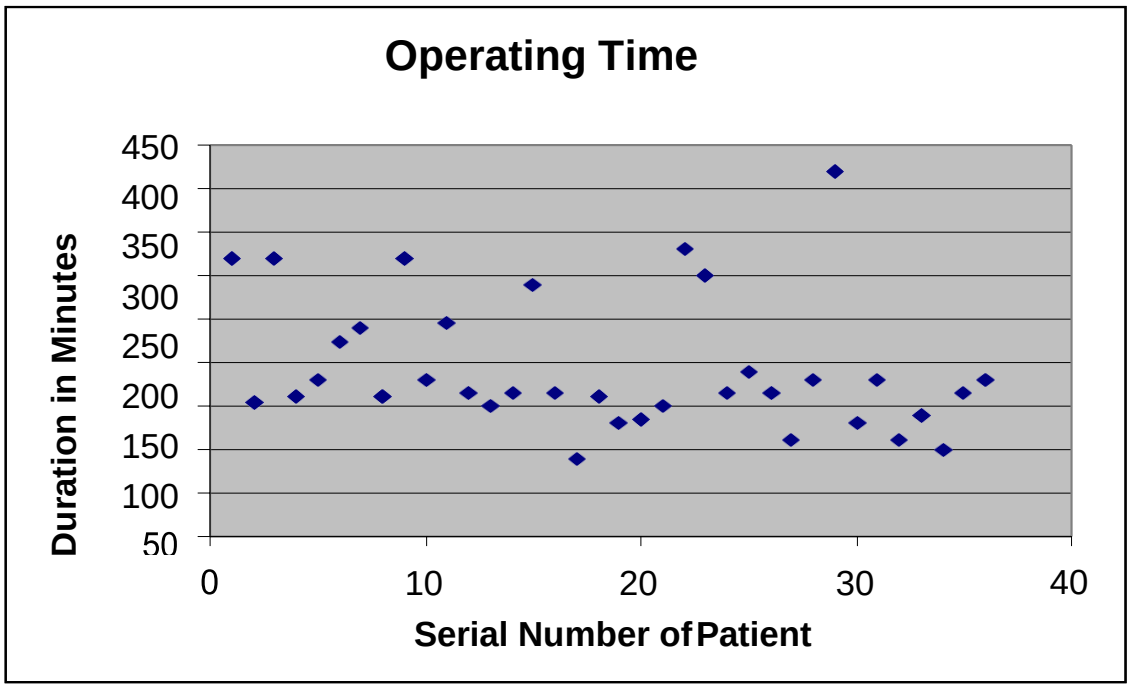

Fig. 15: Operating time

Average duration of surgery for the first 18 cases was 205 minutes
Average duration of surgery for the last 18 cases was 182 minutes

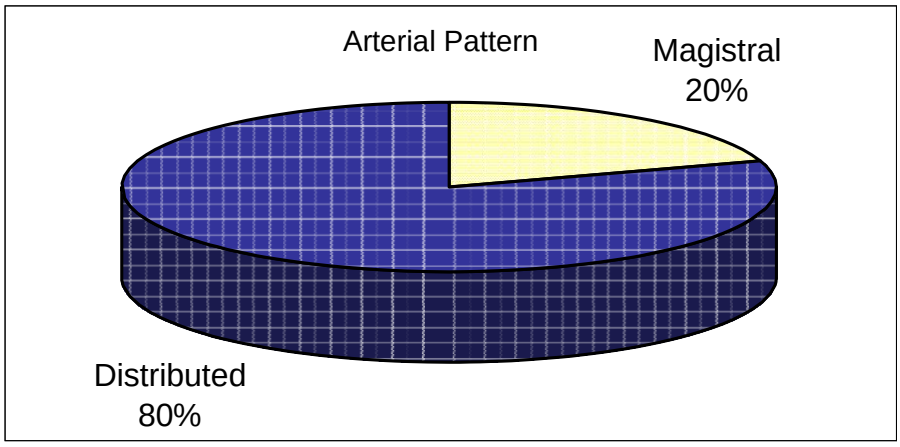

Fig. 16: Arterial distribution

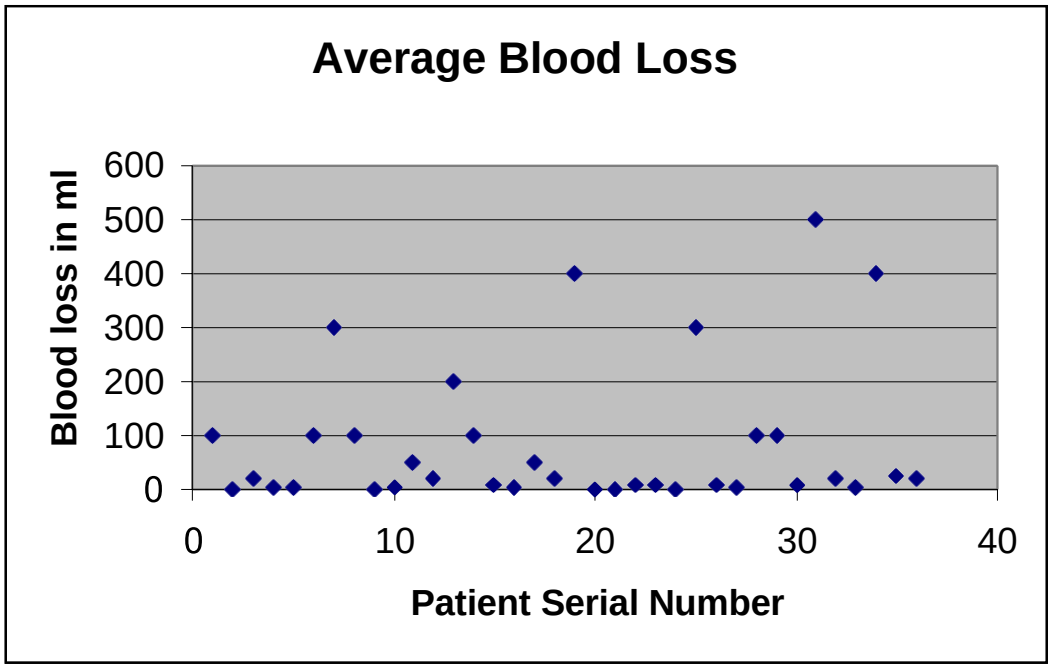

Fig. 17: Average Blood loss

Average blood loss = 83ml
There was no difference in the amount of blood loss in the first 18 and the last 18 cases.

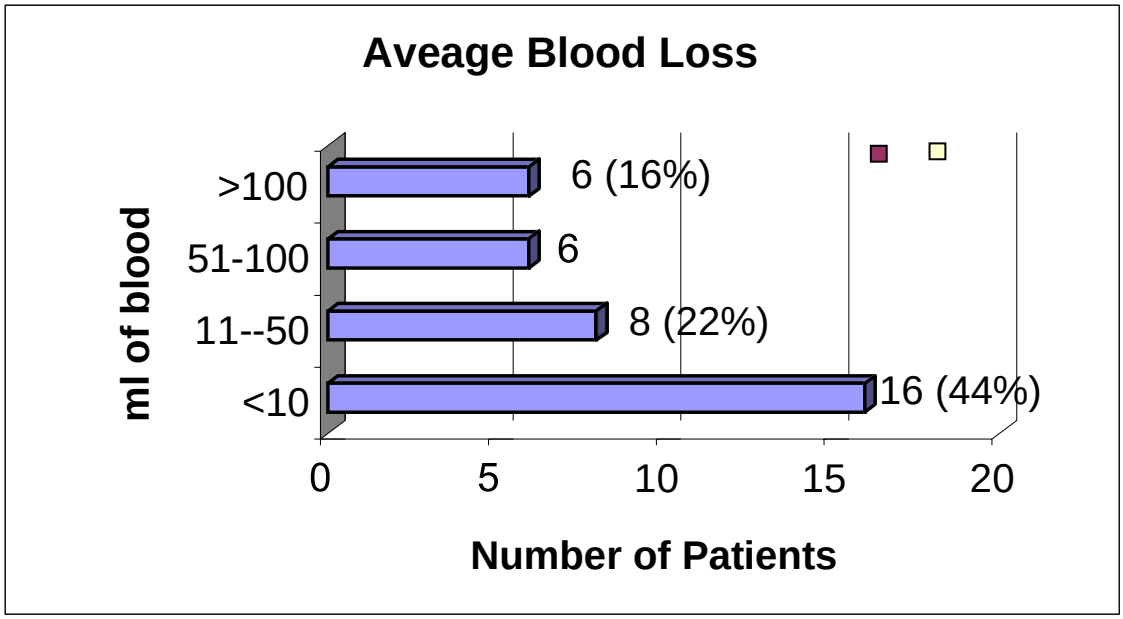

Fig. 18 Quantification of blood loss

In 44% of the cases the dissection was nearly bloodless and perfect hemostatis was achieved.

Table 3: Complications

Bleeding	6
Infection	2
Tear of Retrieval Bag	3
Others	0

Bleeding was the commonest complication encountered. The source was a small vessel and was controlled intra operatively. There was no need for conversion. There were two infections – one umbilical, one left mid-clavicular port site infection. Both responded to conservative measures, antibiotics. There were no untoward consequences of the tear of the retrieval bag and all splenic fragments were promptly recovered. There was no case of post operative pancreatitis or pulmonary complications Response to surgery in ITP patients was graded as follows:

Platelet count before discharge >1,00,000 – Good

Platelet count before discharge 50,000-1,00,000 – Satisfactory Platelet count before discharge 50,000 – Poor 17 of the 22 patients showed a good response.

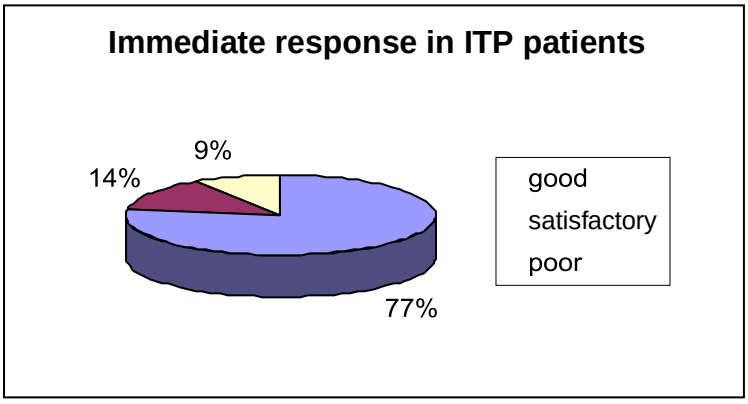

Fig. 19: Response in ITP patients

There was no significant difference between ITP patients and other subgroups in terms of duration of surgery/blood loss. However, ITP patients required platelet transfusion more often (p .002) as their preoperative platelet counts were low.

Complications did not correlate with the age/gender of the patient, first versus last 18 cases, type of arterial supply, diagnosis or duration of surgery. However patients with complications required more transfusions (p .059), had more blood loss (p.018)

In larger spleens, duration of surgery was longer but did not reach statistical significance (p .074). Transfusion requirements, blood loss, complications were not significantly different.

5. DISCUSSION

Feasibility of study

Laparoscopic splenectomy is technically demanding and requires the services of a surgeon conversant with advanced laparoscopic techniques. At the commencement of this study, we had already completed around 15 laparoscopic splenectomies at our Institution. They were not included in this study which was designed to be prospective. However important changes were implemented and standards were established at the beginning of this study which marked the transition towards standardization of operative approach., for instance the adoption of the right lateral approach instead of the supine approach, use of the ultrasonic activated scalpel instead of bipolar electrocautery for control of short gastric vessels and the dissection of ligaments. This has shortened operative time and enabled quicker and reliable hilar vascular control.

The presence of a good Hematology Department has ensured regular referral of appropriate cases and excellent perioperative management of patients.

Comparison with International Standards

The initial experience closely matches that of many international study groups [77] [78] [79] [80] [81] [82] [83] [84] [85]

Table 4: Results Of 461 Collected Cases Of Laparoscopic Splenectomy compared with Siva Hospital*

Results Of 461 Collected Cases Of Laparoscopic Splenectomy					
			OR		
		No.	Time	Conversion	LOS
Study	Year	Patients	(mln)	*n(%)*	(d)
Cadiere	1994	17	180	2 (11.8)	3.0
Emmermann	1995	27	170	5 (18.5)	6.4
Poulin	1995	22	215	2 (9.0)	3.9
Rhodes	1995	24	120	2 (8.3)	3.0
Yee	1995	25	210	4 (16.0)	5.1
Brunt	1996	26	202	0	2.5

Flowers	1996	43	160	8 (19.0)	2.7
Gigot	1996	18	147	2 (11.1)	3.0
Smith	1990	10	261	1 (10.0)	3.0
Friedman	1997	63	153	5 (8.0)	3.5
Park	1975	22	169	1 (4.5)	5.4
Tsiotos	1997	18	130	0	1.8
Katkhouda	1998	103	161	4 (3.9)	2.5
Meyer	1998	16	123	0	4.6
Harold	1999	27	N/A	1 (3.7)	1.5
Siva Hospital	2018 - 20	36	182	1 (2.7)	3.3

OR Time = mean operating time LOS = mean length of stay

The average operating time has dropped from 205 minutes for the first 18 cases in the series to 180 minutes for the last 18. This demonstrates the learning curve involved and corelates with the initial experience of many international study groups.

The references used in the following graphs are:

[26] Walsh RM, Heniford BT, Brady F, Ponsky J. The ascendence of Laparoscopic splenectomy. Am-Surg. 2001 Jan; 67 (1) : 48 – 53.

[85] Park A, Targarona EM, Trias M. Laparoscopic surgery of the spleen : State of the art Langenbecks–Arch–Surg 2001 Apr; 386 (3) : 230 – 9.

[74] Trias M, Targarona EM, Espert JJ, Balague C. Laparoscopic surgery for splenic disorders. Lessons learned from a series of 64 cases. Surg – Endosc 1998 Jan; 12(1): 66 –72.

[18] Katkhouda N, Hurwitz MB, Rivera RT, Chandra M, Waldrep DJ, Gungemhiem J et.al. Laparoscopic splenectomy: outcome and efficacy in 103 consecutive patients. Ann – Surg. 1998 Oct; 228(4): 5 68 – 78

19] Katkhouda N, Mavor E. Laparoscopic splenectomy. Surg -Clin - North- Am .2000 Aug; 80(4); 1285-97.

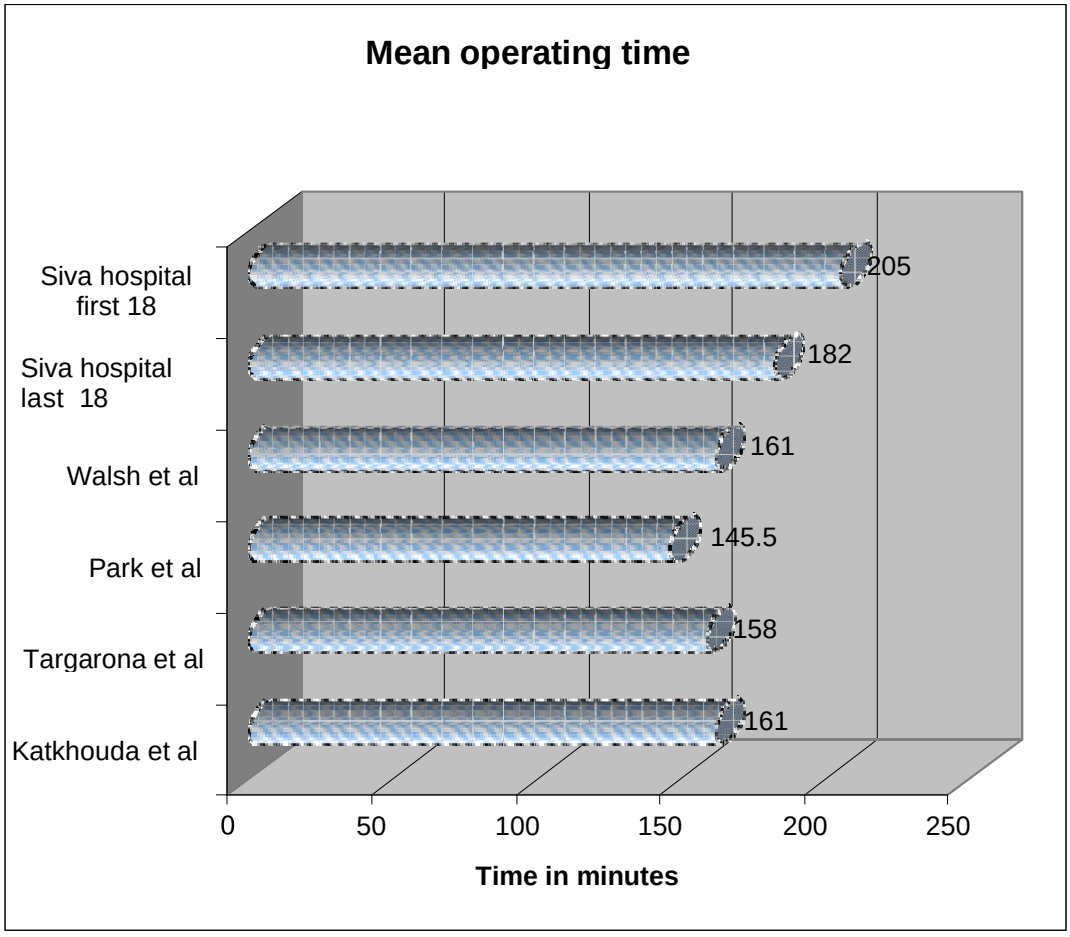

Fig. 20: Comparison of operating time

It is noteworthy that intraoperative blood loss has been minimal. This is due to meticulous dissection, safe control of the individual branches of the splenic artery (three clips proximally, two distally) and the use of the harmonic scalpel.

Surgery was nearly bloodless in 16 of the 36 (44%) patients operated. These results are all the more impressive considering the fact that 37% of the ITP patients referred for splenectomy had a preoperative platelet count of less than 5000 at the time of surgery.

Blood Loss inml

Siva Hospital

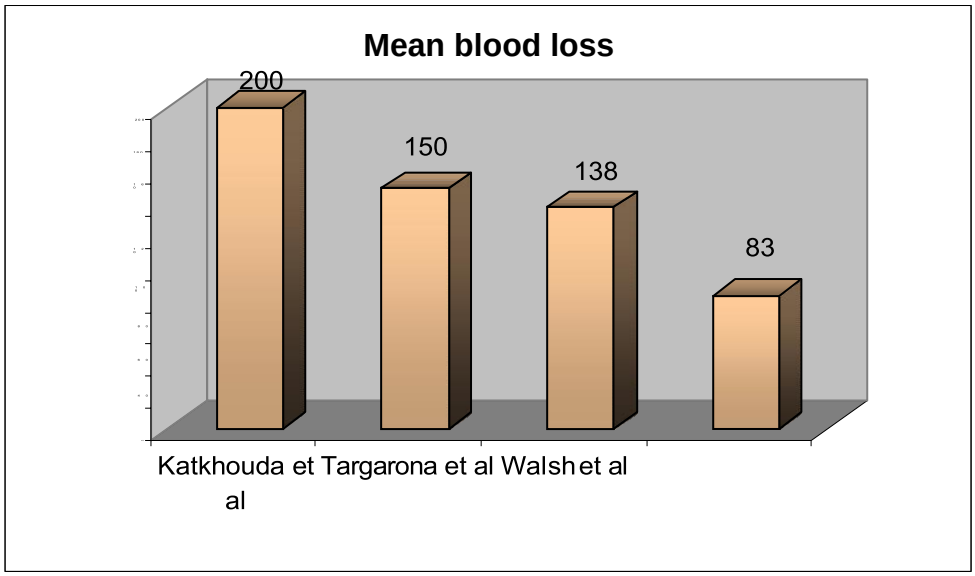

Fig. 21: Comparison of blood loss

There was only one conversion to open splenectomy. It was a case of siderobloastic anemia with hypersplenism, The spleen extended almost upto the pelvis (22 cm in length, weighing 2.5 kg).

A supine approach with a left upward tilt was used and vascular control was obtained via a endoscopic vascular 45mm stapler inserted through a 12mm trocar inserted in the left flank. The case had to be converted as the spleen was too large to fit into any retrieval bag available. It was delivered through a 7cm lower midline incision.

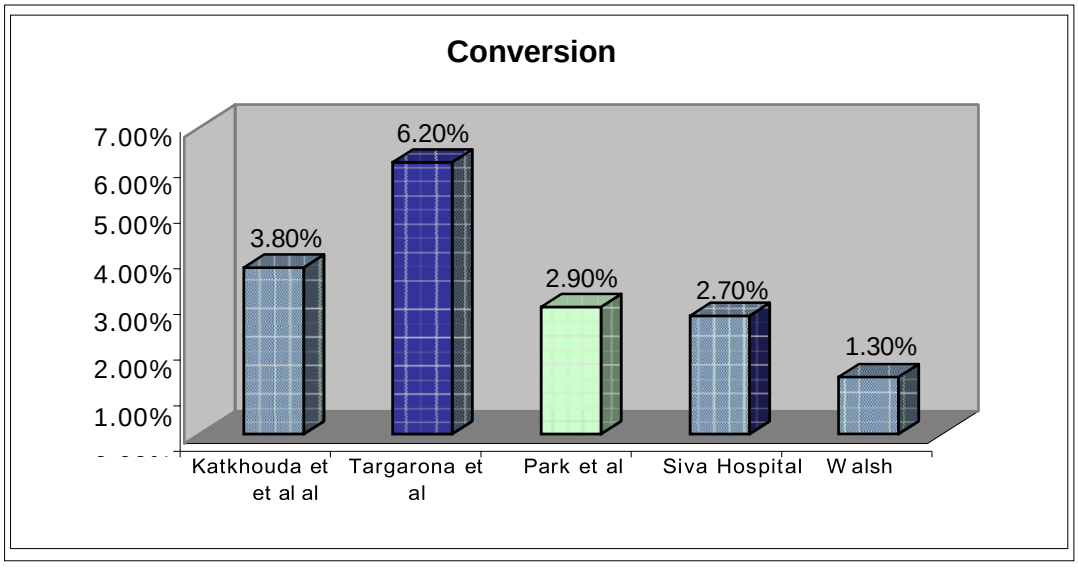

Fig. 22: Comparison of conversion rate

The incidence of accessory spleens is around 11% and compares with published incidence in the literature. One case was that of an acessory spleen picked up on Technitium Scintigraphy in a patient who had undergone a laparoscopic splenectomy two years ago. The suspected tissue was removed laparoscopically. However, the patient requires medication to sustain her counts and is on close follow up.

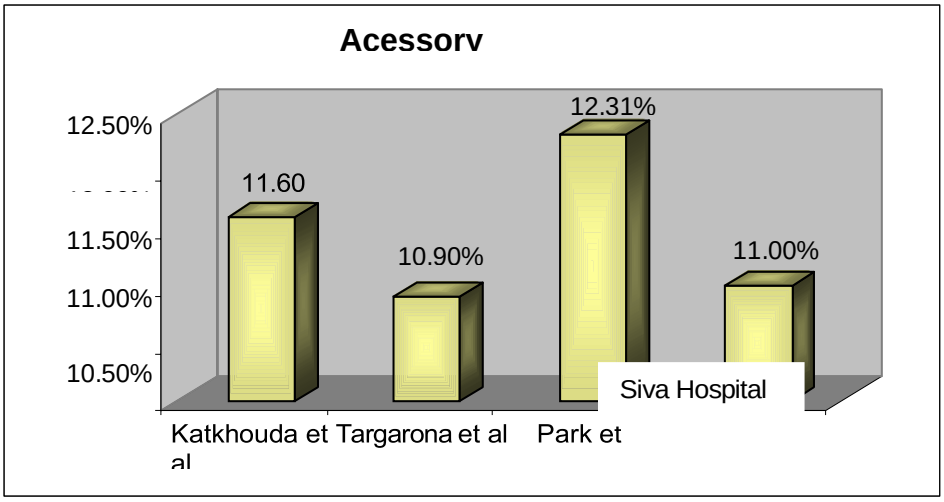

Fig. 23: Comparison of incidence of accessory spleens

The complication rate has been acceptably low. There has been no instance of pancreatitis or pulmonary complications.
There was one mortality not related to the procedure. The pateint was referred from Medical ICU, admitted with epistaxis, lower GI bleed, thrombocytopenia refractory to maximal medical management. Accepted for emergency laparoscopic splenectomy under ASA category IV. Surgery was uneventful. Patient died on post-operative day 6 of severe pneumonia, bilateral ARDS.
Most patients were home by 3-4 days.

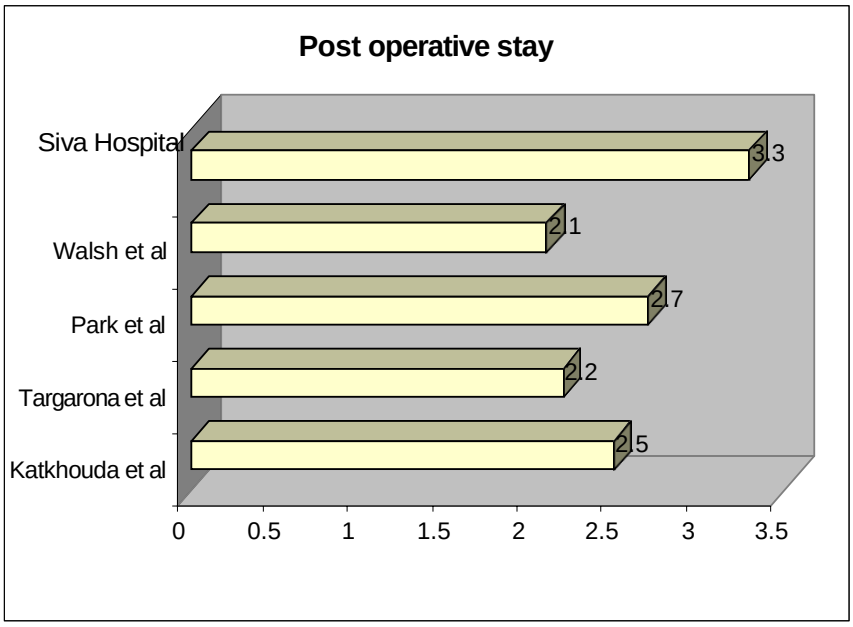

Fig. 24: Comparison of post operative stay

Points of Interest

It is of interest to note that apart from a single 10 mm port in the left midclavicular line, only 5mm ports have been used. The use of a *5mm* 45 degree telescope ensures that the camera can be changed conviniently across various ports during dissection. This minilaparoscopic approach leaves scars which are scarcely visible on follow up. It appears that careful dissection, individual control of the splenic arterial and venous branches is the safest approach as evidenced by the lack of major intraoperative bleeding. We have not used vascular staples routinely due to cost constraints, except in one instance where the splenic vein was too large to be safely controlled with clips. The retrieval system used was an indigenous gas sterilised polythene bag. This served the purpose well and is incomparably cheaper than commercially available bags. The bag did tear in three cases. This was due to inadvertent excessive force applied rather than any intrinsic weakness of the bag itself. In all cases the splenic fragments that were spilled were retrieved and the peritoneal cavity was irrigated with saline. Of these patients one of them is lost for follow up; there is no evidence of relapse in the other two. One patient had tuberculosis of the spleen (biopsy confirmed). She underwent successful laparoscopic splenectomy drainage of a lesser sac abscess and was started on ATT .

Four patients underwent a concommitant cholecystectomy for gallstones. The average operating time was 306 minutes. The patient had to be turned supine for the cholecystectomy and an additional right lumbar port was used. There was no complication and no difference in the post operative course.

Short comings

- There were no cases of malignancies referred for splenectomy. All cases were benign hematological conditions.
- Only 36 cases could be recruited during the time period of this study. However there is a growing number of patients being referred for laparoscopic splenectomy and the significance of the results is likely to increase.

- Long term follow of hematological outcomes were not included in the purview of this study. Most patients follow up with the department of Hematology for further medical management if needed. This study highlights mainly with the technical feasibility of the procedure from a surgeon' s point of view.

6. CONCLUSION

- Laparoscopic splenectomy is safe and efficacious when performed by a trained surgeon.
- It is the gold standard for patients requiring splenectomy for benign hematological conditions.
- Though there is a steep learning curve involved, with time, growing operator experience it is possible to extend the benefits of the laparoscopic approach to a wider spectrum of patients and duplicate the results of reputed international centers.
- The use of 5 mm ports, 45 degree telescope for dissection, indigenous bag for spleen retrieval are examples of incorporation of useful modifications into the standard sequence of steps to optimise patient outcome.

7. SUMMARY

The spleen has occupied a unique place in the history of medicine and its functions have only recently become clearer. The complications associated with open splenic surgery have been minimised since the advent of antisepsis, standardisation of surgical technique. Post 1987, laparoscopy has ushered in a new revolution in patient management. In many instances though the procedure is technically feasible, randomised controlled trials are needed before acceptance into standard practice. There have been numerous reports endorsing laparoscopic splenectomy. As per current knowledge and evidence, laparoscopic splenectomy is the gold standard for benign hematological conditions requiring splenectomy. Its role in malignant conditions, trauma is less well defined but continues to expand as surgical expertise is increasing.

This study prospectively evaluates laparoscopic splenectomy in a tertiary care teaching hospital in India and compares standard outcome measures with International groups. Operative steps have been standardised, complications are minimal and the technical feasibility of the procedure amply demonstrated.

8. REFERENCES

[1] Mc Clusky DA III, Skandalakis L J, Colbom G L, Skandalakis J E. Tribute to a triad: history of splenic anatomy, physiology and surgery- part 1. World J Surg 23:311-325
[2] Mc Clusky DA III, Skandalakis L J, Colbom G L, Skandalakis J E. Tribute to a triad: history of splenic anatomy, physiology and surgery- part 2. World J Surg 23:514-526
[3] Lau WY, Leow CK, Li AKC. History of Laparoscopic and endoscopic surgery. World J Surg 1997 ; 21 :444 – 53.
[4] Delaitre B, Maignien B, Icard PH. Laparoscopic splenectomy. Br J Surg 1992;79:1334.
[5] Carroll BJ, Phillips EH, Semel CJ, Fallas M, Morgenstern L. Laparoscopic splenectomy. Surg Endosc 1992;6:183-5.
[6] Crushieri A, Shumi S, Banting S, Vander Velpen G. Technical aspects of laparoscopic splenectomy. Hilar segmental devascularisation and instrumentation. JR Coll Surg Edinb 1992; 37 (6) : 414-16.
[7] Park A, Gagner M, Pomp A. The lateral approach to laparoscopic splenectomy. Am J Surg 1997;173:126-30.
[8] Yuan RH, Yu SC. Minilaparoscopic splenectomy: a new minimally invasive approach. J – Laparoendosc-Adv-Surg-Tech-A. 1998 Oct; 8(5): 269 – 72
[9] Backus CL, Park AE, Mathews BD, Heniford BT. Minilaparoscopic splenectomy J– Laparoendosc – Adv – Surg – Tech A. 2000 Oct 10 (5) 259 – 62.
[10] Heniford BT, Backus CL, Mathews BD, Greene FL, Teel WB, Sing RF. Optimal teaching environment for laparoscopic splenectomy. Am – J – Surg – 2001 Mar;181(3):226–30.
[11] Giogot JF, Lengele B, Gianello P, Etienne J, Claey SN. Present status of laparoscopic splenectomy for hematologic diseases: Ceritudes and unresolved issues.
[12] Semin – Laparosc – Surg. 1998 Sep; 5(3): 147-67
[13] Schwartz SI. Role of splenectomy in hematologic disorders. World J Surg 1996; 20:1156-1159.
[14] Decker G, Millat B, Guillon F, Atger J, Linon M. Laparoscopic splenectomy for benign and malignant hematologic diseases. 35 consecutive cases. World J – Surg 1998 Jan; 22 (1) : 62 – 8
[15] Katkhouda N, Hurwitz MB. Laparosocpic splenectomy for hematologic disease. Adv.Surg 1999; 33 : 141 – 61.
[16] Deltaire B, Champault G, Barrat C, Gossot D, Bressler L, Mayer C et al. Laparoscopic spelenctomy for hematological diseases. Study of 275 cases. Ann–Chir 2000 Jul;125 (6) : 522 – 9
[17] Caprotti R, Porta G, Franciosi C, Codecasa G, Romano F, Musco F et al. Laparoscopic splenectomy for hematological disorders. Our experience in adult and pediatric patients. Int- Surg 1998 Oct – Dec; 83(4): 303 – 7
[18] Flowers J L, Lefor A T, Steers J et al. Laparoscopic splenectomy in patients with hematological diseases. Ann Surg 1996; 224:19-28
[19] Katkhouda N, Hurwitz MB, Rivera RT, Chandra M, Waldrep DJ, Gungemhiem J et.al. Laparoscopic splenectomy: outcome and efficacy in 103 consecutive patients. AnnSurg. 1998 Oct; 228(4): 5 68 – 78
[20] Katkhouda N, Mavor E. Laparoscopic splenectomy. Surg -Clin - North- Am .2000 Aug; 80(4); 1285-97.
[21] Brunt LM, Langer JC, Quasebarth M. Comparative analysis of laparoscopic versus open splenectomy. Am J Surg 1996;172:596-601.
[22] Macfarlane JK. Laparoscopic splenectomy – not for the faint of heart. Can – J – Surg 1998 Feb; 41 (1) : 9–10
[23] Rattner DW Apelgran KN, Eubanks WS. The need for training oppurtunities in advanced laparoscopic surgery. Surg – Endosc 2001 Oct; 15 (11) : 1066 – 70
[24] Poulin EC, Mamazza J. Laparoscopic splenectomy: Lessons from the learning curve Can–J-Surg 1998 Feb; 41(1): 28.-36.
[25] Rega RV, Joehl RJ. A learning curve for laparoscopic splenectomy at an academic institution. J – Surg Res 1999 Jan; 81 (1) : 27-32.

[26] Bagdasarian RW, Bolton JS, Bowen JC, Furham GM, Richardson WS. Steep learning curve of Laparoscopic spelenectomy.J – Laparoendosc – Adv – Surg – Tech A 2000. Dec 10 (6): 319 – 23.
[27] Walsh RM, Heniford BT, Brady F, Ponsky J. The ascendence of Laparoscopic splenectomy. Am-Surg. 2001 Jan; 67 (1) : 48 – 53.
[28] Coventry BJ, Watson DI, Tucker K, Chatterton B, Suppiah R.Intraoperative scintigraphic localization and laparoscopic excision of accessory splenic tissue. Surg – Endoic. 1998 Feb 12(2): 159 – 61.
[29] Gigot JF, Jamar F, Ferrant A, Van Beers BE, Lengele B, Paulwels b et al. Inadequate detection of accessory spleens and splenosis with laparoscopic splenectomy. A short coming of the laparoscopic approach in hematologic diseases. Surg – Endose. 1998 Feb; 12(2): 101-6
[30] Targarona EM, Espert JJ, Balague C, Sugranes G, Ayuso C, Lomena F et al. Residual splenic function after laparoscopic splenectomy: a clinical concern. Arch – Surg 1998 Jan, 133 (1) : 56 – 60.
[31] Targarona EM, Espert JJ, Lomena F, Trias M. Inadequate detection of accessory spleens and splenosis with Laparoscopic splenectomy:a shortcoming of the laparoscopic approach in hematological diseases. Surg – Endosc 1999 Feb ; 13 (2) : 196 – 7.
[32] Terrosu G, Baccarani U, Bresadola V, Sistu MA, Uzzau A, Bresadola F. The impact of splenic weight on laparoscopic splenectomy for splenmolgaly Surg – Endosc 2002 Jan; 16 (1) 103 – 7
[33] Targarona EM, Balague C Cerdan G, Espert JJ, Cacy AM, Visa J et al. Hand assisted laparoscopic splenctomy in cases of spelenomegaly : a comparision analysis with conventional laparoscopic splenectomy. Surg – Endosc 2002 Mar, 16 (3) : 426 – 30.
[34] Tolte E, Vanttee R, Kloeck I, Hendridex L, Zachee P, Bracke P et.al. Laparoscopic splenectomy after arterial embolisation. Hepatogastroenterology. 1998 May – June; 45(21): 773-6
[35] Poulin EC, Mamazza J, Schlachta CM, Splenic astery embolisation before laparoscopic splenectomy- An update. Surg – Endosc 1998 Jun, 12 (6); 870 – 5
[36] Targarona EM, Espert JJ, Balague C, Piulachs J, Artigas V, Trias M. Splenomegaly should not be considered a contraindication for laparoscopic splenectomy. Ann – Surg. 1998 Jul; 228 (1): 35 – 9.
[37] Kercher KW, Matthews BD, Walsh RM, Sing RF, Backus, Charles et al. Laparoscopic splenectomy for massive splenomegaly. Am–J–Surg 2002 Feb;183(2) :19- 26
[38] Hebra A, Walker JD, Tagge EP, Johnson J.T. Hardee E, Othersen HB Jr. A new technique for laparoscopic splenectomy with massively enlarged spleens. Am – Surg 1998 Dec ; 64 (12) 1161 – 4.
[39] Nicholson IA, Falk GL, Mulligan SC. Laparoscopically assisted massive splenectomy. A preliminary report of the technique of early hilar devascularisation.
[40] Surg–Endosc 1998 Jan; 12 (1) : 73 – 5
[41] Berman RS, Yahanda AM, Mansfield PF, Hemmila MR, Sweeney JF, Porter GA et al. Laparoscopic splenectomy in patients with hematologic malignancies. Am–J– Surg 1999 Dec; 178 (6) : 530 – 6.
[42] Schlachta CM Poulin EC, Mamazza J. Laparoscopic splenectomy for hematologic maliguancies. Surg – Endosc. 1999 Sep; 13 (9) : 865 – 8.
[43] Tricarico, A., Tartaglia, A., Taddeo, F., Sessa, R., Sessa, E., Minelli, S.:
[44] Laparoscopic treatment of spleen injuries. Surg. Endosc. 1994; (8):910
[45] Michels NA. The variational anatomy of the spleen and splenic artery. Am J Anat 1942; 70:21-72.
[46] Poulin EC, Thibault C. The anatomical basis for laparoscopic splenectomy. Can J Surg 1993; 36:484-488.
[47] Poulin EC, Thibault C (1995) Laparoscopic splenectomy for massive splenomegaly: operative technique and case report. Can J Surg 38:69–72
[48] Yee JC, Akpata MO (1995) Laparoscopic splenectomy for congenital spherocytosis with splenomegaly: a case report.Can J Surg 38:73–76
[49] Terrosu G, Donini A, Baccarani U, Vianello V, Anania G, Zala F, Pasqualucci A, Bresadola F (1998) Laparoscopic versus open splenectomy in the management of splenomegaly: our preliminary experience. Surgery 24:839–843
[50] Targarona EM, Espert JJ, Balagué C, Piulachs J, Artigas V, Trías M (1998) Splenomegaly should not be considered a contraindication for laparoscopic splenectomy.
[51] Ann Surg228:35–39
[52] Watson, D., Coventry, B., Chin, T., Gill, P., Malycha, P.: Laparoscopic versus open splenectomy for immune thrombocytopenic purpura.Surgery *121*:18, 1997
[53] Hashizume M, Tanoue K, Morita M, Ohta M, Tomikawa M, Sugimachi K (1998) Laparoscopic gastric devascularization and splenectomy for sclerotherapy- resistant esophagogastric variceswith hypersplenism. J Am Coll Surg 187:263–270
[54] Kuriansky J, Benchaim M, Rosin D, Haik J, Zmora O, Saaredra P et.al. Posterolateral approach - An alternative strategy in laparoscopic splenectomy. Surg – Endosc. 1998 Jun; 12(6): 898 – 900.
[55] Park A, Gagner M, Pomp A. The lateral approach to laparoscopic splenectomy. Am J Surg 1997; 173:126-130.
[56] Gossot D Laparoscopic splenctomy; value of the postenior approach. Ann – Chir 1998; 52(9); 940 – 5.
[57] GagnerM, Lacroix A, Bolte E, Pomp A, Laparoscopic adrenalectomy. The importance of a flank approach in the lateral decubitus positon. Surg Endose 1994; 8:13 5-138.
[58] Hashizume M, Migo S, Tsugawa K, Tanoe K, Ohta M, Sugimachi K. Laparoscopic splenectomy with the newly devised morcellator. Hepatogastroenterology. 1998 Mar – Apr; 45 (20): 554 -7.
[59] Christensen BJ Fisher KS. Splenic retrieval following laparoscopic splenectomy.
[60] JSLS 1998 Jul – Sep 2 (3) : 299
[61] Gentilli S, Velardocchia M, Ferrero A, Martelli S, Donadio F. Laparoscopic splenectomy: How to make it easier using an innovative atraumatic suction grasper. SurgEndosc. 1998 Nov; 12(11): 1345 – 7
[62] Lai PB, Leung KL, Ho WS, Yiu RY, Leung BC, Lan WY. The use of Liposucker for spleen retrieval after Laparoscopic

splenctomy. Surg – Laparosc – Endosc- percutan-Tech. 2000 Feb 10 (1) : 30 – 40
[63] Trias M, Targarona EM, Balague C. Laparoscopic splenectomy: an evolving technique. A comparison between anterior and lateral approaches. Surg Endosc 1996; 10:389-392.
[64] Crushieri A, Shumi S, Banting S, Vander Velpen G. Technical aspects of laparoscopic splenectomy. Hilar segmental devascularisation and instrumentation. JR Coll Surg Edinb 1992; 37 (6) : 414-16.
[65] Gossot D, Frictsch B, Colerier M. Laparoscopic splenectomy : optimal vascular control using the lateral approach and ultrasonic dissection. Surg – Endosc. 1999 Jan; 13(1) : 21-5.
[66] Schaarschmidt Klaus, Kolberg Schrwdt Andreas, Lempe Michael, Saxena Amulya. Ultrasonic shear coagulation of main hilar vessels; A 4 year experience of 23 pediatric laproscopic splenectomies without staples.
[67] Romanelli JR, Kelly JJ, Litwin DE. Hand assisted laparoscopic surgery in the United States: an overview. Semin-Laparosc–Surg . 2001 Jun; 8(2); 96-103.
[68] Targarona EM, Balague C, Trias M. Hand assisted laparoscopic splenectomy. Semin– Laparosc-Surg 2001. Jun ; 8 (2) ; 126–34.
[69] Valeri A, Venneri F, Presenti L, Nardi F, Grossi A, Borrelli D. Portal Thrombosis - A rare complication of laparoscopic splenectomy. Surg – Endosc. 1998 Sep; 12(9): 1173- 6

[70] Ng WT, Lee KW. Control of haemorrhage during laparoscopic splenctomy.Surgery 2001 May; 129 (5) : 52
[71] Targanona EM, Espert JJ, Bombuy E, Vidal O, Cerdan G, Artigas V et al. Complications of laparoscopic splenectomy. Arch – Surg – 2000 Oct; 135(10): 1137–40.
[72] Meyer G, Wichmann MW, Rau HG, Hiller E, Schildberg FW. Laparoscopic splenectomy for idiopathic thrombocytopenic purpura – A 1 year follow up study. Surg– Endosc. 1998 Nov; 12 (11): 1348 – 52.
[73] Duperier T, Brody F, Felsher J, Walsh RM, Rosen M, Ponsky J. Predictive factors for successful laparoscopic splenectomy in patients with immune thrombocytopenic purpura. Arch Surg. 2004 Jan;139(1):61-6
[74] Rosen M, Brody F, Walsh RM, Tarnoff M, Malm J, Ponsky J. Outcome of laparoscopic splenectomy based on hematological indication .Surg Endosc. 2002 Feb;16(2):272-9.
[75] Katkhouda N, Grant SW, Mavor E, Friedlander MH, Lord RV, Adranta K etal. Predictors of response after laaroscopic splenectomy for immune thrombiocytopenic purpura. Surg–Endosc 2001. May; 15 (5) : 484 – 8.
[76] Stanton CJ. Laparoscopic splenectomy for idiopathic thrombocytopenic purpura. A four year experience. Surg Endosc 1999 Nov : 13 (11) 1083 – 6.
[77] Nishizaki T, Takahashi I, Onohora T, Wakasugi . K, Matusaka T, Kume K. Surg Endosc 1999 Oct; 13 (10); 1055 – 6.
[78] Velanovich V, Shurafa MS. Clinical and quality of life outcomes of Laparoscopic and open splenectomy for hematological deseases. Eur – J – Sur 2001 Jan; 167 (1) ;23-8
[79] Rosen M, Brody F, Walsh RM, Tarnoff M, Malm J, Ponsky J. Outcome of laparoscopic splenectomy based on hematological indication .Surg Endosc. 2002 Feb;16(2):272-9.
[80] Trias M, Targarona EM, Espert JJ, Balague C. Laparoscopic surgery for splenic disorders. Lessons learned from a series of 64 cases. Surg – Endosc 1998 Jan; 12(1): 66 – 72.
[81] Park AE, Brigisson G, Mastrangelo MJ, Marcaccio M,J, Witzke DB. Laparoscopic splenctomy. Outcomes and lessons learned from 200 cases Surgery 2000 Oct; 128(4): 660 –7.
[82] Szold A, Sagi B, Marhav H, Klausner JM. Optimizing laparoscopic splenectomy. Technical details and experience in 59 patients. Surg – Endosc. 1998 Aug; 12(8): 1078- 81.
[83] Poulin EC, Thibault C, Mamazza J. Laparoscopic splenectomy. Surg Endosc 1995; 9:172-177
[84] Demeure MJ, Frantzides CT. Early experience with laparoscopic splenctomy. WMJ 1998 Nov; 97 (10) : 33 – 4.
[85] Kuriansky J, BilikR, Shabtai M, Arigad I, Ayalon A. Preliminary report of experience with laparoscopic splenectomy in adults and children. Harefuah 1999 Mar1; 136 (5) 341-3
[86] Baccarani U, Donini A, Terrosu G, Pasqualucci A, Bresadola F. Laparoscopic splenectomy for hematological diseases. Review of current concepts and opinions. Eu–J– Surg 1999 Oct; 165 (10) ; 917 – 23.
[87] Bernard T Rhodes M. Turner GE Winperis JZ, Deane AM. Laparoscopic splenectomy: single centre experience of a district general hospital. Br – J – Haematol 1999 Sep;106(4):1065–7.
[88] Caprotti R, Franciosi C, Romano F, Codesca G, Musco F, Motta M et al. Combined laparoscopic splenectomy and cholecystectomy for the treatment of heriditary spherocytosis: is it safe and effective?: Surg – Laparosc – Endosc – Percutan –Tech 1999 Jan; 9(3) 203 – 6
[89] Katkhouda N, Manhas B, Umbach TW, Kaiser AM. Laparoscopic splenectomy J – Laparoendosc Adv – Surg – Tech -A 2001 Dec 11(6) : 383 – 90.
[90] Brodsky JA, Brody FJ, Walsh RM, Malm JA Ponsky JL. Laparascopic splenctomy. Surg – Endosc 2002 May; 16 (5); 85 1 – 4
[91] Park A, Targarona EM, Trias M. Laparoscopic surgery of the spleen : State of the art Langenbecks–Arch–Surg 2001 Apr; 386 (3) : 230 – 9

