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Editorial

We are now here with third year of publication of World Journal of Laparoscopic Surgery. I am also very happy to inform that World Journal of Laparoscopic Surgery is indexed in the Index Copernicus Journal Master List. The list of indexed journals, with information about current ICV score, is published once a year.

The 8th edition of the Index Copernicus Journals Master List includes over 2,500 journals from all over the world, presenting the current Index Copernicus factor. By active promotion of journals it not only enables nonindexed journals (i.e. those not in Index Medicus/Medline or Current Contents) to reach a wider audience, but also expands their scope world-wide. World Association of Laparoscopic Surgeons is dedicated to medical education, clinical research and skill improvement. It is committed to the dissemination of the technical and scientific exchange of knowledge amongst the various European and Asian countries in the fields of Minimal Access Surgery.

World Association of Laparoscopic Surgeons has also organized 2nd World Congress of Laparoscopic Surgeons on 14th and 15th of February 2010. This World Congress was approved by Ministry of Health and Family Welfare, Government of India and financially supported by Medical Council of India. Delegates from 22 countries have participated in this conference and live surgeries were performed including single incision laparoscopic surgery.

As the Editor-in-Chief of World Journal of Laparoscopic Surgery, it will be my duty to lead our organization for the coming years. We will continue to strive hard to update our knowledge and information on Minimal Access Surgery and pass on the same to our members for their benefit.

The other area will be to develop cooperation with major other European and American Societies such as SAGES and EAES. The WALS will work hard to strengthen its journal and increase the distribution through joint ventures.

We believe that it is of vital importance to our readers that such information be made available. We believe also that a professional journal is the best place to share such information. Your contribution would be most welcome.

RK Mishra
Editor-in-Chief

ORIGINAL ARTICLE

Laparoscopic Extracorporeal Clot Extrusion Under Local Anesthesia for Removal of Intraluminal Fibrin Clot of Peritoneal Dialysis Catheters

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Abstract

In this publication, we present our technique with 14 cases for clot removal using a laparoscopic method under local anesthesia that we have called the procedure "extra-corporeal clot extrusion" (ECCE). The result was that laparoscopic "ECCE" should be a considered option for management of catheter malfunction due to fibrin clot.

Keywords: Laparoscopic clot extrusion, removal of intraluminal fibrin clot, management of intraluminal fibrin clot.

INTRODUCTION

The success of peritoneal dialysis depends on the presence of functional long-term catheter access to the peritoneal cavity. Mechanical problems of peritoneal dialysis catheter are the second most common cause of depriving patients from peritoneal dialysis, next to infectious problems.[1] Intraluminal fibrin clot is one type of mechanical problems that mostly treated conservatively by nonsurgical managements like forced flushing of the catheter, push-and - suck maneuver,[2] infusion accelerator,[3] intraperitoneal administration of urokinase[4] or streptokinase,[5,6] instillation of tissue plasminogen activator[7] manipulation by guide-wire[8] or endoscopy brush[9,10] or fogarty catheter.[11] Failure to push out the clot by the above mentioned methods call for surgical intervention.

SUBJECTS AND METHODS

Between April 2004 and September 2009, fifty laparoscopic procedures for restoring function of malfunctioning peritoneal dialysis catheters were performed. Conservative managements of catheter malfunction failed in all patients. In 15 cases, clot removal was needed. All but 1 case (the first one) we removed the clot, using laparoscopic extracorporeal clot extrusion (ECCE).

PROCEDURE

All procedures were performed in the operating room with an anesthesiologist in attendance. Under local anesthesia, peritoneal insufflations of N_2O is established, with pressure limits set at 8 mm Hg and increased up to 12 mm Hg as needed. Intravenous sedation is used if needed for patient comfort or to relieve fear and anxiety. The procedure involves the placement of 2 or 3 laparoscopic ports. Laparoscopic procedure was initiated by introducing a 5 mm disposable trocar at palmer's point[12] to permit insufflations of gas and insertion of laparoscopic camera. The details of local anesthesia, gas insufflations and first trocar position in all cases were like our technique for laparoscopic implantation of peritoneal dialysis catheter.[13] The laparoscope was used to assist in the placement of a second 5 mm port at a left pararectus area or infraumbilical area depending to the site of previous catheter insertion. In some cases, we inserted an additional 5 mm port at the same side of the second port and with 5 cm distance from it, for releasing adhesions of catheter.

Under laparoscopic vision from the left upper quadrant of abdomen, and after exploration of peritoneal cavity for the cause of malfunction of the catheter, we followed the tip of the catheter and released it from adherent organs if needed by one or two laparoscopic forceps. In the presence of intraluminal fibrin clot, and if it dose not push out by forced flushing, the tip of the catheter was pulled out along with the port device through abdominal wall onto the surface of the abdomen. Out of peritoneal cavity and under direct vision, the clot was extracted often using milking the catheter by hand toward the tip and sometimes it must be push by needle of syringe through holes of the catheter. After complete extraction of the clot, irrigating the catheter and

then returned it to the peritoneal cavity by pushing it back through tissue tract and put it again into the deep pelvis under vision of laparoscopy. Catheter function is tested using a 0.5-L bag of normal saline to demonstrate rapid inflow and out flow. After drainage of insufflated gas, removal of the laparoscopic ports is delayed until a satisfactory irrigation test of the catheter has been achieved. The fascia of the port sites is not ordinarily repaired. Skin wounds are closed with nonabsorbable sutures material. Peritoneal dialysis is generally started at second postoperative day.

RESULTS

A total of 14 laparoscopic ECCE procedures for clot removal were performed for 14 consecutive patients. The mean patient age was 57.64 years (rang 21 to 75) and male to female ratio was 4:3. All catheters were swan-neck, coiled-tip. Previous implantation procedures in 9 patients were laparoscopic and in 5 patients was open surgery. The procedure was possible in 5 cases by one trocar and other cases need to another additional trocar. In 6 patients, the pathologic problem of the catheter was just intraluminal fibrin clot (IFC). Five patients had intestinal entrapment (IE), 2 patients had adhesion of the catheter to the fallopian tube and 1 patient has tip migration as well as IFC.

In all cases, the clot was successfully extracted using the method described herein. Inflow and outflow of all the catheters was excellent at the end of operation. One patient was dead at day 6 due to sepsis and in another patient the catheter was removed due to nontolerance at day 20. Eight of catheters were nonfunctional before day 20. Long-term function of the catheter was achieved in 4 patients**.**

DISCUSSION

In a review of literatures which published from 1999 to 2008, about rescue procedure for malfunctioning peritoneal dialysis catheters, the rate of intraluminal fibrin clot as a cause of mechanical obstruction, was reported between 0 to 60%.[14-18] In our experience according to this study, the rate is 30% (15 from 50).

It is not clearly determined the exact causes of fibrin clot formation in the lumen of the peritoneal dialysis catheter. Peritonitis, intraperitoneal bleeding, visceral entrapment or adhesion to the catheter, delay in the use of the catheter after its implantation and compression of the catheter by adjacent organs are described as predisposing factor of clot formation.[2,9] Without consideration of the cause of clot formation, clot removal by a safe method, may avoid catheter removal or replacement.

Rapid flushing of the catheter by normal saline mixed with heparin and push-and-suck maneuver often used in attempting to push the intraluminal clot but do not always reliably clear PD catheter of fibrin deposited in the lumen.

Streptokinase is used to clear obstructed catheters by clot from 1969[5] and there is many reports about it,[19,20] but streptokinase is not usable for many patients like those having a predisposition to bleeding, a platelet count less than 100,000/cu mm, prolonged prothrombin or partial thromboplastin times, serious infection around the catheter, known allergy to streptokinase, recent Streptococcal infection, or streptokinase therapy in the previous six months.[21] Urokinase is also effective in clearing clotted catheters.[4] It lacks the risk of allergic reactions that may occur with streptokinase. Manipulation of the catheter using malleable stainless steel wire under fluoroscopic guidance[22] have been reported as a successful procedure which achieved 48 to 65% catheter function success rate, however, this technique required sedation of patients because the stiff wire caused discomfort, and there is potential risk of bowel damage with the stiff wire.

Clot removal using endoscopic channel—cleaning brush under fluoroscopic control is suggested.[9,10] Although, it is smoothly rounded tip would be unlikely to cause trauma to the abdominal contents, but it is a possibility, particularly if the brush was accidentally advanced beyond the end of the catheter into the peritoneal cavity. The other concern is the possibility of dislodgement of bristles of the brush in to the peritoneal cavity. According to our experience for clot removal in our first patient with endoscopy brush, under vision of laparoscopy intracorporeal clot extrusion was very difficult and time wasting.

Laparoscopic clot extrusion has many advantages: It allow direct examination of the catheter and whole peritoneal cavity.

It is highly accurate to confirm the diagnosis of intraluminal fibrin clot as a cause of malfunction of the catheter before using any procedure for rescue it and prevent performance of unnecessary interventions. It enable diagnosis of other accompanying pathology and treatment other surgical problems in the same operations.

Some disadvantages for using laparoscopy in PD catheter implantation or management of malfunctioning catheters

are counted like: the need for general anesthesia, the adverse physiologic effects of CO_2 pneumoperitoneum, the requirement of operating room and experienced surgeon and laparoscopic instruments, and the long duration of the procedure.[18]

The advantages of our laparoscopic technique are: no need to general anesthesia, using N_2O instead CO_2 that eliminate adverse effect of CO_2 retentions. Our procedure is simple and no need to full laparoscopic experiences or advanced instruments. Feasibility of this procedure under local anesthesia and conscious sedation, provide it as an appropriate method for all patients even for high-risk cases for general anesthesia.

Using laparoscopy for removal of intraluminal fibrin clot is not new.[14-16] In some of the previous reports the clot was extracted intracorporealy by pushing the clot intraluminally using gastroscopic biopsy forceps or urethral catheter,[14,16] or by milking the catheter using atraumatic laparoscopic forceps.[23] In some other reports, extraction of PD catheter through laparoscopic port for rescuing the malfunctioning catheter is suggested. At 1996, Crabtree reported one case of omental wrapping that after mobilization of the catheter, it pulled out, permitting complete removal of the omental and fibrin debris plugging the side holes and lumen of the catheter under direct vision.[24] In review of the literature we could find also some other reports about this technique,[14,25] but all of them are under general anesthesia.

Extraction of the catheter from peritoneal cavity for a short period in a sterile filed could not be rise catheter contamination. Insisting to intracorporeal extrusion of the clot by intraluminal manipulation using different instruments is most likely to raise contamination. Intracorporeal milking of the catheter by laparoscopic forceps is very time wasting and need to additional port site. Pulling out the catheter by open surgery for extraction of the clot or resolving other causes of malfunction that recently reported[18] is not only more invasive but can lead to new adhesion or restriction to continuing the peritoneal dialysis due to more peritoneal trauma.

The number of patients and catheters in this study is too small for meaningful statistical analysis. However, we feel that the laparoscopic "ECCE" should be a considered option for the management of catheter malfunction due to fibrin clot.

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ORIGINAL ARTICLE

Laparoscopic Common Bile Duct Exploration

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Abstract

Stones in the common bile duct are a common finding and is one of the most common cause for obstructive jaundice. These calculi may be primary ductal stones or secondary, which descend from the gallbladder. There are various therapeutic options for its management and could vary from chemical to surgical management. A combination of different methods is useful in those cases where isolated techniques are not successful. Based on the clinical situation at hand, the facilities available and the level of technical expertise, one should select the ideal modality for its successful management.

Keywords: Laparoscopic CBD exploration, ERCP, opne surgical exploration of CBD.

AIMS

To present an interesting case of obstructive jaundice, its investigation and management.

To discuss the various methods of management of common bile duct stones, with a view to emphasize the ideal treatment modality.

MATERIALS AND METHODS

An interesting case of obstructive jaundice encountered by us in our clinical practice is mentioned here with its investigations and management.

A literature search on PubMed and Google was done using the keywords laparoscopy, common bile duct stones, obstructive jaundice, ERCP, lithotrispy, chemical dissolution.

CASE REPORT

A 44-year-old lady was admitted with abdominal pain, yellowish discoloration of eyes and itching of skin for one month. She also complained of loss of appetite, nausea and pale colored stools. She had no other significant past history. She was not a diabetic or hypertensive.

On examination:

- Obese, short statured lady
- Febrile
- Icterus + +
- R subcostal tenderness +
- No mass
- No organomegaly
- No free fluid
- No lymphadenopathy
- PR/ PV – NAD.

Investigations

- TC-10,100.
- LFT's – T. Bilirubin- 8.3, Direct- 5.6, Indirect- 2.7, SGPT – 150, Alk. Phos.- 1380, GGTP- 385.
- USG – Thick walled gallbladder, dilated CBD, IHBR, with multiple calculi.
- MRCP – Thick walled gallbladder, dilated CBD, IHBR, filled with multiple calculi (Fig. 1).

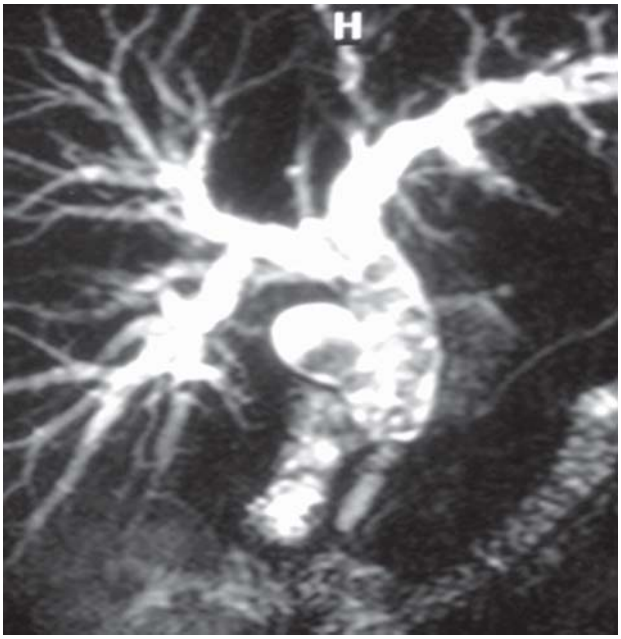

Fig. 1: MRCP showing dilated biliary dutcal system with multiple calculi

Management

The plan was to stabilize the patient, decrease S. Bilirubin preoperatively and take up the patient for surgery. The patient was hydrated with intravenous fluids, antibiotics and proton pump inhibitors were given. One gram of Inj. Vitamin K was given intramuscularly for three days.

The patient was then subjected to ERCP. The findings of which were:

- Dilated CBD, short parallel cystic duct, multiple calculi.

Sphincterotomy was done and one calculus extracted from the CBD. A pigtail stent was placed. Pus was seen while cannulating the cystic duct.

After 48 hours the patient was taken up for surgery. A laparoscopic common bile duct exploration, extraction of all stones, T-tube drainage and cholecystectomy was done. The postoperative period was uneventful and the patient was discharged on the seventh postoperative day. She was reviewed after three weeks when a T-tube cholangiogram was done and the T-tube was removed after ensuring that no stones were present in the duct.

DISCUSSION

Introduction

Ductal calculi have a varied clinical presentation and management. Therapeutic options differ from open surgery to endoscopic and laparoscopic methods. Laparoscopic biliary surgery has advanced significantly over the last decade. Its introduction has made it possible to overcome some of the drawbacks of other therapeutic approaches. This article analyses the current management of ductal calculi.

Ductal Calculi

Primary

Primary calculi form within the bile ducts. They should be suspected if a patient develops stones two years or longer, after cholecystectomy, or if their composition differs from that of gallbladder calculi. These are made of soft brown pigment and harbour bacteria within surface pits thereby have a strong association with biliary infection and stasis.

Secondary

Secondary calculi form in the gallbladder and then migrate to the ductal system. In this case the composition is identical to gallbladder calculi.

Retained

These are calculi that are undetected (missed), or detected but intentionally not removed during surgery, or other treatment for ductal calculi. They cause symptoms within two years of the initial surgery or treatment.

Recurrent

These are primary ductal calculi composed of soft brown pigment that form two years after common duct exploration or other treatment.

There are various therapeutic options available for the management of common bile duct stones:

- Open surgery
- Laparoscopy
- Endoscopy
- Lithotripsy
- Chemical dissolution.

Role of Open Surgery

- Patients unfit for laparoscopic surgery
- All surgeons attempting laparoscopic biliary surgery should have experience of open biliary surgery
- In the event of any mishap or in the presence of significant technical difficulty the laparoscopic surgeon should be able to convert to open surgery and complete the operation.

Laparoscopic Removal of Ductal Stones

Bile duct exploration can be done through the cystic duct and the common bile duct. Laparoscopy can also be combined with other methods like endoscopy and lithotripsy.

However, not all patients can undergo a transcystic exploration and will require a supraduodenal choledochotomy. The indications for choledochotomy are:

- Presence of large (>1 cm) calculi
- Several (> 5 stones)
- Stones in the common hepatic duct
- Very low and spiral cystic duct–common hepatic duct junction.

Once the bile duct has been explored, a T- tube drainage, a biliary enteric anastomosis or a direct closure of the bile duct can be performed. The indications for T-tube drainage are:

- To prevent bile leakage from the dochotomy at the lower end of the CBD.
- Large CBD (> 2 cm) and multiple primary brown stones.

The T-tube is also useful for removal of retained stones by flushing or by the *Burhenne's technique* using baskets for retrieval. The tube is kept *in situ* for two weeks and following this a T- tube cholangiogram is done. If the biliary tree is normal the tube is removed. If stones are detected

they can be removed by endoscopic stone extraction or through the mature T-tube tract (some 4 weeks later).

Other techniques are also available. Laparoscopic transcystic balloon dilatation of the Sphincter of Oddi (LTBDS). It has the advantage of avoidance of sphincterotomy. Percutaneous papillary balloon dilatation is another therapeutic option that can be performed prior to laparoscopic cholecystectomy (LC) or on the operating table immediately after LC. Ductal calculi can be pushed into the duodenum safely and effectively by this technique. Combined laparoscopic and endoscopic treatment can also be done.

Intraoperative Fluorocholangiography

It is a very effective technique for the demonstration of the ductal system intraoperatively and for the detection of ductal calculi. The rate of CBD injury is significantly lower when IOFC is used. Routine cholangiography allows the discovery of concomitant common duct stones.

Choledochoscopy

This method enables the direct visualization of the ducts and if stones are encountered they can be removed by using a Dormia basket or Fogarty's balloon catheters. Choledochoscopy enables the confirmation of ductal stones and may be used for their removal during LC. It may prevent choledochotomy or endoscopic sphincterotomy.

Endoscopy

There is a definite role for endoscopic intervention. Stones can be removed by endoscopic sphincterotomy and stone retrieval with a balloon or Dormia basket. Endoscopy can also be done in combination with mechanical or extracorporeal shock wave lithotripsy (ESWL). Calculi can be removed through an intact papilla after medical or balloon dilatation of the sphincter. The ductal system can be stented after stone extraction. As mentioned previously, it can be used in combination with laparoscopy.

Lithotripsy

Mechanical, extracorporeal shock wave lithotripsy (ESWL) and pulse dye laser lithotripsy are used today.

The *indications for lithotripsy* are:

Large stones.

Incongruity of stone and ampulla, choledochal stricture and incarcerated stone masses.

The *complications of ESWL* are:

- Cutaneous bruising,
- Hemobilia
- Fall of hemoglobin
- Rarely empyema of gallbladder and death
- Cardiac arrhythmias
- Bacteremia.

Chemical Methods

The chemical agents available are Ceruletide IV infusion. Methyl terbutyl ether (MTBE) and Mono octanoin can be used as dissolution agents.

CONCLUSION

LCBDE is a technically feasible procedure with low complication and mortality rates, although it requires careful patient selection and a variety of techniques and equipment. Multiple modalities are available for the management of ductal calculi. Based on the clinical situation at hand, facilities available and technical expertise, the ideal modality or modalities should be selected to treat the individual patient.

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ORIGINAL ARTICLE

Laparoscopic Cholecystectomy *in Situs* Inversus Totalis

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Abstract

A 42-year-old female known case of situs inversus presented with several attacks of epigastric pain. Abdominal ultrasound confirmed the diagnosis of gallstone, as well as situs inversus, laparoscopic cholecystectomy was performed safely, the operation done by left handed surgeon.

Keywords: Laparoscopic cholecystectomy, situs inversus.

INTRODUCTION

Situs inversus totalis is first described in 1600, situs inversus totalis is a rare congenital anomaly with an autosomal recessive genetic pattern of inheritance, which is usually asymptomatic through adulthood. In the absence of rare cardiac anomalies, life-expectancy is normal.[1] It may be partial, where the transposition is confined to either the abdominal or the thoracic viscera, or complete, i.e. involving both the cavities.[2] While acute cholecystitis is one of the most common diagnosis requiring surgical management, it can be difficult to correctly diagnose in a patient with situs inversus.[3]

CASE REPORT

A 42-year-old female was diagnosed as situs inversus presented with several attacks of sever epigastric pain for two months, colicky in nature radiate to the back and her symptom was aggravated by fatty meals.

Abdominal examination revealed no significant finding, upper endoscopy done to her revealed normal stomach and duodenum, three abdominal ultrasounds was done for her revealed multiple gallstones in left sided gallbladder.

TECHNIQUE

Under general anesthesia the patient was in supine position, the surgeon who was left handed with the camera man on patient's right site and the assistant was on left site, the monitor was in the left site near the head of the patient.

Subumbilical incision done with CO_2 insufflations, 10 mm trocar introduced through this incision, another 10 mm trocar was introduced in subxiphoid just to the left of midline with two other 5 mm trocar, 1st in left anterior axillary's line and 2nd in left mid-clavicular line, the fundus grasped with grasping forceps and retracted toward the left shoulder by assistant (Fig. 1).

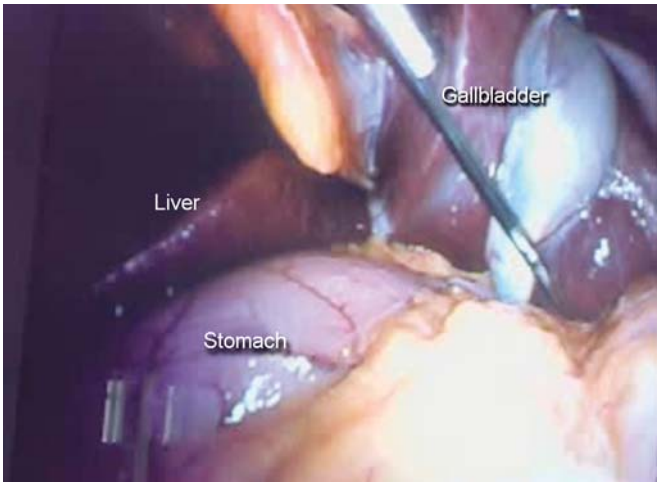

Fig. 1: Left sided gallbladder

We hold the neck of gallbladder with grasping forceps, fairly close to the origin of the cystic duct and dissection in Calot's triangle to visualize the cystic artery and cystic duct then double clipping of cystic artery and cystic duct and cholecystectomy done safely (Fig. 2).

The technique was not so difficult because the surgeon was left handed but only needed some orientation.

DISCUSSION

Situs inversus viscerum is a rare condition, occurring in 1:5,000-1:10,000 hospital admissions.[4] There are several

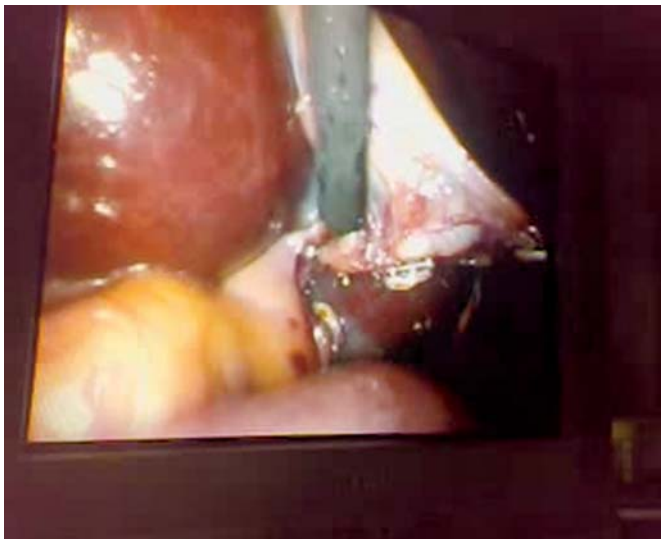

Fig. 2: Dissection of the Calot's triangle

important aspects of the management of gallstones in patients with situs inversus that are worth highlighting. While there is no evidence to suggest that gallstones are more or less common in people with situs inversus, the presentation with left upper quadrant pain may delay the diagnosis of symptomatic gallstones.[5] In this case, the patient presented with epigastric pain only and had no definite left upper quadrant pain. It has been noted in 30% of previous reported cases of acute cholecystitis in patients with situs inversus that the pain was felt in the epigastrium alone and in 10% the pain was localized to the right upper quadrant the proposed explanation for this is that the central nervous system may not share in the general transposition.[6] The first case of laparoscopic cholecystectomy in a patient with situs inversus was in 1991.[1] In patients with situs inversus, the mirror image anatomy poses difficulty in orientation during laparoscopic cholecystectomy. While there is no evidence to suggest that there is an increased risk of bile duct injuries in patients with situs inversus, the orientation and ergonomic challenges may result in an increased operative time.[7] Our total operating time was 50 minutes. As the unusual orientation while operating on a left-sided gallbladder requires mental adaptability and manual dexterity to cope with any evolving difficult or potentially dangerous intraoperative situation.

Laparoscopic cholecystectomy in patients with situs inversus should be performed by an experienced laparoscopic surgeon.[7] Dissection from the mid-clavicular cannula with right hand with the lateral displacement of the neck of the gallbladder using the left hand through the subxiphoid cannula is difficult because the tip of the dissector will lose its perpendicular angle to the dissection plane and become positioned with a very narrow angle. We performed the dissection from mid axillary's cannula. The dissection was quite safe and this confirms the previous reports of safe laparoscopic cholecystectomy in situs inversus totalis.[8] No matter which configuration is used, it is important to clearly dissect the cystic duct and artery, stay close to the inferior gallbladder edge, and obtain the critical view of safety prior to transecting any structures. This is true of all laparoscopic cholecystectomy, but especially true in this case, in which the patient's anatomic configuration is not familiar. Some surgeons may opt to selectively perform a cholangiogram to delineate ductal anatomy.[1] This operation need entire dissection to be performed by left hand, and this may be done easier by left hand surgeon. Though laparoscopic cholecystectomy in such patients is technically more demanding, an experienced laparoscopic surgeon can perform it safely.

Thus, situs inversus totalis does not appear to be contraindication to laparoscopic cholecystectomy.[9]

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REVIEW ARTICLE

Recent Advances in Laparoscopic Hysterectomy: Journey from Multiple Incision to Single Incision Hysterectomy

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Abstract

Four different approaches for hysterectomy are possible: through laparotomy; via the vagina; with the help of laparoscopy using several small incisions; and by single incision laparoscopic surgery. Currently, around 70 to 90% of hysterectomies are carried out via abdominal incision. This article compares the outcome of LAVH with SILS. In the SILS hysterectomy, only a single small incision in the belly button is created for insertion of the surgical instruments. The entire hysterectomy is performed using the SILS Port allows for the removal of the uterus through a small incision which measures only 20 mm. Compare to laparoscopic assisted vaginal hysterectomy recovery from the SILS hysterectomy is similar to the 2 weeks; however, laparoscopic hysterectomies may require multiple incisions which has less cosmetic value. Technological advances in SILS, including those in port structure, will enable gynecologists in future to employ strategies that effectively enhance instrument coordination and suturing. However; benefits of SILS to the patient need to be further documented prospectively before it can be recommended widely for every gynecologist to perform.

Keywords: Single incision laparoscopic surgery (SILS), laparoscopic assisted vaginal hysterectomy (LAVH), operative outcome in LH, pain, operative time in TLH, length of stay after hysterectomy.

INTRODUCTION

The benefits of surgical treatment of disease have always been viewed as being obtained with a certain acceptable level of pain and trauma to the patient. Minimizing this untoward effect of any surgical procedure has been a driving force of laparoscopy since its inception in the early 1900s.[1,2] Even with the clear benefits of laparoscopy over open surgery,[3] we have continued to see a trend toward fewer invasions in the quest for "scarless" surgery.

Laparoscopic assisted vaginal hysterectomy (LAVH) was first performed by Reich in the year 1989. It has been implemented in hysterectomy procedures for uterine myomas and adenomyomas. Three or four laparoscopic ports are traditionally required to complete a LAVH. One port is inserted through the infraumbilical, and the other ports are usually inserted through the lateral abdominal wall muscles, suprapubis, or both.[4] To minimize minimally invasive surgical techniques such as LAVH, single-port-access (SPA) laparoscopic surgery has been developed.[5-7]

SILS AN EMERGING ALTERNATIVE FOR HYSTERECTOMY

SILS was first performed for the treatment of appendicitis at Department of Pediatric Surgery, Dokuz Eylul Medical School, Izmir, Turkey and first presented at—The Annual Congress of Turkish Association of Paediatric Surgeons, October 2005. SILS has the advantage of improved cosmesis, ease of tissue retrieval, increased patient acceptance (Figs 1 and 2). Whether it causes less pain or early recovery needs further trials.

Single incision laparoscopic surgery (SILS) refers to performing laparoscopy through a single incision. This approach is also referred to as single access surgery (SAS), single port surgery (SPS), single port access (SPA), single port laparoscopy (SPL) and one port umbilical surgery (OPUS).

SILS has several other advantages compared with conventional multiple incision laparoscopic hysterectomy. First, operative complications related to trocar insertion such as epigastric vessel injury, operative wound infection, and hematoma and visceral organ damage might be avoided by reducing the number of ancillary ports penetrating abdominal wall. In particular, bleeding from epigastric vessels is one of the major complications after laparoscopic surgery.

Inferior epigastric vessels course cephalad from the external iliac vessels in the lateral third of the rectus abdominis. Injury of these vessels occurs, when the ancillary trocars were inserted through the lower quadrant

Fig. 1: Scarless SILS

Fig. 2: Scar of LAVH

of abdominal wall. For the purpose of preventing this injury, several methods have been recommended, such as identifying vessels before trocar insertion using transillumination, trocar insertion in areas with low-risk of vessel injury, and direct visual examination of the trocar insertion sites after trocar removal.[8,9] In SPLS, an ancillary port does not need to be placed on the abdomen. Therefore, epigastric vessel injury might be reduced. Second, the single-port approach through the umbilicus might offer better cosmetic results in our subjective opinion.

A 1.2 cm vertical intraumbilical skin incision caused little scarring. Third, using SPLS seems to reduce the postoperative pain that results from skin incisions and penetrating muscles and fascia with assistant trocars.

CHALLENGES OF SILS

It must be remembered that with in-line viewing, a move of the camera often results in an inadvertent move of an adjacent instrument. This can increase difficulty in performing relatively simple tasks that require looking at two sides of a structure. Put simply, the multiple instruments and laparoscopes required for a procedure are competing for the same space at the fulcrum of the entry port, causing hand collisions externally and difficulty with instrument tip manipulation internally. Instruments of differing lengths can ameliorate some of this, but some learning on the part of the surgeon still is required.

The major disadvantage of the single-port surgery is limitation of movement due to the proximity of the instruments to each other during operation. Suturing the vaginal cuff laparoscopically using a single-port is especially complex due to the clashing of instruments.

AIMS

The aim of this study was to compare between multiple incision and single incision laparoscopic hysterectomy. The following parameters were evaluated for both multiple incision and single incision laparoscopic hysterectomy.

- Method of patient selection
- Operative technique
- Operating time
- Intraoperative and postoperative complications
- Postoperative pain
- Postoperative recovery
- Cost-effectiveness
- Learning curve
- QOL analysis
- Patient acceptance.

MATERIALS AND METHODS

A literature review was performed using Springer link, Highwire Press, BMJ, Journal of MAS and major general search engines like Google, MSN, and Yahoo, etc. The search terms were used for multiple incisions and single incision laparoscopic hysterectomy. Citations found in selected papers were screened for further references. Criteria for selection of literature were the number of cases (excluded if less than 20), methods of analysis (statistical or non-statistical), operative procedure (only universally accepted procedures were selected) and the institution where the study was done (specialized institution for laparoscopy were given more preference).

EQUIPMENT FOR SILS

The specialized instruments used in SILS are available with following configuration:

- SILS device from Covidien
- Gel Point system from applied medical
- R-Port and TriPort from advanced surgical concepts
- Uni-X from Pnavel.

Hand Instruments for SILS comes in Two Configurations

- Standard laparoscopic instruments
- Articulating instruments.

DIFFERENCE IN SILS OPERATIVE TECHNIQUE

The operative procedures were not different between the two groups with the exception of port placement. For multiple incision laparoscopy three ports (one 12 mm trocar in the infraumbilicus and two 5 mm trocars in lateral abdominal walls) were used. The patient was placed in the dorsal lithotomy position. A uterine manipulator was inserted to effectively make a surgical field. A 2.0 cm vertical or Ω shaped incision was made within the umbilicus (Fig. 3).

A small wound retractor was inserted into the wound opening transumbilically (Figs 4A and B).

Once the wound retractor was fixed in the opening site, it laterally retracted the sides of the wound opening, thus making the small incision into a wider, rounder opening.

A 5 mm rigid laparoscope and an articulating instrument (Roticulator, Covidien, Norwalk, CT, USA) to avoid clashing of the instruments and to optimize the range of motion (Figs 5 to 9).

Fig. 3: SILS incision line

The ovarian ligaments, round ligament, and broad ligament were dissected (Fig. 10).

The adnexal structure and ligaments were dissected bilaterally.

The vaginal approach was started and at the end SILS port wound should be closed (Fig. 11).

POSTOPERATIVE MANAGEMENT

In most of the studies, patients were permitted sips of water starting 6 hours after surgery. A clear liquid diet was offered as the first meal after passing flatus. The next meal was a soft diet and then patients were offered a general diet. If pain control was needed, 30 mg ketorolac was administered intravenously. Intravenous catheters were removed when patients could tolerate a general diet. Urinary Foley catheters were removed on the morning of postoperative day 1 and patients were encouraged for that.

Fig. 4A: Access technique

Fig. 4B: 22 mm incision

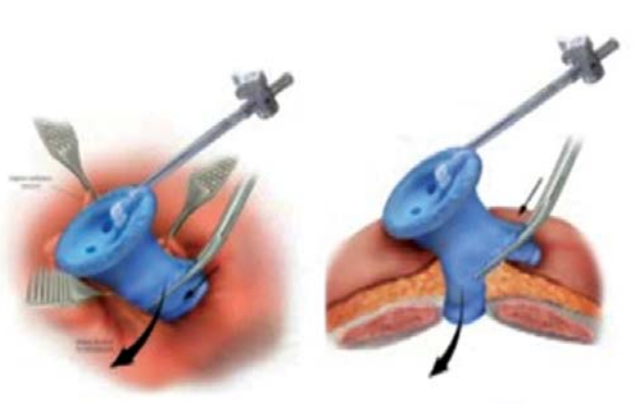

Fig. 5: SILS port

Fig. 8: Manipulation angle maintained

Fig. 6: Introduction of SILS port

Fig. 9: Introduction of instruments

Fig. 7: Port placement

Fig. 10: Dissection of round ligament

Fig. 11: Closure of skin incision

POSTOPERATIVE PAIN

It is proved that single incision laparoscopic procedures cause less or same postoperative pain than their conventional counterparts. In this study, none of the literature reviewed found which can describe pain score comparison between SILS and after laparoscopic procedure.

POSTOPERATIVE RECOVERY AFTER SILS

It was seen that the postoperative recovery was similar in SILS and multiple incision hysterectomy. Although, SILS is newer procedure and the number of SILS hysterectomy performed by most of the gynecologists are less compare to multiple incision so further study is require to draw any conclusion in this regard.

SILS AND PORT WOUND INFECTION

The risk of wound infection is more in SILS compared to the multiple incision procedure it should be cautioned that the definition of wound infection varies between studies. The reason of more port wound infection is bigger defect in abdominal wall and due to open technique of entry more chances of hematoma and necrosis. Some studies have shown increased incidence of postoperative intra-abdominal abscess after SILS as compared to and multiple incision hysterectomy. It could be due to difficulty in localizing the hematoma site after SILS.

SILS IN COMPLICATED CASES OF HYSTERECTOMY

Due to the risk of intra-abdominal abscess formation there is a strong controversy among gynecologists regarding the use of the laparoscopic procedure in complicated cases like complicated broad ligament or posterior cervical myoma, endometrioma, multiple previous laparoscopy, huge uterus, etc.

OPERATING TIME AND SILS

In almost all the literature, the operating time of SILS were found to be more than that of multiple incision laparoscopic hysterectomy. The difference in mean operating time ranged from 100 minutes (57-155 minutes) in SILS compare to 30 to 90 minutes in multiple incision. The operating time also depends on the experience of the surgeon and the competence of their team.[20]

In considering operating time, the exact identification of the timing of the start of the procedure and its conclusion vary. In general, the time should be calculated from the insertion of first trocar to the end of skin suturing. Cox et al defined operating time as the time from incision to wound closure.[10] Tate et al calculated the time as use of anesthesia to the administration of a reversal agent.[11]

Generally, SILS is more time-consuming for the following reasons:

- Triangulation of the instruments
- Time taken due to lack of expertise.

VARIATION IN POSTOPERATIVE IMMUNITY LEVEL

All surgery and anesthesia can cause depression of cell-mediated immunity in the postoperative period, including reduction in the number of circulating lymphocytes, impairment of natural killer cell cytotoxicity, depression of T-cell proliferation, and diminished neutrophil function. Animal and clinical studies have shown that laparoscopic surgery impairs a patient's immune state less than open surgery. Cell-mediated immunity is less impaired after multiple incision laparoscopic hysterectomy than after single incision laparoscopic hysterectomy. The reason is probably the level of Interleukin 6 after SILS is more than that after multiple incision laparoscopy surgery.[12]

COST-EFFECTIVENESS OF SILS

SILS is costlier than multiple incision laparoscopic hysterectomy as the port is costlier and the surgeon has to use the disposable instrument made by standard companies.

DISCUSSION

SILS has gained lot of attention around the world. Several controlled trials have been conducted; some are in favor of SILS. The goal of this review was to ascertain that if the SILS is superior to multiple incisions, and if so what are the benefits and how it could be instituted more widely. There is also diversity in the quality of the randomized controlled trials. The main variable in these trials are following parameters:

- Number of patients in trial
- Withdrawal of cases
- Exclusion of cases
- Blinding
- Intention to treat analysis
- Publication biases
- Local practice variation
- Prophylaxis antibiotic used
- Follow-up failure.

Without proper attention to the detail of all the parameters it is very difficult to draw a conclusion. It has been found among the gynecologist that there is a hidden competition between the gynecologist performing SILS and the surgeons who are still doing multiple incision surgery, and this competition influences the result of study. One should always think of SILS and multiple incision laparoscopic hysterectomy as being complimentary to each other.

A successful outcome requires greater skills from the operator. The result of many comparative studies have shown that outcome of SILS was influenced by the experience and technique of the operator. SILS requires different skills and technological knowledge. Gynecologist should perform the procedure with which they are more comfortable.

In a study, done by Tae-Joong Kim et al, a retrospective case-control study comparing 43 SPA-LAVHs (cases) and 43 conventional LAVHs (controls). SPA was associated with reduced postoperative pain. VAS-based pain scores 24 hours (SPA, 2.5 ± 0.7; conventional, 3.5 ± 0.8; p\0.01) and 36 hours (SPA, 1.7 ± 1.2; conventional, 2.9 ± 1.1; p\0.01) after surgery were lower for the SPA group. However, the pain scores 12 hours after surgeries were not different between the groups. They concluded that SPA-LAVH has comparable operative outcomes to conventional LAVH and the postoperative pain was decreased significantly in the SPA group 24 and 36 hours after surgery. The results of this study show that the operative outcomes, including operative time, hospital stay, and EBL, in the SPA-LAVH group were comparable to those of the conventional LAVH group. In addition, pain after surgery was lower in the SPA group than in the conventional group. The SPA technique has been improved and might be adequate for gynecologic surgery.[13-16]

In another study, Takahiro Koyanagi et al compared outcomes of single-incision LAVH *vs* conventional multiport LAVH. The mean operative time was 76 ± 15.5 *vs* 71.4 ± 21.7 min (P = 0.57).[17] The mean weight of resected uterus was 366.3 ± 144 *vs* 354 ± 95.5 gm (P = 0.85). BMI was 23.3 ± 2.75 *vs* 22.2 ± 3.76 kg/m^2 (P = 0.52). No significant difference was observed between single-incision and conventional LAVH. They concluded that single-incision LAVH can be undertaken safely and with similar operative results to conventional multiport LAVH. They considered it a promising alternative method for the treatment of some patients with uterine myomas as incision-free gynecological operation.

Erica R Podolsky et al went for a 24 months follow-up of novel laparoscopic approach utilizing standard instrumentation.[18] They demonstrated that SPA surgery is an alternative to multiport procedures with proposed initial benefits of decreased number of incisions and improved cosmesis for the patient. Long-term prospective randomized large case series will be necessary to assess pain, recovery, and hernia formation proving advantages, if any, over multiport laparoscopy. Another retrospective study showed an improved pain benefit.[19]

The results of the study of Yong Wook Jung et al revealed that for SILS median operative time was 100 min (57-155 min), median blood loss was 100 ml (10-400 ml), median postoperative hospital stay was 3 days (2-6 days), and there were no operative complications including transfusion.[20] VAS scoring of operative pain at 6, 24, and 48 hours after surgery was 4, 3, and 2, respectively. Although there was a case that required a conversion to two-port TLH, they performed 29 cases of hysterectomy without any operative complications using the single-port approach. In terms of surgical outcomes and operative complications including pain scores, their data were comparable to those of other investigators who evaluated the feasibility of TLH using three or four ports.

General Comparison between SILS Hysterectomy and LAVH

	Number of external incisions	*Size of external incisions*	*Number of visible scars*	*Length of hospital stay*	*Recovery time*
SILS™ hysterectomy	*1 small incision (incision in the belly button)*	*About 3/4 inch (slightly smaller then the diameter of a nickel)*	*Potential for no visible scars*	*Same day*	*2 weeks*
Abdominal (open) hysterectomy	1 large incision	5 to 7 inches	1 large scar	1 to 2 days sometimes 4 days	6 to 8 weeks
Laparoscopic hysterectomy	3 to 4 small incisions	From 1/4 to about 3/4 inch	3 to 4 small scars	same day	2 weeks
Vaginal hysterectomy/ Laparoscopically assisted vaginal hysterectomy (LAVH)	0 to 4 incision	0 to 3/4 inch	0 to 4 scars	1 to 3 days	3 to 4 weeks

Future Prospects of SILS

In the future, SILS will overcome some of the manipulative restriction of current instruments. But the future of any new technology depends upon its acceptance by patient and surgeon. Its ease of application and training may show the acceptance and some long-term randomized control trials are awaited to draw any conclusion.[21]

CONCLUSION

The concept of performing laparoscopic surgery via a single incision regardless of the technique is gaining traction rapidly among patients, surgeons, industry, and investors. It is likely that the public will demand this even less invasive surgical approach much in the same way that it forced the explosion of laparoscopic surgery two decades ago. Days are coming, so that more technological improvement in articulating instruments of SILS for better ergonomics will be there. And there is no doubt that 5 years from now SILS will emerge as method of choice for laparoscopic hysterectomy. In our review, it has been found that SILS is becoming an effective alternative to LAVH but further studies are required to confirm its efficacy.

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REVIEW ARTICLE

Diagnostic and Therapeutic Management of Impalpable Testis in the Era of Laparoscopy

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Abstract

Undescended testis is one of the common urogenital abnormality encountered. Annandale was the first person to perform orchidopexy in 1877. At present single stage, Stephen-Flower's staged, procedure is being carried out for impalpable intra-abdominal undescended testis with open and laparoscopy techniques with various modifications including testicular autotransplant. Cortesi et al[1] were the first to do diagnostic laparoscopy for cryptorchidism in 1976. Jordan et al[2] described laparoscopic orchidopexy in 1992. Since then laparoscopic method has been gaining popularity, with advances in the field of laparoscopy. In this study, recent articles of impalpable intra-abdominal testis were reviewed to see the use of laparoscopy in the diagnosis and management.

Conclusions: Diagnostic laparoscopy has become the gold standard for the diagnosis of impalpable testis. Laparoscopy for surgical correction is gaining popularity in pediatric as well as adult group with more and more surgeons opting for laparoscopic treatment. It can also benefit the patient and is logical if both diagnosis and surgical correction are combined at one time.[3]

Keywords: Laparoscopy, impalpable, orchidopexy, high, cryptorchidism, impalpable, undescended, testis.

INTRODUCTION

This condition has been first described by Hunter in 1786. The prevalence of imperfect descent of one or both the testis in boys at 1 year of age is 1%, in full-term male infants it is 3%, and in premature male neonates it is 33% at birth. Spontaneous descent is possible until 6 months of age (Fig. 1).[4] Nonpalpable testis account for approximately 20% of the undescended testis.[4]

The aim of the surgery is to mobilize the testis to its normal position. There is a need for reposition the testis early into the scrotum to reduce the risk of infertility but the subject is still controversial.[5-7] The incidence of testicular cancer in males with undescended testis is 40 times more that those without undescended testis.[8] Ten percent of testicular cancer patients are those with undescended testis.[9,10]

There is still a lot of controversy regarding the method to be adopted for the mobilization of the testis (single stage or two stage Flower-Stephen, autotransplant) and the results of the various authors vary accordingly. But as our aim in this study, was to know about the use of laparoscopy in this procedure, and its benefits from the articles. We strictly adhered to this protocol by not commenting on the surgical technique.

AIMS AND OBJECTIVES

- Review the recent articles to check the use and efficacy of laparoscopy in the diagnosis and management of impalpable testis

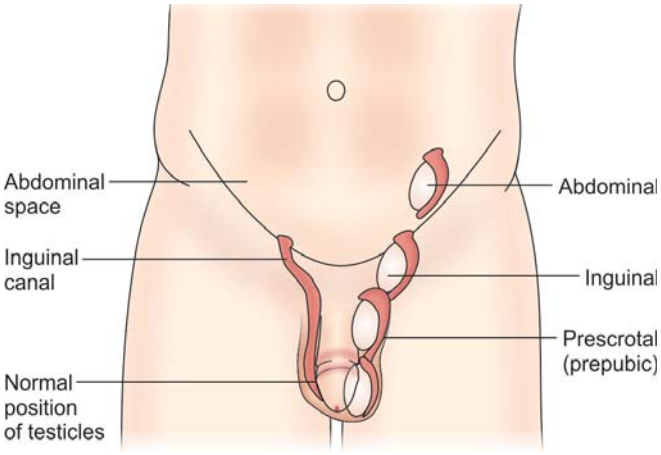

Fig. 1: Sites of ectopic testis

- The use of laparoscopy as a diagnostic tool
- Know the benefits of using laparoscopy in this surgery
- The outcome of the surgery with the use of laparoscopy
- The opinion of the surgeon about the use of laparoscopy in impalpable testis.

MATERIALS AND METHODS

A systematic review of the literature was conducted using search engine, PubMed, google and highwire. All the recent articles were collected which have done laparoscopic surgery for impalpable intra-abdominal testis irrespective of the age

of the patient and the type of operation done by laparoscope (i.e. single or two stage Stephen and Flower or autotransplant of testicle). We also examined the results of the procedures performed. We also selected articles where diagnostic laparoscopy was done for undescended testis to see if it is superior to ultrasound, and MRI. We have selected articles from various hospitals around the world where operations have been done by general surgeon, pediatric surgeon and specialist pediatric urologist. This was done to know the popularity of laparoscopy among different specialist surgeons around the world, and also to see if they have recommended for using laparoscopy for diagnosis and management for impalpable abdominal testis.

RESULTS

We arbitrarily classified the results of surgery from the articles we reviewed as excellent, very good, good, average, and poor, success in this surgery is defined as no testicular atropy and intrascrotal position (Table 1).

> 90%	Excellent
80-90%	Very good
70-80%	Good
60-70%	Average
< 60%	Poor

And for diagnosis we have mentioned (***) if the diagnosis was accurate and (**) if diagnosis could not be made. We have mentioned as (***) for all the cases where the therapeutic procedure was done as it is logical that diagnostic laparoscopy will be done before therapeutic procedure is carried out.

DISCUSSION

All the literature which we have reviewed suggests that laparoscopy is the best method for the diagnosis of

Table 1: Results of laparoscopic surgery for impalpable testis

S no.	*Author*	*+Diagnostic/ Therapeutic*	*++No of patients*	*Results*	*Comment on use of laparoscopy by the author*
1.	Battaglino F, Pesce C, et al[11]	TD	74(86)	Excellent***	Author advocates the use of laparoscopy in all patients with nonpalpable testis
2.	Chang B, Palmer, et al[12]	TD	80(101)	Excellent***	Author states "LO is an effective method for managing intra-abdominal testis"
3.	Argos Rodriguez MD, et al[13]	TD	46(53)	Excellent***	Author concludes "Laparoscopy is the only exploratory procedure that is accurate enough to enable the diagnosis of nonpalpable testis and allow the surgical setting to be done in the same setting"
4.	Samadi AA, Palmer LS, et al[14]	TD	173(203)	Excellent***	Author states "LO has become the standard for diagnosis and treatment"
5.	Radmayr C, Oswald J, et al[15]	TD	84(108)	Excellent***	Author states "The laparoscopic approach allows not only the diagnosis, but also therapy regardless of the procedure carried out for orchiopexy"
6.	Bittencourt DG, Mirinda, et al[16]	TD	51(75)	Very good***	The author concludes " Videolaparoscopy is a safe and effective method for diagnosis and treatment of nonpalpable testis"
7.	Leung MW, Choas NS, et al[17]	TD	18(18)	Excellent***	The author states "LMTV is a safe and efficient adjunctive step in orchidopexy for impalpable or redo undescended testes"
8.	Corvin S, Sturm W, et al[18]	TD	8(8)	Excellent ***	The author concludes "These results demonstrate the suitability of laparoscopy for the treatment of cryptorchidism in the adult population"
9.	Satar N, Bayazit Y, et al[19]	TD	13(21)	Excellent***	The author concludes "Diagnostic laparoscopy is very helpful technique in the diagnosis of impalpable testis especially when ultrasound and CAT scan are not informative"
10. XX	Abolyosr A[20]	TD	82(87)	Excellent***	The author concludes "Although the results for both open and laparoscopic are fairly comparable. However laparoscopy provides significantly less morbidity"

Contd...

S no.	Author	+Diagnostic/ Therapeutic	++No of patients	Results	Comment on use of laparoscopy by the author
11. X	Ishida K, Harada Y, et al[21]	TD	28(32)	***	Author states that laparoscopy can be safely performed to assess the location of the non-palpable testes
12. XX	Lintula H, Kokki, et al[22]	TD	35	Very good	Author states "Although marginally longer in duration primary LO appears to be feasible and safe technique"
13.	Denes FT, Saito FJ, et al[23]	TD	90	Very good	Author concludes "Laparoscopic orchiopexy presents excellent results in terms of diagnosis and therapy of the impalpable testis"
14.	Kaye JD, Palmer LS[24]	TD	21(42)	Excellent	Author concludes that bilateral intra-abdominal testes, single setting bilateral LO can be performed safely on an outpatient basis with a high degree of success
15.	Agarwal A, Joshi M, Mishra P, et al[25]	TD	13(17)	Excellent	Author states "There were no complication of related to laparoscopy
16.	Lindgren BW, Darby EC, et al[3]	TD	36(44)	Excellent	Author states "The low incidence of complications and 93% success rate underscore the feasibility of this procedure"
17.	Burjonrappa SC, Al Hazmi, et al[26]	TD	15(17)	Excellent	Author concluded "Two stage laparoscopic orchidopexy is a fairly easy surgical procedure with minimum morbidity"

X Mainly diagnostic laparoscopy done with orchidectomy for atropic testis

XX Comparative studies done between open and lap orchidopexy

*** Diagnosis was accurate

** Could not be diagnosed

+ T only therapeutic, TD for both therapeutic and diagnostic

++ (x) indicates the number of testicles

unpalpable intra-abdominal testis and some consider it as a gold standard. Therapeutic procedure also gives excellent results with different approaches, but it does require laparoscopic skills, and every surgeon has his own learning curve.

The study conducted by Desireddi NV et al[27] have found that the overall accuracy of magnetic resonance imaging alone and magnetic resonance arteriography/venography for identifying a viable testis or testicular nubbin was 62% and 57%, respectively. The accuracy of magnetic resonance imaging and magnetic resonance arteriography/venography for identifying a viable testis was 74% and 67%, respectively.

Another study by Khalid Ismail et al[28] found the overall diagnostic agreement of ultrasonography with laparoscopy was 21.3%.

In another series conducted by Onal[29] have found that the incidence of a contralateral patent process vaginalis is considerable in patients presenting with a unilateral nonpalpable testis and this can be easily recognized during laparoscopy, which is an additional benefit of using laparoscopy.

One study conducted by Hay SA et al,[30] has done laparoscopic classification of testis to facilitate decision making during the laparoscopy, according to the position of the impalpable testis and in the relation of the spermatic vessels and vas deferens to the internal ring, with a management protocol based on this classification. In this Type I: no testis visualized; Type II: testis seen at the internal ring with the vas and vessels looping to the internal ring; Type III: testis at the ring, with vas and vessels going to the testis directly; and Type IV: intra-abdominal testis not related to the internal ring. This will help to plan the procedure.

The accuracy of diagnostic laparoscopy is the best when compared with the results of the above studies. Thus it can be stated that diagnostic laparoscopy is the best modality available for the diagnosis of nonpalpable testis and planning the operative procedure.

In the series where comparative study of laparoscopic orchidopexy *vs* open orchidopexy were carried out by two different authors Abolyosr A[20] and Lintula et al.[22] The first author had fairly similar results with both LO and OO, but he agrees that the morbidity was significantly less with LO. In the series of Lintula H there was no difference in the length of hospital stay between the LO and OO group the author feels LO is a safe feasible technique and in staged Flower-Stephen LO is more safe than primary LO in cases with high intra-abdominal testis.

In the series of Agarwal A et al[25] which carries out staged Flower-Stephen procedure, where both the stages were carried out by laparoscopy. The results were almost 100%.

In the study conducted by Espasito C et al,[31] they followed-up the cases that had undergone LO by staged Flower-Stephen technique for more than 10 years postoperatively, and they had more than 83% success rate. These results clear the doubts about the long-term results of the use of laparoscopy.

In the study conducted by Kaye JD[24] they performed bilateral LO in single setting as an outpatient basis for 42 testis on 21 boys with a median age of 9 months and their overall result was 91%. This looks very interesting as the entire patient were treated as OPD patients with such excellent results. This study shows that morbidity is very less with laparoscopic in particular surgery and also holds the same in general for all the laparoscopic procedures.

It can be said that laparoscopy because of its magnification and illumination gives a more clear picture of the anatomy and visualization of vessels compared to open procedure. Another advantage is that it can help in better dissection in places where it is difficult to approach in open surgery. But we have to definitely agree that complex laparoscopic procedures require more skills to perform, which can only be achieved with more advance training and dedication.

CONCLUSION

Laparoscopic management of impalpable testis had rapidly gained popularity in the last decade. Diagnostic laparoscopy for impalpable testis has become Gold standard. Diagnostic and therapeutic procedure can be performed at one sitting with less morbidity, excellent results, short stay in hospital and better cosmetic outcome. After the review of the recent articles and their results it looks like a consensus of opinion is emerging among the surgeons for accepting laparoscopic orchidopexy as a standard procedure for the management of impalpable testis.

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REVIEW ARTICLE

Evaluation of Risk Factors and Preventive Measures for Deep Vein Thrombosis of Lower Limbs in Minimal Access Surgery

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Abstract

Deep vein thrombosis of lower limbs affects 1-2% of hospitalized patients. Interplay of factors like vessel wall injury, venous pooling, decreased blood flow and state of hypercoagulability predispose to thrombi formation.

In conventional surgery as compared to the minimal access surgery, the prolonged surgery time, longer hospital stay, prolonged immobilization and enhanced tissue disruption favors thrombi formation in lower limbs. However, the risk of deep vein thrombosis in laparoscopic surgery is related to the high intra-abdominal pressure and the reverse Trendelenburg position causing venous pooling in lower limbs particularly in upper gastrointestinal surgery.

Keywords: Deep vein thrombosis, laparoscopic surgery, cholecystectomy, gastric by-pass, gynecological surgery, heparin prophylaxis, preventive measures.

AIMS AND OBJECTIVES

This article aims to focus on the relative risk of deep vein thrombosis in laparoscopic gastrointestinal as well as gynecological surgery with a special focus on the thromboprophylaxis and mechanical therapeutic measures necessary to prevent deep vein thrombosis.

MATERIAL AND METHODS

A literature search was performed using Google search engine, High wire press, Springerlink and PubMed using above mentioned keywords. Selected papers were screened for further references. Criteria for selection were the number of cases (excluded if less than 20), methods of analysis (statistical or nonstatistical), operative procedures (only universally accepted procedures) and the institution where study was performed (reputed for laparoscopic surgery).

Search provided a variety of review articles but only 7 were selected as per the criteria.

CONTENT

1. Systemic coagulation and fibrinolysis after laparoscopic and open gastric by-pass.
   Nguyen NT, Owings JT, Goselin R, et al. Arch Surg 2001(Aug);136(8):909-16.
   70 patients were randomly assigned to laparoscopic (n = 36) or open (n = 34) gastric by-pass deep vein thrombosis prophylaxis in form of antiembolism stockings and sequential pneumatic compression devices were given. D-dimer, antithrombin III and protein C levels were checked along with venous duplex scan of lower limbs. DVT was found in 1 of 34 patients after open gastric by-pass but none developed in laparoscopic group.
2. Incidence of lower limbs deep vein thrombosis after open and laparoscopic gastric by-pass—a prospective study.
   Brasiliero AL, Miranda F Jr, Ettinger JE, et al. Obes Surg 2008;18(1):52-57.
   136 patients were included in the study group of which only 126 concluded the protocol. All were subjected to RYGBP by laparotomy or laparoscopy using 40 mg/day of enoxaprin for 15 days. 69 under went laparoscopy and 57 underwent open RYGBP. DVT incidence was 0.79% (1/126).
3. Venous stasis and DVT prophylaxis during laparoscopic fundoplication.
   Kiudelis M, Enndzinas Z, et al.
   Zentralbl Chir 2002(Nov);127(11):944-49.
   54 patients undergoing elective laparoscopic fundopli-

cation were included in the study and divided into 3 groups, first group were given leg bandages, second group were given intermittent pneumatic compression, third group were given intermittent electric calf muscle stimulation.

Doppler ultrasonography was during operation. DVT and pulmonary embolism incidence after laparoscopic fundoplication was 1.8%

4. Low frequency of phlebographic DVT after laparoscopic cholecystectomy—A Pilot study.
   Fredrik lindberg MD, PhD.
   Clinical and applied thrombosis/hemostasis
   2006 (Nov);12:421-25.
   50 patients were screened for DVT by bilateral phlebography after laparoscopic cholecystectomy. Frequency was 2%.
5. Incidence of deep vein thrombosis after gynecological laparoscopy.
   Feng L, Song J, Wong F, et al. Chin Med J (Engl) 2001(Jun);114(6):632-35.
   70 patients undergoing gynecological laparoscopic surgery were screened by B-mode ultrasound supplemented by Doppler. No DVT was found.
6. *Original Article:* The incidence of venous thromboembolism following gynecological laparoscopic —a multicentric, prospective cohort.
   W Ageno, E Manfredi, F Dentali, et al.
   J Throm Hemostat. 2007(Mar);5(3):503(6).
   In a prospective cohort patients undergoing gynecological laparoscopic surgery were assessed by compression ultrasonography and clinically for venous thrombosis. Cus was done on 7+/- 1 and 14 +/- day postoperative. Mean duration of procedure was 60.5 minutes. No episodes of CUS detected DVT nor clinical episodes of DVT were seen.
7. Thromboembolism prophylaxis and incidence of thromboembolic complications after laparoscopic surgery.
   Catheline JM, Cappeluto E, Gaillard JL.
   Int J Surg Investig. 2000;2(1):41–47.
   2384 patients received low molecular weight heparin (LMWH). 8 patients developed DVT, 6 out of 8 were diagnosed after cessation of LMWH.

INTRODUCTION

"*Necessity is the Mother of Invention*". The pitfalls of conventional surgery paved the way for minimal access surgery. Since its introduction there has been a vast improvement in the techniques and approach of minimal access surgery.

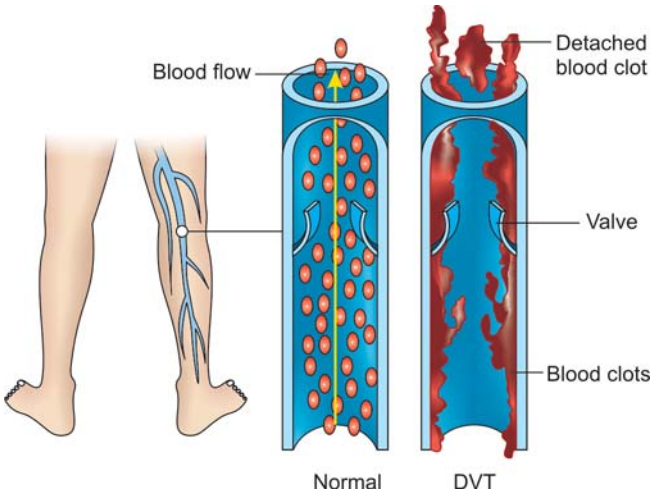

Fig. 1: Deep vein thrombosis (DVT)

Creation of pneumoperitoneum which is the basis of laparoscopic surgery is associated with reduction in the blood flow of the splanchnic, renal, femoral and venacaval circulation (Fig. 1). This reduction in blood flow associated with venous pooling in lower limbs due to reverse Trendelenburg position paramounts to formation of venous thrombi. Migration of venous thrombi to vital organs like brain, lungs and heart can prove fatal.

Laparoscopic upper GI surgery are more prone for thrombi formation due to long sugery time, high intraperitoneal pressure and reverse Trendelenburg position as compared to gynecological laparoscopic surgery. Even the laparoscopic colorectal surgery are prone for DVT due to extensive dissection, prolonged surgery time, old age and at times associated malignancy.

A variety of risk factors predispose to DVT like previous h/o venous insufficiency, old age, obesity, malignancy, immobilization, hypercoagulable state, varicose veins, surgery more than 2 hours. Hence judicious selection of cases and preoperative work up is necessary in all patients undergoing laparoscopic surgery.

Symptoms and signs of DVT are caused by obstruction to venous outflow, inflammation of the vessel wall or pulmonary embolization.

Diagnosis is on clinical grounds while the imaging modalities confirm the diagnosis (Fig. 2). Noninvasive tests like Duplex ultrasound, color. Doppler, MRI, CT while invasive tests include venography. Ultrasound has a 96%

Fig. 2: A case of DVT

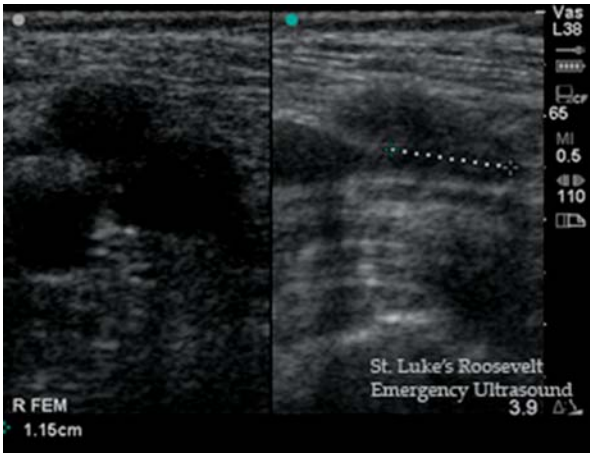

Fig. 3: Doppler imaging

specificity and sensitivity while color Doppler imaging has 100% sensitivity and specificity for diagnosing DVT (Fig. 3).

Preventive measures towards thrombosis include use of elastic stockings, intermittent pneumatic compression, electric calf muscle stimulation coupled with thrombo-prophylaxis in form of LMWH. Heparin prophylaxis is recommended in moderate and high-risk patients hence risk stratification of patients is necessary before surgery to avoid DVT. Recommendations suggest that heparin prophylaxis be started 12 to 24 hours before surgery and to be continued till discharge of the patient.

Advantages of heparin prophylaxis include cost efficacy, single dose administration and high potency. Adverse effects have been noted with heparin like abdominal hematomas, poor wound healing, bruises, intracranial bleed hence pros and cons should be weighed before using this drug.

DISCUSSION

Laparoscopic surgery, specially the upper GI surgery, predispose the patients to DVT as compared to gynecological surgery due patient positioning and high pressure requirements.

Review article 1 shows that open gastric by-pass predisposes to DVT more in comparison to laparoscopic surgery. Mechanical therapeutic measures like elastic stockings, intermittent sequential compression were considered in all patients still 1 patient developed DVT hence these preventive measures seem necessary to prevent a fatal outcome.

Review article 2 reflects the incidence of DVT in lower limbs after gastric by-pass. Study showed that obesity may not be a predisposing factor. However, obese patients require extensive preoperative check-up as well as intraoperative prophylactic measures to curb the risk of DVT.

Review article 3 was included with a purpose to reflect the role of mechanical therapeutic measures in preventing DVT as well as to study the effect of pneumoperitoneum on femoral venous blood flow. There was a decrease the venous blood flow and the cross-sectional area of the vein after creation of pneumoperitoneum. Of all the measures Intermittent sequential compression seems to be most effective in combating the adverse effects of pneumo-peritoneum.

Review article 4 depicts low incidence of DVT after laparoscopic cholecystectomy. The role of thrombo-prophylaxis in all laparoscopic surgeries seems questionable.

Review articles 5 and 6 were included with a purpose to reflect the low incidence of DVT after gynecological surgery for benign conditions like ovarian cyst, endometrioma, adnexal masses and also in patients with infertility. Negation of factors responsible for DVT in upper GI as well as colorectal surgery might be the cause for low-risk.

Review article 7 was included with the prospect of highlighting the need for heparin prophylaxis in moderate and high-risk patients prior to surgery and to be continued till the day of discharge of the patient. It is important as well to advocate the use of low insufflation pressures, intermittent release of pneumoperitoneum and using the reverse Trendelenburg position for a minimum time to avoid DVT.

CONCLUSION

"*An Ounce of Prevention is Worth a Pound of Cure*"

Deep vein thrombosis developing after laparoscopic surgery can be prevented by optimizing the intraperitoneal pressure, intermittent release of pneumoperitoneum and using reverse Trendelenburg position for minimum time. Preoperative risk stratification of patients for heparin prophylaxis and intraoperative use of the intermittent pneumatic compression in prolonged surgery is the key to prevent deep vein thrombosis of lower limbs.

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12. Risk factors and clinical impact of post-op symptomatic venous thromembolism. J Vasc Surg 2007.
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REVIEW ARTICLE

Review of Literatures on Laparoscopic Prosthetic Repair of Giant Hiatal Hernia than Pure Anatomical Repair of Crura

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Abstract

The recurrence rate after laparoscopic primary repair of giant hiatal hernias with paraesophageal involvement is reported to be high. Mesh reinforcement repair of hiatal defect is proposed for solving this problem which is debated. The indication for mesh use, the type of mesh to use, and the placement technique are controversial. After review of all literatures of our study it has been concluded that the use of prosthetic reinforcement of cruroplasty in laparoscopic giant hiatal hernias has very low recurrence, though certain mesh related complications are worse than recurrance which are up to certain extent are surgically correctable complications, as per different studies no one mesh type is clearly superior in terms of avoiding failure and complication. Only further studies and long-term evaluation will allow judgment of the effectiveness of laparoscopic mesh repair in patients with large hiatal hernias.

Keywords: Giant hiatal hernia, laparoscopic repair, prosthetic/mesh repair, nonabsorbable and reabsorbable/biological mesh, recurrence, complications.

INTRODUCTION

The esophagus passes through an opening in the diaphragm (i.e. esophageal hiatus) as it courses through the chest to the abdomen eventually ending at the stomach. This opening is usually adequate for passage of the esophagus and nothing else (Fig. 1). However, patients that have a hiatal hernia have an enlarged opening. There are four different types of hiatal hernias described. Giant hiatal hernia is defined as greater than one third of the stomach in the thoracic cavity[1] and representing 5 to 10% of all hiatal hernia.[2] The hiatal opening in a patient with a large hernia is wide, with the right and left Crura very thin and often separated by 5 cm or more.[2] Types of hiatal hernia are represented diagrammatically in Figures 1 to 2D.

Traditionally repair of giant paraesophageal hernia has been performed through laparotomy or thoracotomy, with the advent of laparoscopy, nowadays giant hiatal hernia (type III, type IV) are performed with laparoscopy.[3] The recurrence rate after laparoscopic repair of hiatal hernias with paraesophageal involvement (LRHP) is reported to be high.[4]

Several recent reports have shown laparoscopic repair of paraesophageal hiatal hernia.[5-7] Suggesting that it is feasible and effective obtaining comparative result to open surgery.

AIMS AND OBJECTIVES

The aim of this review is to analyze the role of laparoscopic prosthetic cruroplasty in the management of Giant hiatal hernia.

MATERIALS AND METHODS

A systematic Google, Highwire press search looking for all of the studies published in English in relation to treatment

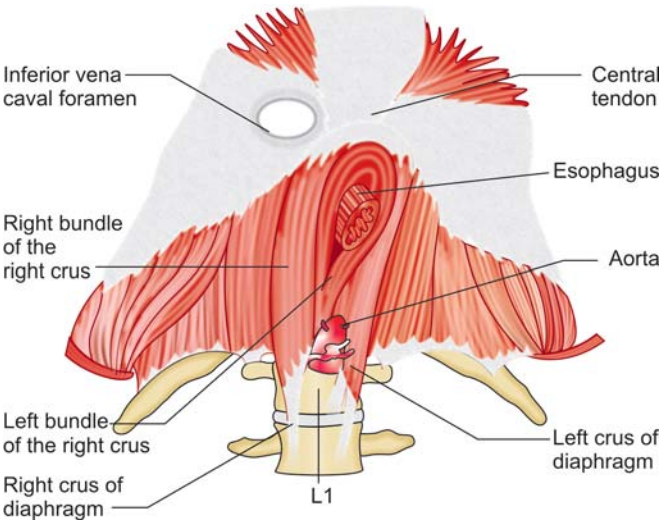
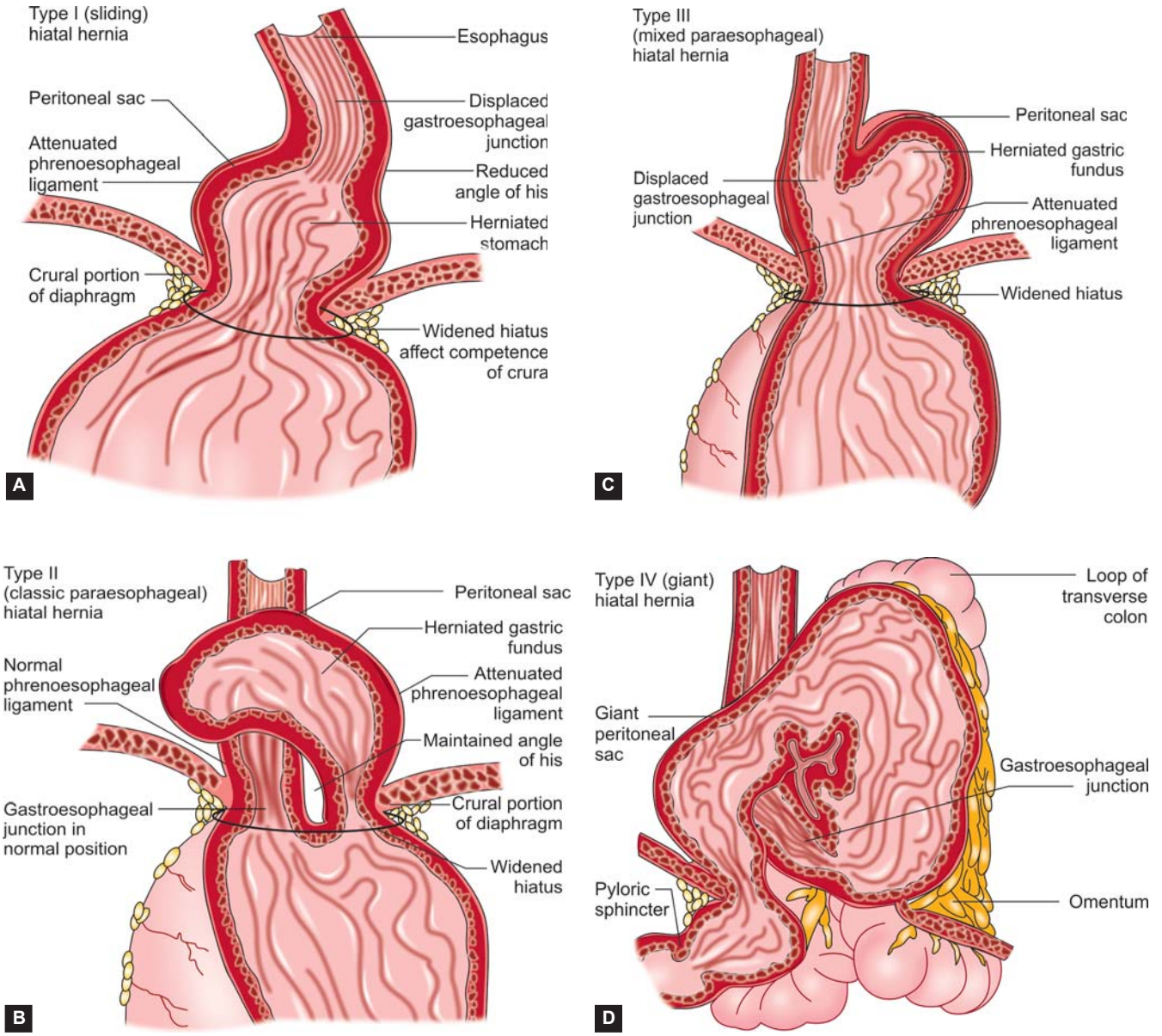


Fig. 1: Anatomy of hiatus



Figs 2A to D: Types of hiatus hernia

of giant paraesophageal and mixed hiatal hernias was performed (Figs 2A to D). Particular attention was paid to the use of meshes for reinforcement of the hiatal repair.

OPERATIVE PROCEDURE

The standard surgical technique include:

- Standerd five cannula technique
- Devide the lesser omentum to expose the right hilar piller within the sac
- Reduction of hernia by means of atraumatic grasper in a hand over hand fashion
- Complete excision of sac
- Primary closure of hiatal hernia defect with either suture approximation of crura or by different type of mesh application (for tension free repair)
- After closing the hiatus a fundoplication (Nissen or toupet) with or without collis gastroplasty will complete the operation depending upon the finding of intraoperative assessment of short esophagus and esophageal manometry.

The most controversial issue in the use of prostheses in the hiatus is the surgical technique. Several models have been proposed,[8] which are discussed below.

Tension-free Techniques

1. One tension-free technique is anterior placement of a triangular piece of mesh, proposed by Paul et al[9] (Fig. 3). A triangular or semilunar polytef patch is placed to occlude the anterior segment of the hiatus and fixed with staples or stitches. The stomach is fixed to the abdomen and a fundoplication is added.
2. For posterior placement of a triangular piece of mesh (Fig. 4), the aim is the same as in the technique for anterior placement. Kuster and Gilroy[11] proposed a posterior segmental occlusion, occluding the base of the pillar overture, and placing the esophagus anteriorly, fixing the mesh with staples or stitches. Fixation to the abdominal wall or a gastrostomy is also performed.[12]
3. A third technique involves onlay of a piece of mesh, with a hole facilitating the passage of the esophagus. The mesh covers the whole of the hiatal defect, and no attempt is made to close the hiatus (Fig. 5).
4. There are several shapes of mesh designed to allow the passage of the esophagus and to facilitate fixation (e.g. U shape,[13,14] A shape[15]) (Fig. 6). Casaccia et al[15] recently proposed a composite polytef-polypropylene A-shaped mesh. This mesh was designed according to the strength lines of the hiatus and produced good results after 8 months of follow-up.
5. A piece of mesh may be placed just covering the defect below the esophagus, overlapping both pillars laterally. This was described by Basso et al[16] (Fig. 7).
6. In another technique, after a standard closure of the hiatus, a relaxing incision lateral to the right crura is placed, and a patch is fixed with stitches or staples

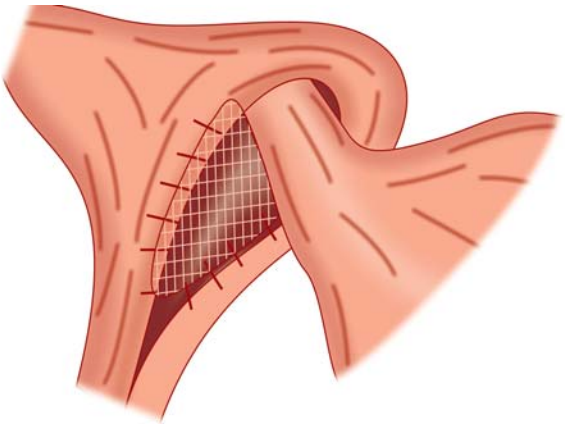


Fig. 4: Tension-free repair: Posterior placement of a triangular piece of mesh[11]

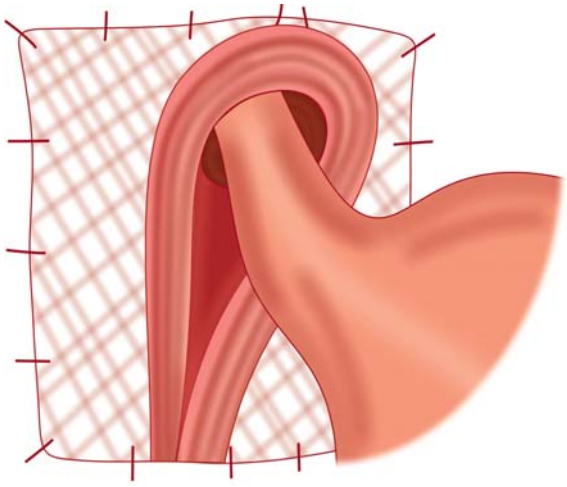


Fig. 5: Tension-free repair: Onlay piece of mesh, with a hole facilitating the passage of the esophagus

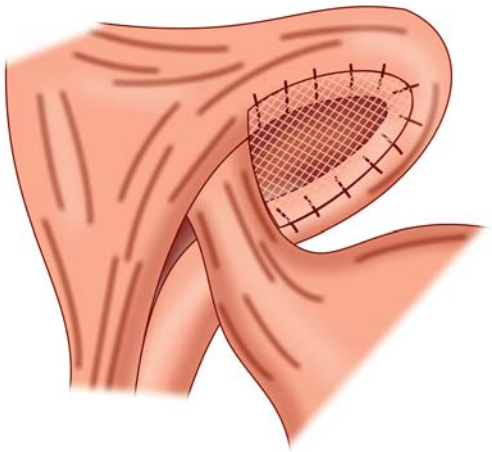


Fig. 3: Tension-free repair: Anterior placement of a triangular piece of mesh[10]

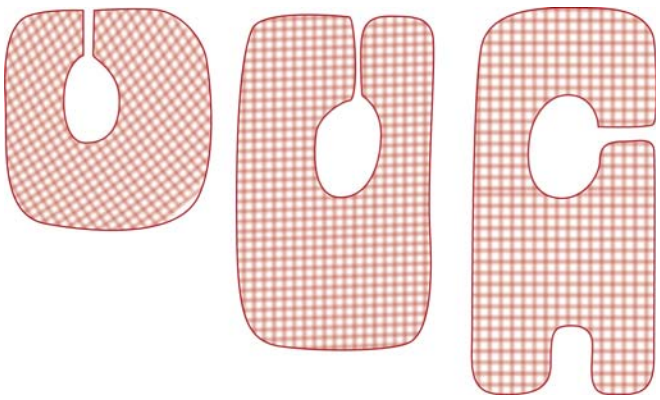


Fig. 6: Shapes of mesh designed to allow passage of the esophagus and to facilitate fixation (U shape,[13,14] A shape[15])

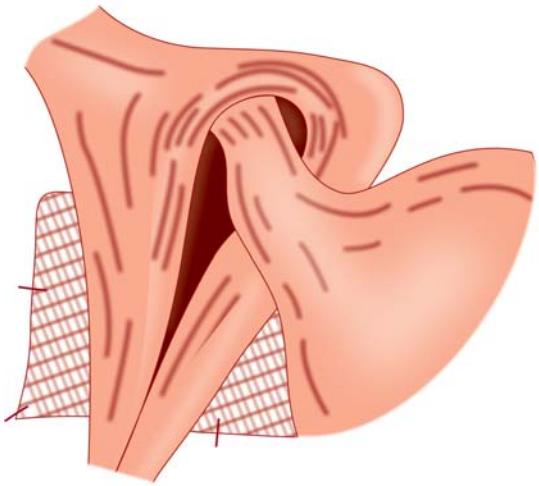


Fig. 7: Tension-free repair: Piece of mesh just covering the defect below the esophagus, overlapping both pillars laterally[16]

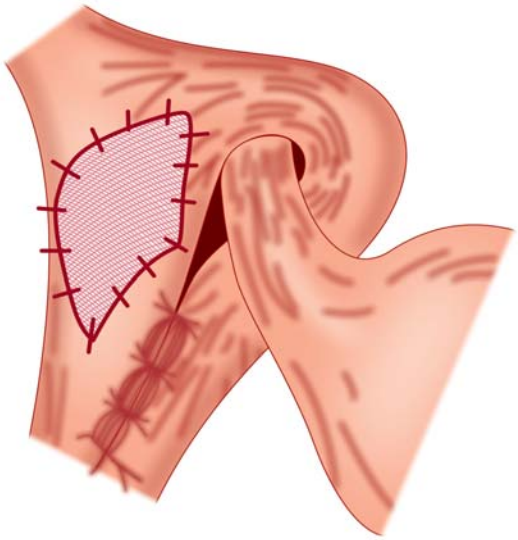


Fig. 8: Tension-free repair. After a standard closure of the hiatus, a relaxing incision lateral to the right crura is performed, and a patch is fixed with stitches or staples covering the diaphragmmatic defect[17,18]

covering the diaphragmmatic defect (Fig. 8). Described by Huntington in 1997,[17] it has been also proposed by Horgan et al.[18]

Nontension-free Techniques

A buttress mesh technique has also been described (Figs 9 to 11). A long strip of mesh is placed below the esophagus, covering the pillar closure (Fig. 12). The advantage is that it avoids the encircling of the esophagus, reducing the risk of dysphagia or erosion. Champion and Rock[22] reported good results in a series of 52 cases, with a recurrence rate of 2%.

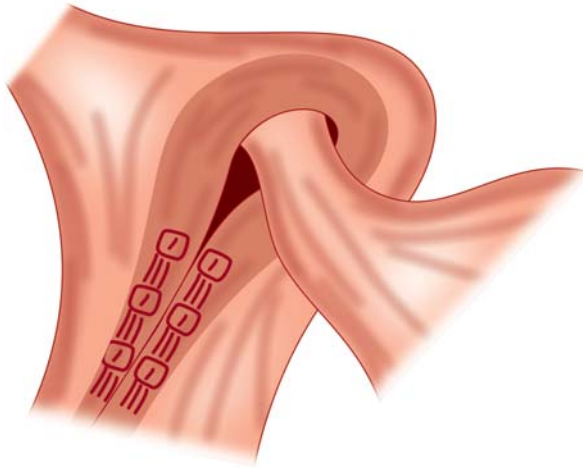


Fig. 9: Nontension-free repair with reinforcement of the crural closure to avoid the cutting effect of the stitches, using simple stitches with Teflon or Dacron pledgets[19,20]

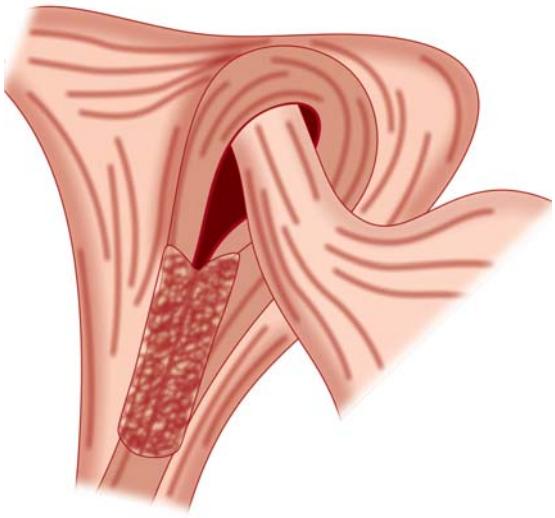


Fig. 10: Nontension-free repair with reinforcement of the crural closure, using a polypropylene strip along the crura to hold the stitches

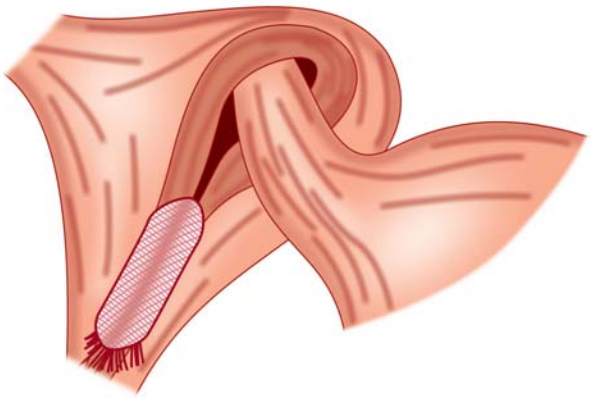


Fig. 11: Nontension-free repair with reinforcement of the crural closure, using a polypropylene piece of mesh covering both edges of the pillars[21]

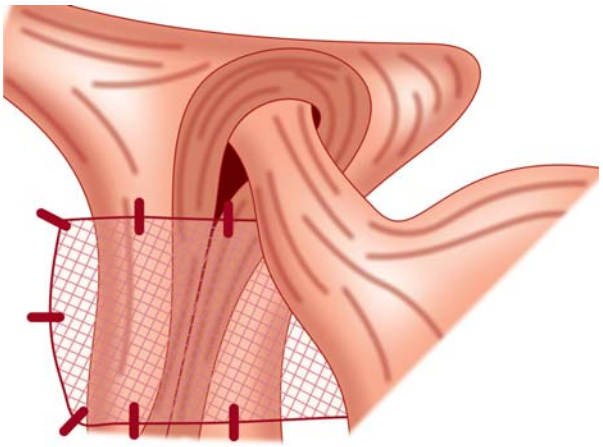


Fig. 12: Nontension-free repair with reinforcement of the crural closure using buttress mesh. A long strip of mesh is placed below the esophagus, covering the pillar closure[22]

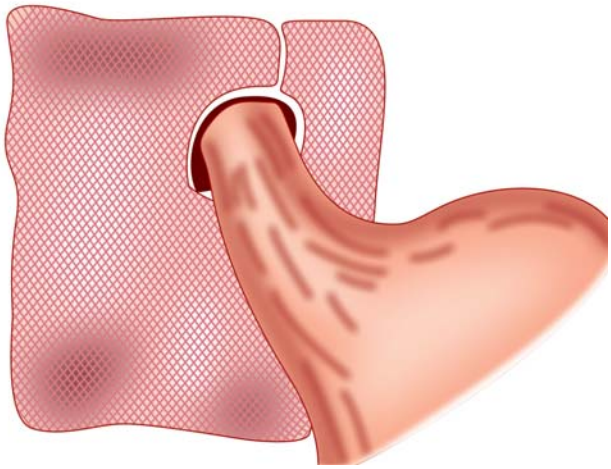


Fig. 13: Nontension-free repair with reinforcement of the crural closure. Onlay mesh is placed around the esophagus once the defect has been closed[23,24]

Placement of onlay mesh around the esophagus with a hole in the middle, once the defect has been closed, has been used (Fig. 13). There are also pre-shaped meshes designed to adapt anatomically to the characteristics of the anatomic area.[23,24]

REPAIR MATERIALS

The prostheses available for hiatal reinforcement are made of a range of materials. Most authors agree that the material used should be nonresorbable, because resorbable material (polyglycolic acid) loses its mechanical properties as it is resorbed. Nonresorbable material may be made of polypropylene, polytef, or composite (polytef plus polypropylene). Recently, surgisis a nonresorbable material of biological origin has been used. [24]

Acellular human dermal matrix may be an effective method to buttress the crural closure in patients with large hiatal hernias. Longer follow-up in larger numbers of patients is needed to assess the validity of this approach. [25]

COMPLICATIONS

Early nonreoperative complications[26]

- Dysphagia
- Heartburn
- Chest pain
- Fever
- Epigastric pain
- Weight loss.

Main reoperative complications[26]

- Intraluminal mesh erosion
- Esophageal stenosis
- Dense fibrosis.

DISCUSSION

The most common mesh types used in different studies were biomaterial then polytetrafluoroethylene and polypropylene. Suture anchorage was the most common fixation technique . The findings in different studies showed on an average failure rate of 3%, a stricture rate of 0.2%, and an erosion rate of 0.3%. Biomaterial tended to be associated with failure, whereas nonabsorbable mesh tended to be associated with stricture and erosion.

On the basis of various studies, it appears that the tension-free repair of large hiatal hernias (type II and III) with polypropylene–PTFE mesh is technically feasible and easy to perform. The novelty represented by the new shape of the mesh and the use of a composite material for this region is encouraging.

Follow-up period is too short in most of the present literatures, but short-term functional results are promising. Only long-term evaluation will allow judgment of the effectiveness of laparoscopic mesh repair in patients with large hiatal hernias.

Further studies are necessary to define which hiatal defects canbe successfully treated with a simple cruroplasty and which ones need a prosthetic reinforcement.

CONCLUSION

Laparoscopic hiatal hernia repair using mesh resulted in a low recurrence rate[3,8,12-15] which appeared to be lower than that obtained historically without mesh. Different mesh placement tecniques has their own merits and demerits.

Thus laparoscopic mesh hiatoplasty for giant hiatal hernia is acceptable though certain mesh related complications are worse than recurrence which are up to certain extent are surgically correctable complications[26] and as per different studies no one mesh type is clearly superior in terms of avoiding failure and complication.

ACKNOWLEDGMENT

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REVIEW ARTICLE

Laparoscopic Adrenalectomy: Surgical Technique

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Abstract

Laparoscopic adrenalectomy was first described in 1992 by *Gagner et al.* In present, this minimally invasive procedure are become *"gold standard"* surgical management of small and medium sized benign adrenal tumor. This review article aims to describe various type of surgical technique to perform laparoscopic adrenalectomy including new minimally invasive technique as single access laparoscopic adrenalectomy, role of natural orifice transluminal endoscopic surgery (NOTES) in adrenalectomy to complete gland dissection, method of patients selection (indication, contraindication) and show benefits of laparoscopic adrenalectomy compare with conventional open surgery technique.

Keywords: Adrenal gland, laparoscopic surgery, surgical technique, adrenalectomy.

INTRODUCTION

Laparoscopic adrenalectomy was first described in 1992 by Gagner et al. In present this minimally invasive procedure are become "gold standard" surgical management of Cushing's syndrome, pheochromocytoma, aldosteronoma, and adrenal incidentaloma. Benefit outcome of laparoscopic adrenalectomy are less postoperative pain, decrease postoperative morbidity, decreased hospital stay and allow patients to recover faster, more overall patient satisfaction when compared with an open approach.[1]

AIMS

The aim of this study was to describe various type of surgical technique to perform laparoscopic adrenalectomy including new minimally invasive technique as single access laparoscopic adrenalectomy, role of natural orifice transluminal endoscopic surgery (NOTE) in adrenalectomy. The following parameters were evaluated for this laparoscopic and procedures.

- Method of patient selection
  - Investigation
  - Indication for surgery
  - Contraindication for surgery
- Preoperative preparation
- Operative technique
  - Type of anesthesia
  - Patient position
  - Operative approach
  - Comparison outcome of various surgical technique
- Intraoperative and postoperative complications
- Postoperative care
- Postoperative recovery
- Benefit outcome compare with open surgery.

MATERIALS AND METHODS

A literature review was performed using Google, MD consult, PubMed. The following search terms were used: laparoscopic adrenalectomy, surgical technique, laparoscopic *vs* open adrenalectomy, complication of laparoscopic adrenalectomy. Criteria for selection of literature were the methods of analysis (statistical or non-statistical), operative procedure (various type of laparoscopic adrenalectomy technique) and comparison of various surgical technique (operative time, blood loss, complication).

Method of Patient Selection

All of patients present with adrenal lesion should be evaluated for:

1. *Biochemical hormonal activity:* The aim of this test is to determine functional activity of adrenal lesion, such as plasma and urine catecholamines for pheochromocytoma and 24 hours urine cortisol for Cushing's syndrome. That is important in perioperative care including blood pressure control, fluid and electrolyte status and other anesthesia considerations.
2. *Imaging study:* CT scan is the preferred radiologic modality, Finding on CT scan that suggest benign adrenal lesion include homogenous round shape, size–smaller than 3 cm, smooth, well-circumscribed border and attenuation coefficients less than 10 Hounsfield's units. Potential adrenal malignancy lesion are finding on CT scan as size larger than 5 cm, presence of central

necrosis, tumor calcification, evidence of nodal, hepatic, venous invasion.[2,3]

Indication for Surgery

All of hormonal active adrenal tumor and nonfunctional size, more than 4 cm, or rapid increase in size adrenal tumor should be removed. Laparoscopic adrenalectomy is a surgical option but should be carefully in large adrenal masses (8 cm or greater) that may associated with significant longer operative time, increased blood loss, and longer hospital stay. Indication for laparoscopic adrenalectomy is given in Table 1.[3-6]

Table 1: Indication for laparoscopic adrenalectomy[3]

- Hormonally active adrenal tumor
- Aldosteronoma
- Pheochromocytoma
- Cortisol-producing adrenal tumor
- Nonfunctioning adrenal lesion greater than 5 cm in size
- Nonfunctioning adrenal lesion with progressive growth
- Solitary adrenal metastasis with negative metastatic survey

Contraindication

Laparoscopic adrenalectomy has few absolute contraindications as suspected primary adrenal carcinoma that shown aggressive activity as adjacent organ invasion should be *en bloc* resection with open surgery. Other of absolute contraindication are severe cardiopulmonary disease, uncontrolled pheochromocytoma and uncorrectable coagulopathy. Relative contraindications are including extensive previous surgery and tumor size more than 12 cm that may increase risk of bleeding and visceral organ injury.[3-5]

Preoperative Preparation

All of patients with hormonal active adrenal tumors should be carefully preoperative evaluated in blood pressure control, fluid and electrolyte management. Collaboration between surgeon, endocrinologist, and anesthesiologist are still necessary. Other preoperative preparations include mechanical bowel preparation, broad-spectrum antibiotic prophylaxis, and deep vein thrombosis prophylaxis.[3-5]

Operative Technique

There are many surgical approaches to performed laparoscopic adrenalectomy. Including transperitoneal approach and lateral retroperitoneal approach, transthoracic approach, single incision laparoscopic adrenalectomy, NOTES adrenalectomy will be described.

This procedure was performed under general anesthesia. Routine placement of nasogastric tube and urinary catheter are still requiring.

TRANSPERITONEAL APPROACH

Left Adrenalectomy[3-5,7]

Patient position: Lateral decubitus position with the left side up, operative table slightly flexed at the level of the umbilicus and the surgeon and assistant were standing on the side opposite to the lesion.

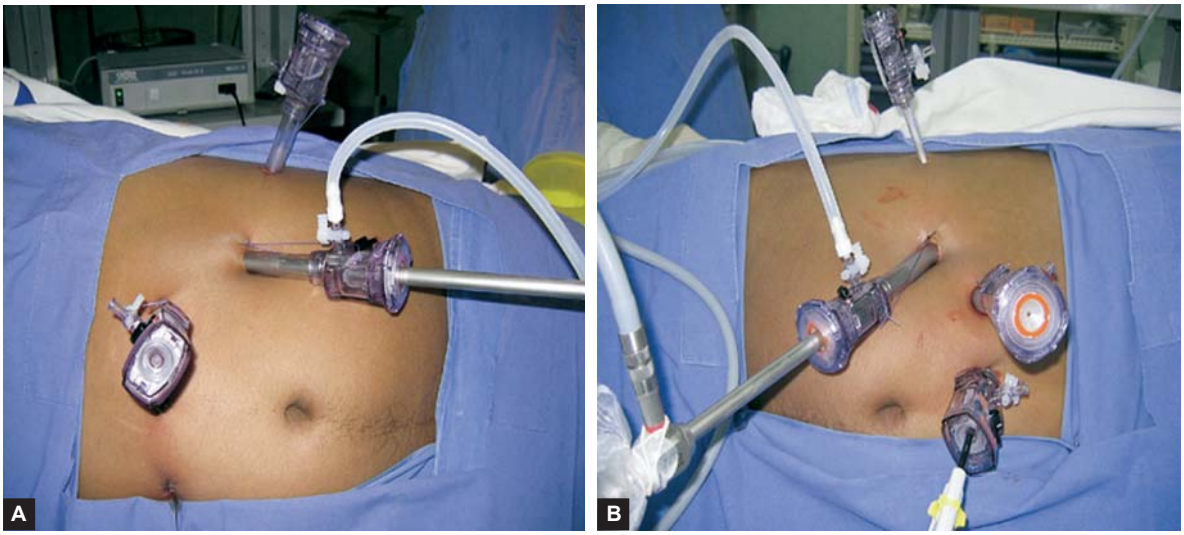
Port site placement: Insertion of Veress needle at 3 cm under costal margin at the anterior axillary line then insufflations of carbon dioxide up to 15 mm Hg. Then 10 mm trocar replaced the Veress needle for a 30 degree 10 mm laparoscope. A second 10 mm trocar on the posterior axillary line, and a third 5 mm trocar on the midclavicular line.

Operative Approach[3-5,7,8]

1. Mobilization of splenic flexure colon by divide splenocolic ligament, leinorenal ligament and dissection of splenorenal ligament, lateral peritoneal carried up to the diaphragm to provide adequate exposure of left adrenal gland. Ultrasonic laparoscopic coagulation instrument or bipolar cautery can be use during mobilization of adrenal gland.
2. Dissection of Gerota's fascia between upper pole of left kidney and adrenal gland. Continue dissection to medial aspect of kidney for identified of left renal vein.
3. Meticulous dissection was performed for isolation of left adrenal vein then clipped and divided. Mobilizations of medial part of adrenal gland out off of the aorta. All small blood vessels were either clipped or cauterized. Then continues to superior aspects of the adrenal gland. Carefully divide the phrenic vessels at this level, avoid injury to pancreatic tail. The lateral part was mobilized to free adrenal gland from surrounding tissue.
4. Adrenal gland was extracted in a sterile plastic bag through the most anterior trocar. Complete hemostasis checking and suture skin incision. Routine drainage is not necessary.

Right Adrenalectomy

Patient position: Lateral decubitus position with the right side up, operative table slightly flexed at the level of the umbilicus and the surgeon and assistant were standing on the side opposite to the lesion.



Figs 1A and B: Port site placement for laparoscopic (A) left adrenalectomy, and (B) right adrenalectomy

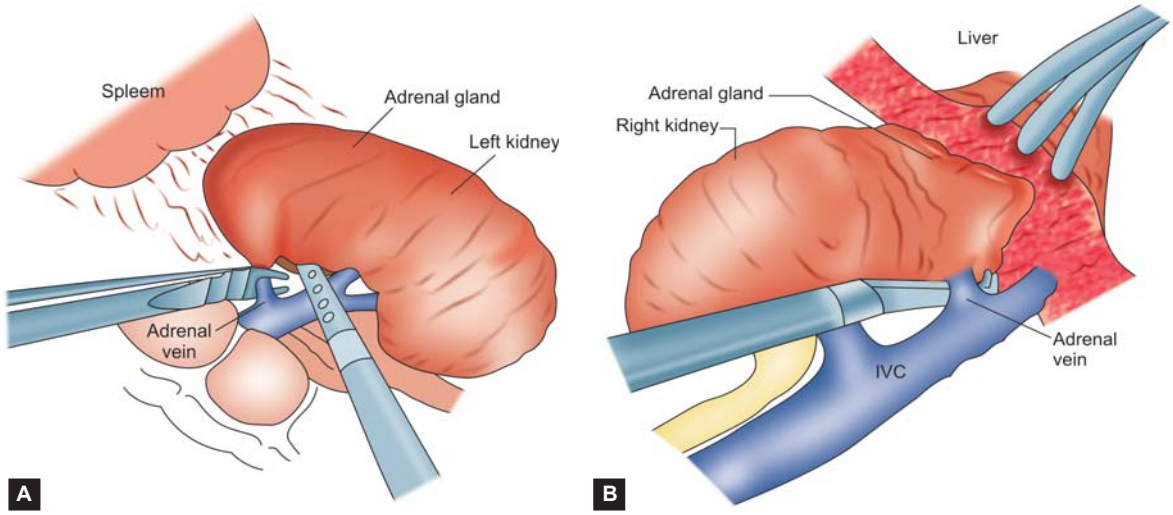
Port site placement: Similar as describe for left adrenalectomy but adding 5 mm port at epigastrium for liver retractor insertion (Figs 1A and B).

Operative Approach[3-5,7,8]

1. Mobilization of Toldt's line through triangular ligament for upward liver retraction. Then mobilization of duodenum to exposure of right kidney, right adrenal gland and inferior vena cava (IVC).
2. Dissection was done medially and upward along IVC for identified right adrenal vein then clipped and divided (Figs 2A and B). This step should be done carefully, avoid massive bleeding from IVC.
3. Continue dissection of adrenal gland as describe in left adrenalectomy. Adrenal gland was extracted in a sterile plastic bag, complete checking for hemostasis and suture skin incision.

Lateral Retroperitoneal Approach

The lateral retroperitoneal approach to the adrenal gland is providing benefit in case of prior extensive abdominal surgery to avoid visceral organ injury. Limitation of this surgical technique in case of adrenal tumor size larger than 7 cm that may lack of anatomical landmark in retroperitoneal space. *Patient position:* Full flank position with slightly flexed operative table for expands the operative space between the



Figs 2A and B: Port side placement for laparoscopic dissection of (A) left adrenal vein, and (B) right adrenal vein

costal margin and the iliac crest (Figs 3A and B). This position is most widely used because it permits proper bowel mobilization and makes exposure of the surgical area.

Retroperitoneal space access: Open Hasson's technique by made 2 cm skin incision is at 2 cm below the inferior edge of the twelfth rib then split the muscles until the lumbodorsal fascia was divided by blunt dissection then enter to retroperitoneal space. Retroperitoneal requires the creation of a working space using a balloon dilatation (800 cc of air inflated to balloon).

Port site placement: After dilatation, 10 mm trocar was inserted for 30 degree 10 mm laparoscope, then insufflations of carbon dioxide to generate pneumoretroperitoneum pressure of 15 mm Hg. A second trocar is placed in the anterior axillary line midway between the costal margin and iliac crest. A third port is placed posteriorly between the twelfth rib and iliac crest along the lateral border of the sacrospinalis muscle. A fourth port (5 mm) is inserted for retraction of the kidney and is placed cephalad to the first port in the anterior axillary line. An optional fourth port is placed in the anterior axillary line 5 to 7 cm inferior to the third port and may be used for retraction during dissection of adrenal gland.

Operative Approach[3-5,7]

Important key anatomical landmark of this surgical approach is psoas muscle. The kidney and adrenal gland locate on lateral border.

Left Adrenalectomy

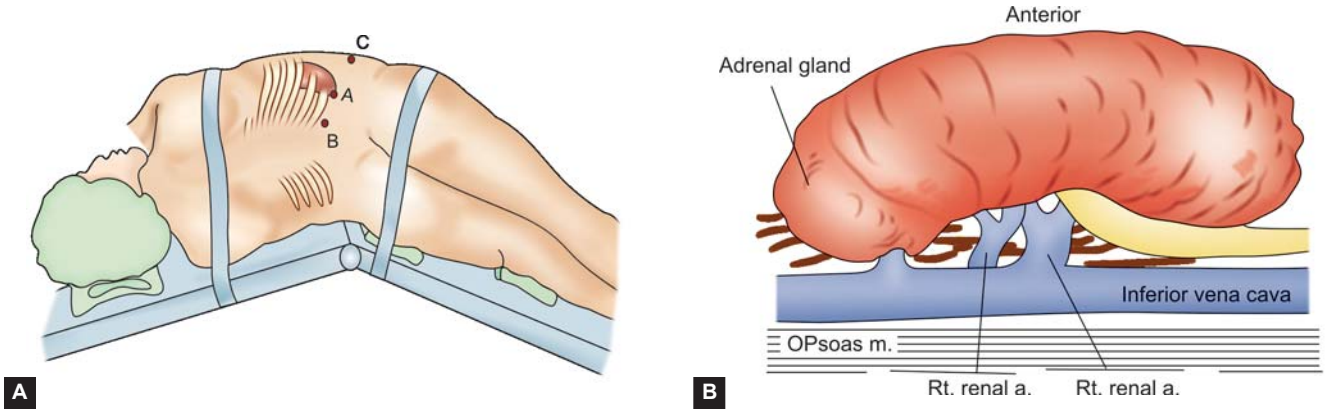
1. Dissection along lateral border of psoas muscle to medial border left kidney, then retract kidney upward and anteriorly.
2. Carefully dissection of renal hilum to identified left renal vein and medial border of adrenal gland.
3. Left adrenal vein are located at inferomedial of adrenal gland in conjunction with left renal vein. Identification of left adrenal vein at this level then clipped and divided.
4. Continue mobilization thought lateral and inferior surfaces of adrenal gland and carefully dissected away from the kidney. Then superior aspect and inferior phrenic vessels are controlled with ultrasonic laparoscopic coagulation instrument or bipolar cautery.
5. Adrenal gland was extracted in a sterile plastic bag and extracted from primary port. The trocars were removed and suture skin incision.

Right Adrenalectomy

1. Dissection of right adrenal gland is the same principle of left adrenal gland dissection. Psoas muscle is the important key anatomical landmark.
2. After identification of right kidney and right adrenal gland. Carefully dissection of IVC that is located at medial part of psoas muscle.
3. Right adrenal vein was identified in conjunction of IVC the clipped and divided. Avoiding of avulsion injury that may be causing massive hemorrhage.
4. After completion of adrenal gland dissection, specimen was extracted in a sterile plastic bag and extracted from primary port. The trocars were removed and suture skin incision.

Posterior Retroperitoneal Approach

This technique was initially reported in 1999 by Walz et al. The patient is placed on a lateral flank technique and creation of working space by balloon dilatation as described in lateral retroperitoneal approach. A three- to four-port was used for camera and working instruments. Initial dissection was performed at superior of adrenal gland continue thought



Figs 3A and B: Patient position with port site placement for lateral retroperitoneal right adrenalectomy and important anatomical landmark[3]

medial surface of adrenal gland thee adrenal vessels is exposed and ligation. After complete dissection of the gland then placed into a specimen retrieval bag and removed. This surgical approach is not popular option because need more surgical experience and limitation of working space.[3,7]

Rubinstin et al report a comparison of perioperative outcome between transperitoneal approach and lateral retroperitoneal approach in 57 consecutive benign adrenal conditions. Finding that both surgical techniques are safe. There are not different in operative time (130 *vs* 126.5 minutes), blood loss, postoperative pain, length of hospital stay and postoperative complication.[9]

Zusuki et al report clinical outcomes of the transperitoneal, lateral transperitoneal and lateral retroperitoneal approach. This article conclusion is—(1) Lateral transperitoneal approach is proper for a tumor is more than 5 cm and/or the surgeon is not yet skilled in laparoscopic adrenalectomy (2) Lateral retroperitoneal approach is suitable, if the surgeon has performed at least 20 operations, the adrenal tumor is unilateral and the lesion is less than 5 cm.[10]

Transthoracic Approach

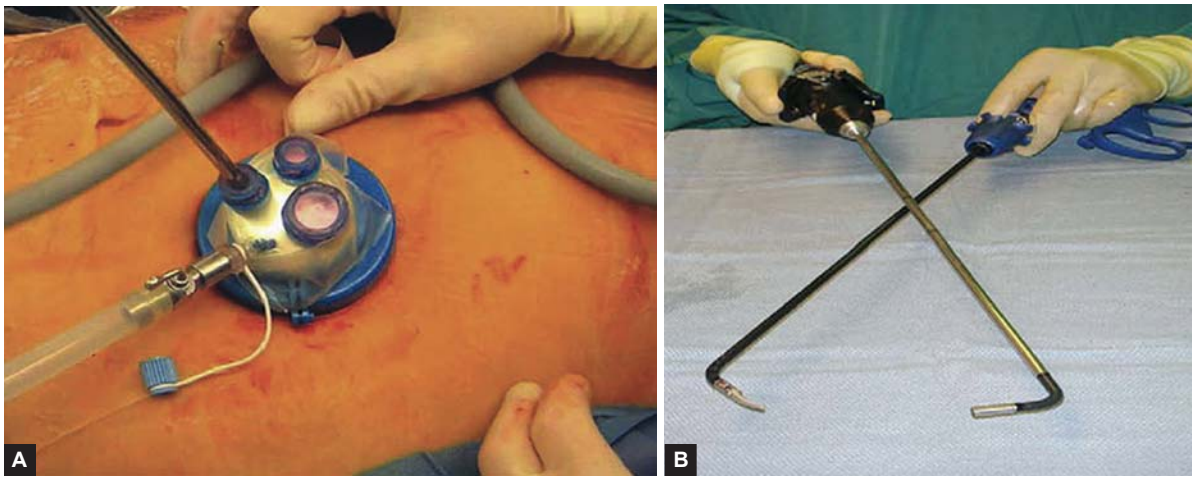
Gill et al report "Thoracoscopic transdiaphragmmatic adrenalectomy" in 3 patients with prior history of extensive abdominal surgery. This technique was performed after double lumen endotracheal intubation without pneumo-insufflation and the patient is placed in the prone position. Four port transthoracic approaches were used. The diaphragm was incised under thoracoscope vision, and then enters to retroperitoneal space to identification of adrenal gland. Adrenal vasculature was controlled and complete mobilization of adrenal gland. The specimen was entrapped and retrieved through a thoracic port. The diaphragm was suture repaired with intracorporeal knot tying and chest tube was placed. The outcomes are—(1) No perioperative complications (2) Operating time was 2.5 to 6.5 hours (3) Blood loss was 50 to 500 cc.[11]

Single Access Retroperitoneal Adrenalectomy

Single access laparoscopic surgery is becomes a new trend in minimally invasive surgery. This surgical access is need articulating or bent instrumentation insert to adjacent trocar in same incision to allow triangulation intracorporeally during surgery (Figs 4A and B). Now development of new laparoscopic access ports allowing several instruments to be inserted through different cannulae of a single port.[12,13]

Hirano et al report technique of single incision retroperitoneoscopic adrenalectomy. The patient was placed in lateral decubitus position with slight flexion. A 4.5 cm skin incision was performed below the twelfth rib in the midaxillary line. Balloon dilataion combined with finger dissection were used to create working space in retroperitoneal. A rectoscope tube, 4 cm diameter, was inserted for camera and working instrument to perform adrenalectomy port without carbon dioxide insufflations. This operation was successful in 98.1%. The average duration of surgery was 203 minutes, and the mean estimated blood loss was 252 cc. Postoperative major complications, including fulminant hepatitis and pulmonary thrombosis, were observed in two patients (3.7%).[14]

Walz et al report outcome of single-access retroperitoneoscopic adrenalectomy (SARA) in 47 patients with benign adrenal tumor. SARA results are need long operative time, decrease postoperative pain when compare with traditional retroperitoneoscopic three-port approach.



Figs 4A and B: Single port with three working channel and articulated instrument for single access laparoscopic surgery[13]

But overall complication and length of hospital stay are not different.[15]

Natural Orifice Transluminal Endoscopic Surgery (NOTES) for Adrenalectomy

The concept of NOTES is "incisionless surgery". This technique access by transgastric or, transvagina or transcolonic approach to access peritoneal cavity. That can allows perform intra-abdominal surgery without surgical scar.

In present role of NOTES for adrenalectomy are only reports in many porcine or cadaveric models. Transvaginal retroperitoneal adrenalectomy in porcine model is performing by made a 1 cm posterolateral colpotomy. The retroperitoneal tunnel was created using carbon dioxide. Dissection by movement of gastroscope up to superior pole of kidney to allowed access of adrenal gland. The vascular pedicle was identified and controlled by clips or endoloop. NOTES transvaginal retroperitoneal may be option for humans in future. But further experiments and better practice surgical skill are needed.[16,17]

Bilateral Adrenalectomy

The most common indication for bilateral adrenalectomy is Cushing's syndrome. This procedure was performed by lateral transperitoneal approach. The larger tumor or the more difficult side should be performed first, then change patient position to opposite side and redraped.[3,7]

Mikhail et al report comparison of outcome between laparoscopic bilateral adrenalectomy with open surgery. The results of laparoscopic procedure are—(1) Need more operative time (295.2 *vs* 236.8 minutes) (2) Less intraoperative blood loss (100 *vs* 500 cc.) (3) Short hospital stay in laparoscopic surgery group (3 *vs* 8.5 days).[18]

Complication of Laparoscopic Adrenalectomy

Intraoperative complication

1. *Hemorrhage*: Adrenal vein are directly into IVC on the right side and directly to left renal vein on the left. If avulsion injury occur during dissection of adrenal vein may be cause of massive hemorrhage. Prevention of this complication by meticulous dissection of adrenal vein.
2. Adjacent organ injury
   - *Liver*: Liver laceration of liver retractor may be cause of bleeding. This condition can be managed by argon plasma coagulation and hemostasis agent (such as methyl cellulose).
   - *Spleen*: Splenic injury occurs during left adrenalectomy. This condition can be managed by argon plasma coagulation and hemostasis agent. If this is not control bleeding, splenorrhaphy or splenectomy may be necessary.
   - *Pancreas*: If pancreatic injury occurs at tail of pancreas, distal pancreatectomy is a surgical option. If there is uncertainty of pancreatic injury management by leaving of closed suction drainage and total parenteral nutrition.
   - *Visceral organ*: Small bowel, colonic injury may occur during laparoscopic adrenalectomy. If this complication cannot repair by laparoscopic procedure, conversion to open surgery may be an option.

Postoperative Complication

1. Hypokalemia can occur in the immediate period after adrenalectomy in patient with primary hypoaldosteronism. Potasium replacement is requiring if this condition still persistent replacement of mineralocorticoid with fludrocortisone is essential.
2. Hypotension secondary to α blockade can occur after adrenalectomy in case of pheochromocytoma. Close monitoring of blood pressure in postoperative period still necessary.
3. Complication after prolong steroid supplement after adrenalectomy such as increased risk of fracture secondary to osteoporosis, hyperglycemia, and poor wound healing.

During learning period of laparoscopic adrenalectomy, surgeon should select a case of unilateral, small adenomas without comorbid disease to avoid perioperative complication.[19]

Postoperative Care

After completion of operation nasogastric was removed. Carefully monitoring of blood pressure, fluid-electrolyte balance as mentioned in postoperative complication. Oral intake can start on first operative day and take off urinary catheter. Postopertive pain is control by parenteral narcotics in the first 24 hours. Then oral analgesic drug start after first operative day. If the patient was uneventfully, they can discharge from hospital within 48 hours after surgery. Recovery time of patient is about 10 to 14 days after surgery.

Benefit Outcome Compare with Open Surgery

In present, many of literature showing benefits outcome of laparoscopic adrenalectomy above conventional open surgery, include decrease blood loss during surgery,

Table 2: Comparison outcome between laparoscopic adrenalectomy and open surgery[20]

	Open group (n = 35)	*Laparoscopic group (n = 5)*	*P value*
Mean operation time (min)	154 (38)	175 (66)	NS
Mean blood loss (mL)	270 (181)	78 (108)	< 0.0001
Mean specimen size (mm)	28 (15)	31 (14)	NS
Postopperative length of hospital stays (days)	26 (17)	12 (6)	0.004
Petients with SIRS (%)	18 (51.4)	11 (31.4)	NS
Mean duration of SIRS (days)	1.9 (1.0)	1.2 (0.4)	0.04
Letest postoperative day SIRS diagnosed	1.9 (2.6)	0.7 (1.3)	NS

Note: NS—not statistically significant; SIRS—systemic inflammatory response syndrome; Data in parentheses are standard deviations, unless otherwise noted.

decrease postoperative pain, shorter length of hospital stay (Table 2). This is causing laparoscopic adrenalectomy become a "gold standard" for surgical management of benign adrenal lesions.[20,21]

CONCLUSION

Laparoscopic adrenalectomy is a safe and effective surgical technique for management for adrenal lesions. This minimally invasive approach is providing benefit over open surgery. Adequate patient selection with meticulous surgical technique is a key to good patient outcome.

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REVIEW ARTICLE

Laparoscopic Ovarian Drilling versus Medical Treatment in Management of Clomiphene Citrate Polycystic Ovarian Syndrome

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Abstract

Polycystic ovarian syndrome (PCOS) has remained an enigma since it was first described as a clinical entity by Stein and Leventhal in 1935. The treatment of this condition has evolved through ovarian wedge resection at laparotomy, induction of ovulation with clomiphene citrate (CC) to laparoscopic ovarian drilling or other chemotherapeutic agents when CC treatment has failed. Evidence shows that laparoscopic ovarian drilling (LOD) reverses all the abnormalities associated with PCOS especially in those with CC treatment failure. The same could be said for these chemotherapeutic agents (metformin, gonadotropin-releasing hormone analogues (GnRHa), or follicle stimulating hormone (FSH) alone or in combination with CC). The seeming comparative advantage of LOD is in its one off therapy, sustained reversal of the pathology, high ovulation and pregnancy rates, cost safety reduced risk of multiple pregnancy and acceptability by patients.

Keywords: Laparoscopic drilling, laser, diathermy, polycystic ovarian syndrome, polycystic ovaries hyperandrogenemia, insulin resistance,

AIMS/OBJECTIVES

The aim of this review is to highlight the efficacy and safety of laparoscopic ovarian drilling in the management of clomiphene resistant polycystic ovarian syndrome. The effectiveness, safety and controversies of laparoscopic ovarian drilling is compared to the different chemotherapeutic agents used in treatments for clomiphene resistant PCOS.

MATERIALS AND METHODS

A literature search was conducted with Google search engine, Highwire press and PubMed. Laparoscopic ovarian drilling, polycystic ovarian syndrome, clomiphene citrate, metformin, GnRHa with polycystic ovaries were entered as search words.

Articles were selected for review from all the citations produced from the search. These were selected based on predetermined criteria as stated below.

1. Year of publication not exceeding 15 years ago.
2. Randomized controlled trials and systematic reviews were favored and other studies of high power addressing the criteria for comparison.
3. Method of patient selection to involve only those with polycystic ovarian syndrome (WHO Type II).
4. Laparoscopic ovarian drilling done for clomiphene resistant polycystic ovaries was compared with any further medical treatment with metformin, CC, FSH or GnRHa.

These articles were reviewed for the following considerations.

1. Technique, operative care and time for laparoscopic ovarian drilling.
2. Operative and postoperative complication/morbidity.
3. Length of hospital stay and time to normal activity.
4. Safety cost and effectiveness.
5. Quality-of-life analysis.

DIAGNOSIS OF PCOS/PATIENT SELECTION FOR LOD

The diagnosis of polycystic ovarian syndrome is by clinical and ancillary investigations revealing the presence of 1) Irregular menstrual cycles and anovulation with onset at puberty. (Note that 25 percent of women who have PCOS have regular menstrual cycles), elevated total and free

testosterone levels (hyperandrogenemia) and the presence of polycystic ovaries as recognized at the ESHRE/ASRM consensus meeting in Rotterdam in 2003. A refined definition of the PCOS also was agreed and this encompasses a description of the morphology of the polycystic ovary. It was agreed that the criteria fulfilling sufficient specificity and sensitivity to define the polycystic ovary (PCO) are the presence of 12 or more follicles measuring 2 to 9 mm in diameter and increased ovarian volume (>10 cm^3). If there is a follicle greater than 10 mm in diameter, the scan should be repeated at a time of ovarian quiescence to calculate volume and area.[1,2] Patients presenting with this description are termed to be clomiphene citrate resistant if they fail to ovulate after 3 to 4 cycles of treatment with CC. Some of these patients are offered LOD while others are offered other chemotherapeutic agents such as gonadotrophins, metformin, GnRHa to overcome the problem of anovulation and infertility in the CC resistant women.[2-5]

EVOLUTION OF LOD

Ovarian wedge resection was the mode of treatment for women with PCOS prior to the '70s when CC was introduced as an ovulation induction agent. Physicians thought that it was the increased ovarian size that resulted in the anovulation and infertility and so wedge resection was considered appropriate. This was a major breakthrough as it resulted in about 80% ovulation and 50% conception rates. However, many of the women later reverted back to the anovulatory state and the development of postoperative pelvic adhesions was thought to be the cause of the low pregnancy rates.[2] With the advent of CC, which had the advantage of cost and low monitoring, and high ovulation and pregnancy rates, a group of women was identified that failed to ovulate with CC. Laparoscopic ovarian drilling was introduced in the '90s as another surgical method of ovulation induction with the aim of minimising the pelvic adhesions caused by open surgery. This has met with certain degree of success with respect to restoring ovulation and fertility with reduction in chances of pelvic adhesion.

OPERATIVE CARE AND TECHNIQUE OF THE LOD

Preoperative Preparation

Patient is screened for medical diseases through the history, physical examinations and ancillary investigations, and usually for infertility if present. Patient will undergo an overnight fast prior to surgery. An indwelling urinary catheter is retained in the bladder in the theater and anesthesia administered.

ANESTHESIA

An intravenous access is secured with maintenance of water and electrolyte balance.

General anesthesia with endotrachial intubation and close monitoring is recommended.

Patient Position

Patient should be in steep Trendelenburg's and Lithotomy position.[5]

Position of Surgical Team

The surgeon stands to the left of the patient with camera man on his right. Monitor should be placed opposite the surgeon to maintain co-axial alignment. One assistant should stand between the patient's legs to do uterine manipulation if required and the instrument trolley should be towards the left leg of the patient with a scrubbed assistant.

Port Positions and Ovarian Drilling

The patient is cleaned, painted with antiseptic lotion and draped. The light cable, insuffilation tube, electrosurgical cautery wires, suction irrigation tube and Veress needle should be checked. Focusing and white balancing of the telescope is done, then pneumoperitoneum is created by Veress needle using the inferior crease of the umbilicus. Once pneumoperitoneum has been created then 10 mm or 5 mm port is introduced into the abdominal cavity through the inferior crease of the umbilicus for a 5 mm or 10 mm telescope. Another 5 mm port is introduced into the abdominal cavity under vision through the left iliac fossae and a diagnostic laparoscopy with chromotubation for tubal patency done. Thereafter, an atraumatic grasper is used to hold the utero-ovarian ligament to stabilize the ovary to perform the ovarian drilling.[2,4] Laparoscopic treatment options include multiple ovarian punch biopsy, ovarian electrocauterization and laser vaporization or photo-coagulation, harmonic scapel.[5,6] About 4 to 5 holes drilled into each ovary is adequate[2-4,7,9] and are relatively easy to perform with the procedure lasting about 30 minutes in experienced hands. These options of drilling into the ovary have similar success rate in inducing ovulation and achieving pregnancy.[8]

Operative and Postoperative Complications

The procedure is devoid of major complications, and yield satisfactory ovulation and conception rates. However, adhesion formation is a potential complication following such procedures.[4,5] Other potential complications include premature ovarian failure in the future.[3] The procedure usually done as a day case and patient need not be admitted. Postoperative pain is relieved with mild analgesics such as paracetamol for 2 to 3 days. Other potential risks is that of anesthesia which is beyond the scope of this review.

Safety and Cost-effectiveness

The procedure does not add to more cost or risk from anesthesia for a patient having diagnostic laparoscopy for evaluation of infertility. Successful pregnancy from treatment with LOD will of course treat the patients infertility fulfilling the desire of the patient. LOD is more effective than or equivalent to metformin, GnRHa, or FSH in resolving anovulation and pregnancy.[3,9-11] Systematic review has shown that there is no difference in ongoing pregnancy, births and miscarriages between LOD and FSH but LOD has reduced risk of multiple pregnancy.[12] FSH and to lower extent CC have the added risk of causing ovarian hyperstimulation syndrome (OHSS),[4] which is a potentially fatal condition. Futhermore, GnRHa is expensive and could cause distressing pseudomenopausal symptoms and which may require add back hormone therapy for the treatment to continue.[4] The cumulative cost of treatment with FSH over LOD was found to be higher in a randomized trials and one systematic review.[13-15] This may be similar with other chemotherapeutic agents that have higher risks of multiple gestation. In a study, the median time to pregnancy after LOD was 135 days and LOD alone resolves infertility within 4 to 6 months in 50 to 60% of couples. The researchers were advocating a strategy of diagnostic laparoscopy and LOD as the first line of treatment of infertility in women with PCOS as this will shorten the time to pregnancy for many women, reduce the need for medical ovulation induction and enable diagnosis of those women with anatomic infertility, who can achieve pregnancy only by *in vitro* fertilization treatment.[16]

There is however, a risk of periovarian adhesions and premature ovarian failure in the future. Studies to determine ovarian reserve and possibility of future premature ovarian failure are few and equivocal. There were statistically significant differences between Day 3 FSH, inhibin B levels, ovarian volume and antral follicle count before and after LOD in some of the reports. Although, the after LOD values were found to be lower than the before LOD values by means of ovarian reserve markers, the after values stayed higher than normal when compared with normal women without PCOS.[17,18] Even though the fear for ovarian reserve and premature ovarian failure is not unfounded with LOD, hormone replacement therapy could be used if need be. Some studies have tried to identify makers for positive response to LOD to include high levels of Luteinizing hormones and androstendione, short period of infertility (< 3 years) and absence of pre-existing tubal disease and advocate their use to identify patients who will respond well to LOD.[19,20]

Quality-of-life Analysis

LOD promotes a better quality-of-life when used in women especially amongst those who have not conceived following treatment. A study on women's health-related quality-of-life (HRQoL) on 168 CC-resistant women with PCOS that were randomly assigned to receive either laparoscopic electrocautery of the ovaries followed by CC or recombinant FSH (rFSH) if anovulation persisted. Overall, HRQoL was not affected in both groups. In women still under treatment, rFSH was slightly more burdensome for women's HRQoL than electrocautery.[21]

Future prospects of LOD:

With increasing evidence that LOD is more effective with less cost, and as techniques to reduce periovarian adhesions improves, more practitioners will begin to consider it ahead of chemotherapeutic agents in treatment of CC-resistant PCOS.

CONCLUSION

LOD has obvious comparative advantages to competitive chemotherapeutic agents. Reduction in overall cost of treatment and risk of multiple gestation implies that it may be the treatment of choice in women with CC-resistant PCOS.

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WJOLS

REVIEW ARTICLE

Management of Spilled Stones during Laparoscopic Cholecystectomy

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Abstract

Laparoscopic cholecystectomy has become the preferred method to treatment for patients with cholelithiasis. Perforation of the gallbladder during laparoscopic cholecystectomy with spillage of stones into abdominal cavity is not uncommon. Although, overall complication rate is less than in open technique, injury of biliary tree and perforation of gallbladder with spillage of stones are more frequent in laparoscopic cholecystectomy.

The fate of spilled bile with gallstone is on a continuous debate. Recent reports have implicated dropped gallstones as a source of infrequent but severe complications of laparoscopic cholecystectomy. For this reason we have done this review regarding different possible outcomes, few suggestions to prevent these and their management.

Keywords: Spilled gallstones, lost gallstones, laparoscopic cholecystectomy, spilt gallstone, gallstone retrieval.

INTRODUCTION

Nowadays, laparoscopic cholecystectomy is considered to be the golden standard for the treatment of symptomatic gallstone disease. Compared to open surgery, all studies show a lower rate of complications. Compared to open cholecystectomy, in LC, there are, however, two more frequent problems: (1) Injury to the common bile duct and (2) Complications from spilled gallstones. The rate of common bile duct injuries in LC has declined over the last 15 years, due to the fact that laparoscopic surgeons have gained more experience; but, unfortunately, the incidence of spilled gallstones has remained unchanged.

During the open cholecystectomy, spillage from the gallbladder cannot migrate from the right upper quadrant, as it is packed off routinely and Morrison's pouch occluded with a laparotomy pad. In LC, stones can become disseminated in abdominal cavity.

The common bile duct injury and bile leakage can be diagnosed soon after operation, but intraperitoneal gallstone spillage can manifest only months to years after the operation, and may have a confusing preservation, that leads to further examinations.

During laparoscopy, bile spillage is still relatively benign; however, the loss of gallstones causes considerable morbidity.

Even though lost gallstones were initially considered to be inoffensive, in the past years, with the shift from open cholecystectomy to LC, numerous reviews have reported a wide variety of complications.

This review aims to categorize these complications through a systematic literature search in order to show the variety of complications and to evaluate the frequency and management of spilled gallstones in LC.

MATERIALS AND METHODS

The search was performed using the following search engines: Google, Springer link and Medline. The search strategy was performed with the below mentioned key words and combinations: "spilled gallstones", "lost gallstones", "laparoscopic cholecystectomy", "spilt gallstone" and "gallstone retrieval".

Out of 412 listed references, titles, abstracts, and full text articles were monitored to accumulate a selection of relevant studies. Afterwards, all reviews and case reports concerning lost gallstones in LC were screened for the reported complications.

The main search criterion was the "management of spilled gallstones", thus all studies that reported the incidence of lost peritoneal gallstones and/or perforated gallbladder were analyzed in this review for the intraoperative and postoperative actions.

OPERATIVE TECHNIQUE

The laparoscopic procedure has been performed by either an attending surgeon or resident under direct staff supervision. The study included both elective and emergency cases. A four-trocar technique with a 30° angled laparoscopic video camera was used. Dissection of the gallbladder was performed using a combination of electrocautery and blunt dissection with fine graspers, and the cystic artery and cystic duct were ligated with titanium clips. The gallbladder was removed through either the umbilical or epigastric port. When perforation of the gallbladder occurred, attempts were made to retrieve all spilled stones, and the peritoneal cavity was irrigated with saline solution to evacuate the spilled bile. Patients typically received one preoperative and one postoperative dose of antibiotic, most commonly a cephalosporin. In patients with acute cholecystitis, especially when the bile culture was positive, broad-spectrum antibiotics were administered for a longer period depending on the clinical situation.

RESULTS

The purpose of the study was to perform a systemic literature search in order to identify the different possible outcomes of the infrequent but severe laparoscopic cholecystectomy complications, the different possible outcomes, few suggestions to prevent these and their management. The most frequent complications that were found published are: intra-abdominal abscesses and abscesses of the abdominal wall, followed by subhepatic and subphrenic abscesses. (Fig. 1).

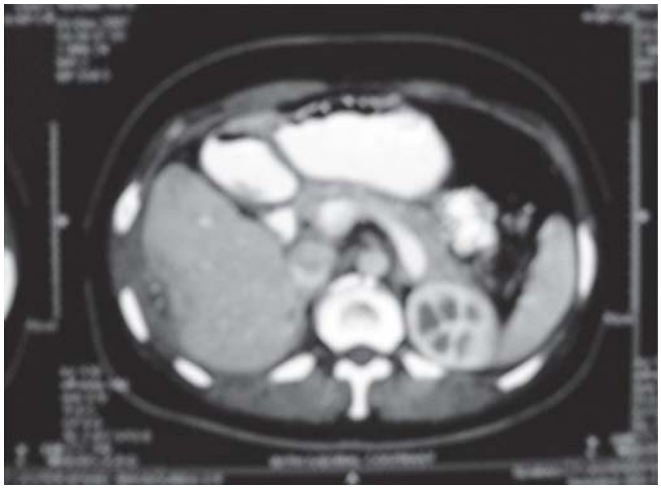

Fig. 1: CT scan which shows intra-abdominal mass representing the gallstones and the surrounding reaction

Other common encountered complication were fistula formation, which occurs across a broad spectrum, ranging from fistulas of the skin or umbilicus to colocutaneous or colovesical fistulas. Due to the fact that complications of lost gallstones in LC are infrequent, occurring in approximately 1,7 per 1000 LCs,[1] diagnosis becomes very difficult, if the complication occurs late. The incidence of lost gallstones in LC may be summarized at approximately 2%, out of 8 studies with more than 500 LCs. From this estimation, we can calculate that 8.5% of these lost gallstones will lead to a complication.

During this systemic search of the literature, several factors that lead to the development of severe septic complications were found. As shown in several studies,[2-7] whether the bile is infected or not, bile and gallstones are at an increased risk for abscess formation and formation of adhesions. The type of stones is one of the factors involved in complication occurence; more experimental studies and reported cases show that the bacterial contamination is less in cholesterol calculi than in pigment stones (black, brown or mixed). The size and number of spilled gallstones is another involved factor. In Brockmann et al[8] systemic review, a total of 91 patients had 555 stones in locations ranging from the abdominal wall to all possible intra-abdominal sites. At the time of reoperation, 40% of these patients were found to have 15 or more stones. Based on these systemic observations, they concluded that the risk factors for complications because of lost gallstones are, as summarized by Woodfield et al,[1] stone size (>1.5 cm), spillage of pigment stones, acute cholecystitis with infected bile, multiple stones (>15 stones), and age. From the published case reports and studies as well as the experimental studies, we can conclude that spilled stones are no indication for laparotomy if the following therapeutic guidelines are followed.

DISCUSSION

A great number of animal experiments have been conducted in order to study the fate of the retained intraperitoneal gallstones.

Using the rat model, Zisman et al[4], performed a study during a follow-up period of one year and he found no systemic deleterious outcome except for minor local effects due to the presence of the implanted gallstones.

They have concluded that there is no systemic illness associated with the presence of gallstones in the peritoneal cavity and the local effects consisted mainly of fibrosis, adhesions, and mild local inflammatory reaction in 83% of

the rats. Seventeen percent of them have not reacted to the presence of the stone at all. These results are in concordance with and also complement Welch et al observation, which showed very little, mild inflammatory reaction, no evidence of infection, and satisfactory clinical outcome in both rabbits retaining gallstones for up to 3 months, and in humans with intraperitoneal gallstones.[9]

Based on the rat model the authors have concluded that a conversion of the laparoscopic procedure to an open laparotomy has no justification only for the purpose of retrieving a lost stone, however, reasonable effort should be made in order to retrieve an escaped gallstone.

Other authors, like Bonar et al[10] reported increased adhesions and inflammatory response due to retained intra-abdominal gallstones, especially when these are associated with infected bile. Chin et al[11] also found numerous adhesion in the rat and inflammatory reactions in dogs with no spontaneous resolution tendency, due to lost gallstones. Johnston et al[2] studied the effects of retained human bile and gallstones in rats. They found that the combination of gallstones and bile (infected or sterile) in the intraperitoneal cavity was associated with significant adhesion formation.

A few studies have specifically examined the potential early and long-term consequences of bile spillage and unretrieved gallstones in the abdomen, however, in humans, the natural history of retained gallstones is not documented. Some reports, like Brueggemeyer et al,[12] demonstrated that spillage of gallstones can cause intraperitoneal abscess. Zamir et al[13] reported similar findings. Antibiotic prophylaxis may decrease the rate of early complications, especially infections, although the late sequelae of retained stones are unaffected. The time between laparoscopy and clinical manifestation has been reported to be as long as 9 years.[15] A recent case report by Walch et al[14] has showed that the spillage of stones during LC occurs in 10% of operations. Late complications associated with this type of surgical procedure include abscesses and fistulas in the abdominal cavity and on the abdominal wall.

Implanting human gallstones in the peritoneal cavity of rats, Hornof et al[3] sustain that only cholesterol stones in association with gram-negative bowel germs cause abscess formations. Other studies sustain that intraperitoneally retained cholesterol gallstones remained inert and are well tolerated in the abdominal cavity except when they are caused by acutely inflamed gallbladder or were crushed (Yerdel et al[5]). Agalar et al[6], using a mouse model, showed that free gallstones within the peritoneal cavity with or without Escherichia coli, sterile bile, or both increased the rate of formation of both abscesses and adhesions. In the same way, Aytekin et al[7] sustains that spilled gallstones and bile cause postoperative adhesions, no matter if the bile is infected or not.

Soper and Dunnegan[16] and Schafer et al[17] have analyzed 10,174 laparoscopic cholecystectomies performed at 82 surgical institutions over a 3-year period. They have discovered that the mortality rate and the incidence of serious complications of retained gallstones are extremely low, thus have advised surgeons against converting laparoscopic cholecystectomy to an open procedure.

The same opinion is shared by Rice and Associates, at the Mayo Clinic, who have studied the long-term consequences of intraoperative bile and gallstones spillage during laparoscopic cholecystectomy. They advised conversion to an open procedure only in patients for whom it is not possible to retrieve the majority of the gallstones laparoscopically, especially when bacteriobilia is suspected or confirmed by Gram stain of the bile. Also they emphasized the need for removal of as many calculi as possible during the laparoscopic procedure. Moreover, they showed that if the inciting gallstones were not removed, the percutaneous drainage of intra-abdominal abscesses was ineffective in most of their patients.[18]

Hussain[19] reported that of seven patients who harbored dropped surgical clips or spilled gallstones, five had no complications; in the other two patients, subphrenic abscesses, empyemas, and a lung abscess can develop. He suggests that stones may remain silent a long-time in the peritoneal cavity but dropped gallstones and clips represent a risk factor for abdominal sepsis. Consequently, during the laparoscopy, every procedure must be made to avoid leaving any surgical clips or dropped gallstones in the peritoneal cavity. Laufer et al recommends that if the gallbladder is accidentally perforated, all efforts must be taken in order to prevent the spread of the bile and calculi and remove the spilled gallstones whenever possible.[20]

Despite the unaffected long-term sequel, any patient with gallbladder perforations and spillage of bile and gallstones should be considered for extension of antibiotic prophylaxis to avoid early complications. Patient records should be properly kept and checked when necessary.

Management of Gallbladder Perforation

The incidence of the gallbladder perforation complications was analyzed and the management discussed in the recent published reviews.[1,8] During laparoscopy, the incidence of

gallbladder perforation is 13 to 40%,[21] with a mean of 18.3% out of those 8 studies with more than 500 LCs. The incidence is higher in acute cholecystitis, the most accurate predictor of rupture being the hydropic gallbladder.[23] On the other side, the reason for gallbladder perforation is mostly correlated with the surgeon's skill and experience.[22] To minimize this complication, proper dissection is required. If a perforation occurs, the use of suction devices to minimize the spilled bile and spilled gallstones as well as the use of an endo-bag is mandatory. If possible, the hole in the gallbladder should be closed by the grasp forceps or by an endoclip or endoloop. The abdominal cavity should be intensively irrigated immediately to reduce the spillage of bile and gallstones.

Management of Spilled Gallstones

Careful removal of as many stones as possible should be performed immediately if gallstones are spilled in the abdominal cavity, either through gallbladder perforation during dissection or extirpation of the gallbladder.[24] After collecting the visible stones, in order to minimize the number of lost gallstones, intense irrigation and suction should be performed carefully, without spreading the gallstones into difficult accessible sites. The use of an intra-abdominal bag and a laparoscopic grasper, a 10 mm suction device, may facilitate the gallstones retrieval.[25]

Most authors do not advise conversion to open surgery. They recommend that in cases of patients with a high probability for lost gallstones or acute cholecystitis with visibly infected bile therapeutic antibiotics should be used in cases of spilled gallstones.

Other studies[1,8] emphasize the importance of documentation and patient information. They advise that in the medical report the surgeon should alert the clinician in the future to the possibility of stones causing any subsequent problems that might lead to earlier diagnosis. Moreover, the medicolegal risk for further prolonged diagnosis may be reduced by informing the patient, in case of late complications occurrence. However, this might also provoke unnecessary repeated examinations.

CONCLUSION

In our opinion, each and every surgical procedure has a potential of unwanted or unexpected outcome. The main purpose for all surgeons is to minimize the physical and psychological discomfort for the patient, and sometimes this implies managing their own complications with minimal harm to the patient. Thus, a complication can be accepted as an unwanted consequence of a surgical procedure. In many institutions, the consequences of spilled stones are virtually never mentioned as a part of the preoperative consent process. In case patients are not informed preoperatively about the possibility of bile and gallstone spillage, they will be surprised and confused if related complications appear.

Even though spilled gallstones have a low Incidence of causing complications, they have a large variety of different postoperative problems. In order to remove the lost gallstones for preventment of further complications, every effort should be made, but conversion is not mandatory. When abscesses due to spilled gallstones occur, open or laparoscopic removal should be preferred to interventional drainage.

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