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Editorial

World Journal of Laparoscopic Surgery is now starting the Robotic surgery section in the content of our forthcoming journal. Robot-assisted surgery was created to beat limitations of conventional laparoscopic surgery. World Association of Laparoscopic Surgeons is organizing 3rd World Congress on the Recent Advances of Minimal Access Surgery on 14th and 15th February 2012.

The 3rd World Congress on the Recent Advances of Minimal Access Surgery is an educational and scientific meeting that focuses on the clinical implications of recent advances of laparoscopic surgery, as well as novel techniques and strategies changing the future of Robotic Surgery. New surgical techniques and promising studies that provide information about how to optimally individualize laparoscopic surgery in every part of world will be discussed, and controversial issues will be debated.

The conference provides a unique opportunity for surgeons, gynecologists, urologists, pediatric surgeons, endocrinologists and other health care professionals to learn from and interact with international leaders in minimal access surgery in order to enhance knowledge, apply new data to practice and ultimately improve patient outcomes.

This World Congress is designed for physicians and surgeons from various specialties, including urology, gynecology, colorectal surgery, bariatric surgery and general surgery, as well as engineers, nurses, medical administrative staff, and surgical technicians who are interested in the minimally invasive techniques of single-port laparoscopy and robotics. Fellows, nurse practitioners, nurses, physician assistants, researchers and other health care professionals interested in the laparoscopic surgery are also invited to attend. This multidisciplinary learning activity concentrates on teaching attendees the skills and techniques needed to perform these surgeries and helping them understand the challenges and benefits involved. Expert lecture sessions and live surgery demonstrations will be held in the morning with optional non-CME hands-on workshops in the afternoon.

"I request all the WALS Members to get united for this International Conference"

RK Mishra
Editor-in-Chief

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ORIGINAL ARTICLE

Role of Laparoscopy in Diagnosis and Management of Nonpalpable Testes

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ABSTRACT

There is still a lot of controversy among urologists with regard to the treatment of nonpalpable (intra-abdominal) testes. This is a prospective randomized comparative study between open and laparoscopic orchidopexy for abdominally located testes. It is an assessment of the usefulness of laparoscopy in the diagnosis and definitive treatment of nonpalpable (abdominally located) testes.

Methods: For a span of 5 years, orchidopexy was performed for 64 patients between the ages of 1 to 15 years (mean age of 4.6 years) with nonpalpable (intra-abdominal) testes. In all, 75 testes were involved in the study during which some had laparoscopic and open Fowler-Stephens orchidopexy while others had laparoscopic orchidectomy.

One stage Fowler-Stephens orchidopexy was performed laparoscopically for 28 testes; 17 had two stage Fowler-Stephens orchidopexy. Laparoscopic orchidectomy was done for five testes. Postoperative follow-up consisted of clinical and color Doppler utrasonography. This was done for all who underwent orchidopexy.

Results: The diagnostic convergence of US and laparoscopy was 16 out of 75 testes (21.3%). Laparoscopically 20 testes were located low intra-abdominally (26.6%), 17 were in the category of high intra-abdominal testes (22.7%). 18 testes had entered the inguinal canal (24%). Four of the patients had associated hernia. Mean follow-up period was 26 months (1 month to 5 years) during which the testes where found in their respective hemiscrotums except for two testes which had atrophied and three which were retracted up the scrotum.

Conclusion: Laparoscopy can provide accurate diagnosis of nonpalpable testes and thereby enabling a simultaneous, comparable definitive treatment.

Keywords: Laparoscopy, Nonpalpable (intra-abdominal) testes, Orchidopexy, Hemiscrotum.

INTRODUCTION

Cryptorchidism (undescended testes), according to independent investigators (Scorer and Farrington, 1971; Berkowitz et al, 1993; Thong et al, 1998) is the most common congenital anomaly found at birth and affects 3% or more of full term male newborns. Approximately 80% of undescended testes are clinically palpable and 20% nonpalpable (intra-abdominal).[1-3] Intra-abdominal testes can be located anywhere between the lower pole of the kidney (cephalad) and caudally, the internal ring. Rarely, they are found in the perihepatic and perisplenic regions. The consequences of cryptorchidism include infertility, neoplasm, testicular torsion, hernia. The aim of surgery is to avert these consequences and give the testes better endocrine function.[4-7] The modalities employed in the diagnosis of cryptorchidism include US, computed tomography, magnetic resonance imaging, angiography among others. Many of these techniques are associated with false-negative and false-positive results.

Diagnostic laparoscopy was first introduced by Cortesi et al[8] and first series in children was described by Scott.[9] The use of laparoscopy for the management of nonpalpable testes was first described by Jordan et al in 1992. It has since proven to be versatile and is used widely now for the purpose of diagnosis and definitive management of undescended testes.[10,11]

PATIENTS AND METHODS

In accordance with our hospital's protocol all patients underwent the following:

(1) History taking; (2) Clinical examination of a relaxed patient in the supine position with warm examining hands. Other common sites for testicular ectopia also inspected; (3) Routine laboratory examinations and (4) Ultrasonography to locate testes. Testes which were not palpable even after attempts to get them down the inguinal canal were considered nonpalpable (intra-abdominal). Laparoscopy was performed for these testes (75) in 64 patients. Based on laparoscopic findings, the testes were categorized according to their location and following definitive management were carried out:

1. One stage laparoscopic Fowler-Stephens orchidopexy. Of the patient who underwent this technique, 20 testes were in lower abdomen and six located at the deep inguinal ring (in all 26). The testicular vessels of 14 testes were dissected free from the peritoneum for an adequate length and in a tension free fashion brought down to the respective hemiscrotums. Twelve testes had to be delivered through a scrotal peritoneal port. All testes were housed in a sub dartus pouch.
2. Two stage Fowler-Stephens orchidopexy. This technique was employed for 17 testes. Second stage was performed 6 months after the first.

3. Open orchidopexy was performed for 8 testes (Figs 1A to 2B).

Laparoscopic orchidectomy was done in two instances of atrophied testes.

RESULTS

Laparoscopy was done for 64 patients with 75 nonpalpable testes. Eleven patients presented with bilateral nonpalpable testes (17.2%) with 41 of the testes on the right and 34 on the left.

Ultrasonography and Laparoscopy Diagnosis Compared

Ultrasound could find only 40 of the 75 testes and the location of 27 of these correctly described. Using laparoscopy, 72 of the 75 testes were found and their locations accurately described and viability determined. The diagnostic convergence of US and laparoscopy was only 16 out of 75 testes (21.3%).

Laparoscopic Categorization and Treatment

Using laparoscopic findings testes were categorized according to location and viability:

Category 1: Testes located in inguinal ring were 18 (24%) with four of them being atrophic.

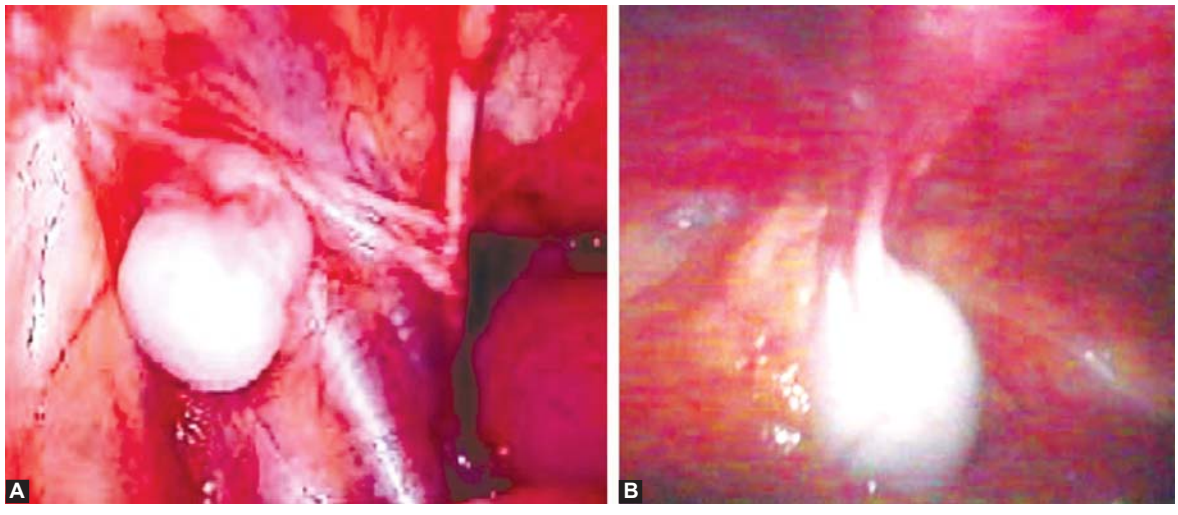
Category 2: Testes located less than 3 cm from inguinal ring (low intra-abdominal) were 20 (26.6%).

Category 3: Testes located more than 3 cm to inguinal ring (high intra-abdominal) were 22 (29.4%) with five of them atrophic.

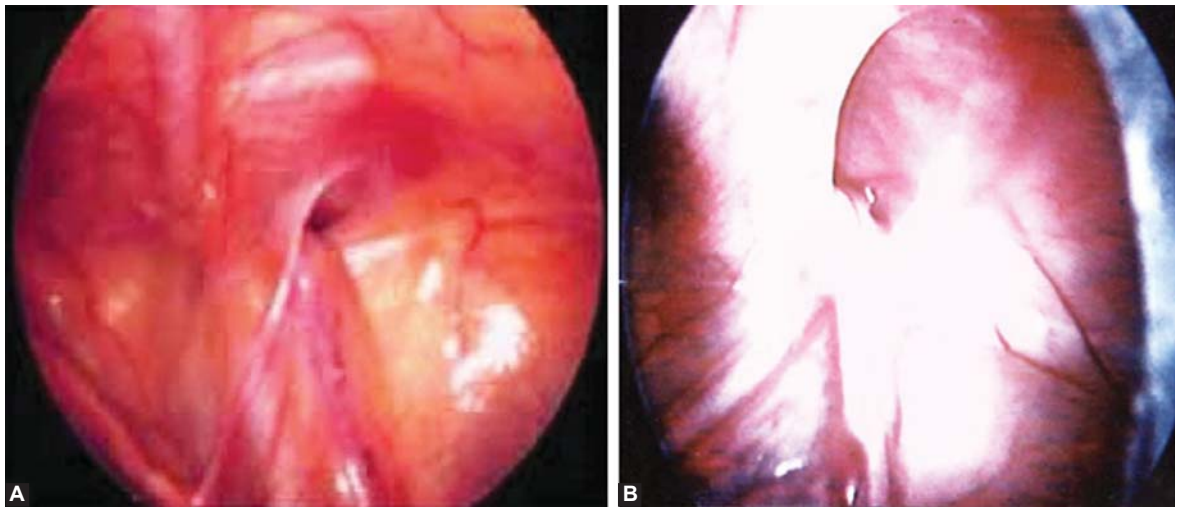
Category 4: Testicular vessel and vas seen ending blindly (vanishing testes). These were 12.

Category 5: Three testes were not seen, 26 testes in category 1 and 2 were subjected to laparoscopic one stage Fowler-Stephens orchidopexy, eight had open orchidopexy and the four atrophied testes were excised.

In category 3, 17 testes had two stage Fowler-Stephens procedure while laparoscopic orchidectomy was done for five. Associated hernias which were four in number, were repaired simultaneously.



Figs 1A and B: Mobilization of intra-abdominal testes



Figs 2A and B: Undescended testes with deep ring and triangle of doom anatomy

Hospital Stay

Basically, this was a day procedure and patients were discharged home except for 10 (15.6%) who stayed overnight and six (9.4%) stayed for 48 hours.

Follow-up

For a period of 6 months to 5 years patients had follow-up during which each patient who underwent orchidopexy had clinical examination and Doppler ultrasound scan. All testes which underwent one stage laparoscopic orchidopexy were located in their respective hemiscrotums and are of good size with Doppler confirming their viability. Two were, however, retracted high up the scrotum. Only two of the testes which had orchidopexy by a two stage Fowler-Stephens procedure were found atrophic. The rest were normally placed in the scrotum.

DISCUSSION

Since the first reported case of laparoscopy in the diagnosis and management of nonpalpable testes was reported over 25 years ago, there are thousands of documented cases now showing the impact of laparoscopy in the management of nonpalpable (intra-abdominal) testes. The principles of surgery has been enhanced as exposure, lighting and magnification, which are crucial to the success of pediatric procedures, are achieved. Besides accurate assessment of testicular position in the abdominal cavity as well as their viability, which are essential to good surgical outcomes, are taken care of.[12,13] Moore et al and Tennenbaum et al in 1994, reported the accuracy of testicular localization by laparoscopy to be greater than 95%. Radiographic imaging studies according to Hrebinko and Bellinger (1993) and Siemer et al (2000) carry unacceptable false-negative and false-positive rates and are more invasive.[14,15] Some authors even report that abdominopelvic ultrasonography rarely locates intra-abdominal testes and in only 18% cases correctly identifies testes located in the inguinal canal. Bakr and Kotb (1998) found that magnetic resonance imaging detected only 37% of cases.

Laparoscopic management of nonpalpable testes has gained considerable acceptance since it was first described by Jordan et al in 1992. Chang et al (2001) reported 85% success rate for one stage or two stage Fowler-Stephens procedure with 4% failure rate. This technique is now being used in many centers. Potential major complications include vascular injury, bowel injury and bladder perforation. Fortunately with an open Hasson technique of trocar placements these complications are rare. Other minor complications, such as hematoma, subcutaneous insufflations do not require conversion to open technique.

In our series, laparoscopy was used as a tool for diagnosis and definitive management of nonpalpable (intra-abdominal) testes in 64 patients over a period of 5 years (2003-2008). Laparoscopic Fowler-Stephens orchidopexy was performed for 43 testes (57.4%) and eight (10.6%) by open orchidopexy.

We describe testes as vanishing if the vas and vessels end blindly either in the abdomen or close to the internal ring. These are not considered as absent testes. Approximately 36 to 64% of children with nonpalpable would actually be monorchid. In our series three testes were not seen. To have accurate intraoperative assessment of the viability of the testes it is suggested that in future intraoperative Doppler scan of the testes could be done. We believe this, combined with improved technique good patient selection (appropriate age for orchidopexy should be between 6 to 12 months) would give better outcomes.

CONCLUSION

Laparoscopy has proven to be an effective and accurate method of diagnosis of nonpalpable (intra-abdominal) testes as it enables accurate determination of anatomical localization as well as viability. It is also comparatively an effective tool for definitive management of nonpalpable testes in which case the simultaneous surgical correction of the anomaly makes it more acceptable. This minimal access technique makes open exploration of the abdomen difficult-to-find testes unnecessary.

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REVIEW ARTICLE

Laparoscopic Splenectomy using a Single Incision Access

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ABSTRACT

Conventional laparoscopic splenectomy is now considered standard in splenectomy. The superior cosmetic result of single incision laparoscopic surgery (SILS) has seen an increasing interest in all areas of surgery, including splenectomy. Literature search was done, and 26 cases reported in literature were reviewed. Age of the patient, position, access technique, duration of surgery, intraoperative complications, postoperative hospital stay, cosmetic and patient/parents satisfaction were noted. Age range was from 7 months to 73 years with satisfactory outcome.

Conclusion: Single incision splenectomy can be performed safely in patients of all ages. Immediate indicators show superior cosmetic outcome compared to conventional laparoscopic splenectomy, however, bigger series with long-term follow-up are required.

Keywords: Laparoscopy, Single incision, Splenectomy.

INTRODUCTION

The spleen forms part of the reticuloendothelial system of the human body (Fig. 1). It is located in the posterolateral aspect of the left hypochondrial area of the abdominal cavity closely related to the stomach, tail of pancreas, splenic flexure of the colon and the diaphragm in the posterosuperiorly[1] (Fig. 2).

Diseases of the spleen and trauma may lead to the need for the removal of the spleen which warrants a surgical procedure.

Common indications for splenectomy include: Hematologic diseases, such as hereditary spherocytosis, thalassemia major, idiopathic thrombocytopenic purpura (ITP), thrombotic thrombocytopenia and unresponsive hairy cell leukemia. Hodgkin's disease staging for malignancies and iatrogenic (intraoperative) splenic trauma.[1,2]

Surgery of the spleen traditionally was by open method, which required a big incision in the abdominal wall, followed by long hospital stay and subsequent disfiguring scar. The developments in minimal access surgery, which started in the late 80s and early 1990s, have led to laparoscopic splenectomy as a standard operation for small and medium size spleen and hand-assisted laparoscopic surgery (HALS) for big spleens in selected patients.[1,4] In standard laparoscopic splenectomy,[4,5] access ports are used, whereas in HALS, an additional minilap incision which is fitted with a special devise (LapDisc /Omniport) is used to allow a nondominant hand to be passed without loss of pneumoperitoneum.

The benefits of laproscopic over open surgery included shorter hospital stay, less wound pain, quick return to work, less tissue trauma and related wound complications and better cosmetic results.[2-4] Of recent single incision laparoscopic surgery (SILS) (Fig. 3) also known as single port access (SPA), single port surgery (SPS), laparoendoscopic single site (LESS), single port incisionless conventional equipment-utilizing surgery (SPICE), natural orifice transumbilical surgery (NOTUS), embryonic natural orifice transumbilical endoscopic surgery (E-NOTES), one port umbilical surgery (OPUS), has gained popularity among laparoscopic surgeons. In this technique, a

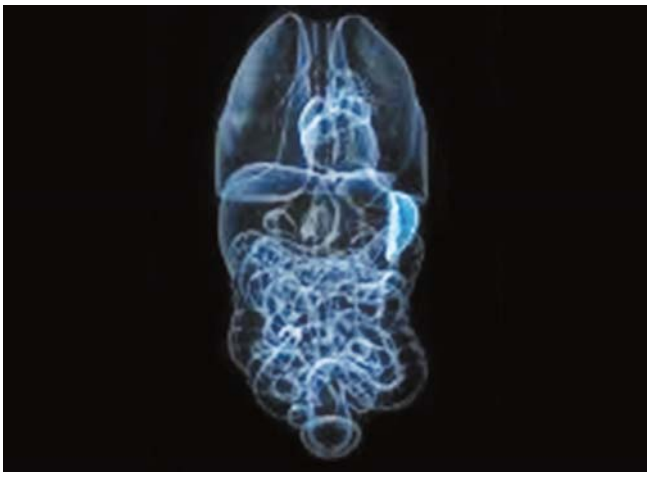

Fig. 1: Anatomy of spleen

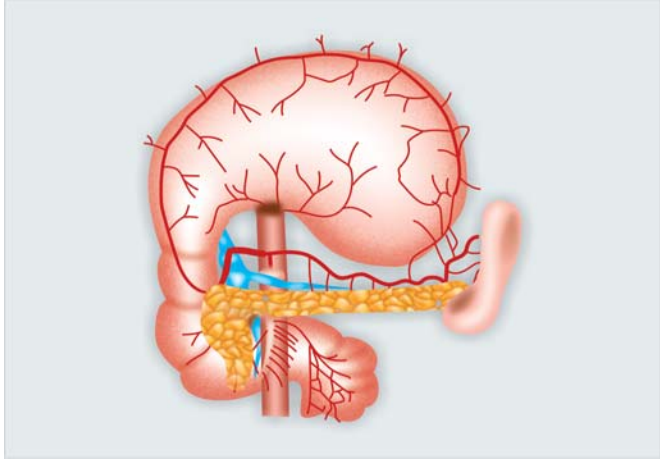

Fig. 2: Important vasculatures around spleen

special port is used in a single small open incision of about 2 to 3 cm through umbilicus and all instruments passed through it for performing an intra-abdominal operation (Fig. 4). However, the anatomical position of the spleen coupled by the limited and compromised ergonomics theoretically poses some challenges to the operating surgeon as the instruments are more delicate and manipulation angle small.[1,5]

This study is aimed at reviewing the experience of SILS in performing splenectomy and its outcome.

AIMS AND OBJECTIVES

To review cases of single incision/single port splenectomy reported in the literature and analyze the outcome and complications. Specific objectives were to look at the access technique, duration of surgery, intraoperative complications, conversion rate, postoperative pain, postoperative hospital stay, cosmetic outcome and patient/parents acceptability.

MATERIALS AND METHODS

Literature search was done using Google, HighWire Press, Medscape, SAGES website and Hinari. All papers in which splenectomy was done using single incision were found and included in the review. Other papers that had relevant literature to help in the review, such as series of comparative study between open and conventional laparoscopy, were also reviewed. Parameters of particular concern are:

Position of the patient, abdominal access technique, intra-operative complication, time of surgery, weight of the spleen, conversion, postoperative pain, duration of hospital stay and patient satisfaction.

RESULTS

A total of nine articles were found that were specific for single incision splenectomy, most were case reports and one small series of eight patients (Table 1). There was one series of 20 patients in a review of experience with single incision splenectomy in which six patients had splenectomy. In this review, total of 26 patients underwent splenectomy. Age of patients ranged from 7 months[16] to 73 years.[7] There were three conversions (11.56%), time of surgery ranged from 64 to 195 minutes (average of 129.5 minutes), 22 patients had access

Fig. 3: One of the ports (SILS) used for single incision laparoscopic surgery

Fig. 4: SILS port applied in the abdominal wall

Table 1: Single incision splenectomy cases

Author	*Year*	*No. of patients*	*Age range*	*Access*	*Duration of surgery (mins)*	*Intraoperative complication*	*Blood loss*	*Conversion*	*Spleen weight*	*Hospital stay (days)*
Rottaman S	2004	1	36	Umbilicus	NR	–	NR	NO	NR	–
Mallardi P	2009	1	24	LUQ	130	–	NR	NO	NR	–
Barbaros U	2009	2	25	Umbilicus	110,150 (130)	–	NR	NO	NR	2.5
Erica R	2009	2	–	Umbilicus	190	Adherent pancreatic mass	NR	1	NR	2
Dutta S	2010	6	8	Umbilicus	90	–	NR	NO	NR	2.5
Targoma EM	2010	8	26-73	Umbilicus	60-170 (97)	–		2	340-590 gm	2.5
Hansen N	2010	1	5	Umbilicus	84	–	Minimal	NO	NR	2
You YK	2010	3	38	ULQ	125-195 (151)	Gastric perforation	NR	NO	NR	NR
Srinkanth G	2011	1	20	Umbilicus	130	–	NR	NO	NR	2
Joshi Manishi	2011	1	7 months	Umbilicus	–	–	NR	NO	NR	4

through the umbilicus and four through the left quadrant along the anterior axillary line at the level of the umbilicus. Time of hospital stay was 2 to 5 days (average 3.5 days), weight of the spleen was reported only in one study of eight patients and ranged from 340 to 590 gm (average 485 gm).[7] One intraoperative complication in which iatrogenic gastric perforation was reported but was managed laparoscopically.[9] All reported good cosmetic outcome and patient/parents satisfaction.

DISCUSSION

Laparoscopic splenectomy (LS) is now considered a gold standard in splenectomy due to its superior benefits to the patient, namely small incision, minimal postoperative pain, short hospital stay, quick return to work, less infection rates and superior cosmetic outcome when compared to open splenectomy.[2,5,6] The search for better cosmetic outcome has seen single incision laparoscopic surgery (SILS) gaining ground in many areas of surgery, including splenectomy. In SILS splenectomy, the patient is placed in supine semi left lateral position and the surgeon stands on the right side of the patient. Access port generally recommended at 5 cm lateral at the level of the umbilicus, however, this should take into consideration the size of the patient and the spleen, and should follow the base ball diamond concept for maximum task performance.[1,4]

There is no randomized comparative study reported to date comparing conventional 4 to 5 port laparoscopic splenectomy (LS) to single incision laparoscopic (SILS) splenectomy. In this review, 26 patients that were reported, they were mainly case reports and small series of eight and 20 patients.[7,8] The left lateral position was used by all surgeons, although in three cases, a change to supine position had to be adopted during conversion.[7,9] The umbilicus was used for access by eight surgeons while two surgeons preferred left quadrant lateral to the umbilicus as this provided better visualization of the upper dorsal area especially in big spleens.[9,18] I did not come across an agreed standard mode of reporting specifically laparoscopic splenectomy complication both intraoperative and post-operative. Using classification that was recommended for surgical operations by Clavien (Clavien Classification of Surgical Complication, 1992) and modified 2004,[10,11] most of the reported complications in this review fall in grade I and only one patient was grade IIA as he required postoperative transfusion[10,11] (Tables 2 and 3). The conversion rates depend on among other factors, the experience and level of confidence of the surgeon. In this review, the conversion rate was 11.5 (3 patients). In a comparison study between open (OS) and conventional laparoscopic splenectomy (LS), in which 25 patients had LS and 27 had OS, Maurus et al found almost a similar conversion

Table 2: Clavien classification of surgical complications

Grades	*Complication*
I	Alteration from the ideal postoperative course, non-life-threatening, no long lasting disability. Do not prolong hospital stay
II	Potentially life-threatening but without residual disability or requiring hospitalization more than twice the median stay for the procedure a. Only medical and noninvasive intervention b. Require invasive intervention
III	Life-threatening with residual disability, e.g. organ resection or persistence of life-threatening condition
IV	Death of a patient

Table 3: Modified Clavien classification of surgical complications

Grades	*Description of complication*
I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions Allowed therapeutic regimens are: Drugs as antiemetics, analgesics, antipyretics electrolytes and physiotherapy. Includes wound infection open at bed side
II	Requiring pharmacological treatment with drugs other than those allowed for grade I complications. Blood transfusion and total parenteral nutrition (TPN) included
III	Requiring surgical, endoscopic or radiological intervention a. Intervention not under general anesthesia b. Intervention under general anesthesia
IV	Life-threatening (including CNS), requiring IC/ICU management a. Single organ dysfunction (including dialysis) b. Multiorgan dysfunction
V	Death of a patient
Suffix "d"	If patient suffers from a complication at the time of discharge suffix "d" (for disability) is added to the respective grade of complication

of 8% (2 patients).[12] The duration of surgery ranged from 60 to 195 minutes which does not differ from what was found in two comparison studies by Maurus and Cogliandolo in LS.[4,5,12] Some of the reasons that contributed to long operating time included inexperience of the surgeon, need to do combined procedure and iatrogenic gastric injury that was managed endoscopicaly.[8,9] Exposure is one of the challenges in SILS splenectomy, Srinkanth found that using a suture on the stomach helped to retract the stomach away and improve exposure of the splenic hillum.[15] Short hospital stay is one of the advantages of laparoscopic procedures over open, in this review the median stay was 2.5 days which compares well with conventional LS.[4,5,12] There was no good way of reporting pain, most surgeons reported moderate postoperative pain, Barbaros and Hansen reported postoperative pain of 2/10.[13,14] Spleen retrieval was done by putting the spleen into an endo bag and morcellating with forceps except when the spleen was required for histopathology whereby an incision was extended to remove it in block.[17,19] This predisposes the port site for possible future hernia as seen in the study of Erica in a 24 months follow-up of patient who underwent SILS surgery.[19] Patient satisfaction with the cosmetic outcome at discharge and in the immediate postoperative period was reported to be very satisfactory by all.

CONCLUSION

Single incision laparoscopic splenectomy is gaining popularity, the review indicates it is a feasible procedure that can safely be done in patients of all ages with low morbidity and clear superior cosmetic outcome, at least in the immediate postoperative period. Additional exposure of the hillum of the spleen can be obtained by use of percutaneous suture to hold the stomach. The operating time is expected to continue to drop as surgeons get more confidence and used to the new and delicate instruments meant to compensate for the compromised ergonomics. The standard way of reporting on laparoscopic complication is lacking, the advantages of single incision splenectomy over LS need a well-balanced prospective cohort study with long term follow-up, before firm conclusions can be drawn.

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REVIEW ARTICLE

Does Timing of Laparoscopic Bile Duct Injury Repair affect Long-term Outcome?

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ABSTRACT

Objective: This article will review the controversies and prevailing views that deal with the vexing questions of "what is the optimal time of repair" that delivers the best long-term outcome following laparoscopic surgery injury of bile duct system.

Materials and methods: Literature review conducted using Google search engine and HighWire press, using keywords, like bile duct injuries, timing of repair, outcome and laparoscopic cholecystectomy.

Results: The reported incidence of bile duct injury after laparoscopic cholecystectomy varies widely due to the inclusion or exclusion of minor or self-limited events, such as bile leak from intrahepatic radicles or leak from a cystic stump. Once a major bile duct injury occurs, early recognition is paramount to minimize morbidity and potential mortality. Once recognized, appropriate measures are instituted to address the damage. However, controversy surrounds as to the optimal time for repair of the injury. The literature gives conflicting assessment and interpretation of when such injuries should be repaired. Patients cared for in facilities that lack the expertise to perform immediate repair may inherently end up at a tertiary referral center in a delayed manner. Some recognized institutions and individual surgeons with the expertise and resources to perform immediate repair opt for repair without delay claiming good outcomes while others delay the repair to intermediate and late repairs with claims of equally good outcomes reported.

Conclusion: While immediate recognition of any injury is mandatory for improved patient outcome, the timing of repair remains controversial with convincing arguments on both sides of the issue. However, there seems to be more evidence to support either immediate repair in experienced hands or delayed repair beyond six weeks. Intermediate repair (within 3 to 14 days) is more likely to lead to failures and long-term complications.

Keywords: CBD Injury, Common bile duct, Laparoscopic bile duct injury.

INTRODUCTION

Laparoscopic cholecystectomy (LC) has now been universally accepted as the gold standard for symptomatic cholelithiasis. However, the incidence of bile duct injury is higher compared to open cholecystectomy (0.1-0.2% for open and 0.4-0.7%) for LC.[1-3] These iatrogenic bile duct injuries can have outcomes ranging from minor perioperative morbidity to catastrophic outcomes with reduced long-term survival, poor quality of life and even death.

There is limited data that addresses the issue of quality of life after repair of a major bile duct injury. Boerma et al from the Netherlands studied 106 patients who had sustained a variety of biliary injuries, ranging from cystic duct leaks to major transaction, 31 of whom were treated surgically and the remaining by non-surgical interventions. Despite an overall excellent clinical outcome in the series, quality of life was found to be reduced in both the physical and psychological aspects (Boerma D, Rauws EAJ, Keulemans YLA, et al. Impaired quality of life 5 years after bile duct injury during the laparoscopic cholecystectomy: A prospective analysis. Ann Surg 2001;234:750-57).

Management of biliary ductal injuries depends on timely recognition of the injury, the extent and type of the injury, the patient's co-morbid status and the availability of an experienced surgeon.

Immediate detection and repair leads to an improved outcome with the goal of repair being the restoration of a durable functional conduit, prevention of fistula, abscess, stricture, cholangitis and secondary biliary cirrhosis.

DISCUSSION

Bile duct injury (BDI) following LC has been proposed as the most serious and important cause of morbidity.[4,5]

Although the reported incidence is around 0.7%, the true incidence is unknown. It is believed that at least half of all practicing general surgeons will encounter one or more bile duct injuries in their life time.

Cuschieri[6] identified improper anatomic identification as one of the major causes of BDI and Jin-Shu Wu[7] came to the same conclusion by reporting on a large series of patients with CBD injury, 60% of which were identified to have had poor identification of proper anatomy. The remaining causes were related to anatomic variation, poor control of intraoperative bleeding, and blind confidence in some. One study demonstrated that in more than one-third of all bile duct injuries, the basic cause of error is not the inexperience of the surgeon but the use of an improper approach to the fundamental structures of the extra-hepatic biliary tree because of a visual perceptual illusion (Br J Surg 1996;83:1356-60).

Arezou Yaghoubian made indirect reference to surgeon fatigue as a source of increased duct injuries by studying injury rate at a major US teaching hospital before and after reduction of resident work hours. In this study, injury and complication

rates were significantly reduced after implementation of the 80-hour work rule for residents. One could extrapolate and recommend LC surgery cases be scheduled at the beginning of the day when the surgeon and his team are fresh.

Fletcher[8] advocated routine use of operative cholangiography to minimize and identify duct injuries though the true value of this approach has been inconsistent. 15 to 30% of the injuries are detected during the initial surgical procedure. Most injuries diagnosed on the OR table are treated immediately, often by conversion to open. Selected patients or those with failed repairs are referred to specialized centers. For patients not diagnosed on the table, the presenting symptoms may vary widely and are frequently not in accordance with the severity of the injury or extent of the intra-abdominal fluid/bile collection.

Krige places an emphasis on the presence or absence of sepsis in determining early or late repair.[9] Sahajpal examined factors influencing outcomes of repair in a large retrospective study of LC associated BDIs and concluded that repairs in the intermediate period after injury (72 hours) were associated with increased incidence of strictures compared to the immediate and delayed (more than 6 weeks) repairs.[10]

Kappor reported poor outcome (stricture) in patients who underwent early repair.[11]

Gouma stresses that when the local anatomy is unclear, further exploration should be avoided to minimize proximal extension of the lesion and damage to blood supply that could have an adverse effect on future reconstruction. If the diagnosis is made late, these patients should be stented and/or drained and return for repair 6 to 8 weeks later.[12]

Walsh retrospectively reviewed 144 repairs of BDIs using the Bismuth-Strasberg stratification and found that the level of injury was predictive of postoperative stricture. At a mean follow-up of 67 months, more strictures developed in the cases repaired after 7 days of injury (19%) *vs* 8% in the delayed repair five patients developed.[13]

Whether repair is performed early or late, operative technique focuses on the site of proximal BDI and conducts the repair according to the type or classification of BDI. Jin-Shu[7] advocates the proximal duct should have at least an 8 mm diameter before duct repair can be contemplated. He does not consider chills, fever or jaundice as contraindication to repair but abscess in the vicinity of the injury is a contraindication.

There are various classifications of BDI, including the Corlette-Bismuth, Wu, McMahon and Strasberg classification. Each has its own merit and can guide a surgeon to select the best appropriate repair for each injury.

Corlette-Bismuth classification:

- *Type 1*—low common hepatic duct stricture, with a length of the common hepatic duct stump of > 2 cm
- *Type 2*—middle stricture, length of common hepatic duct < 2 cm
- *Type 3*—hilar stricture, no remaining common hepatic duct, but the confluence is preserved
- *Type 4*—hilar stricture, with involvement of confluence and loss of communication between right and left hepatic duct
- *Type 5*—combined common hepatic and aberrant right hepatic duct injury, separating from the distal common bile duct.

Strasberg classification:

- *Type A*—bile leak from cystic duct or liver bed without further injury
- *Type B*—partial occlusion of the biliary tree, most frequently of an aberrant right hepatic duct
- *Type C*—bile leak from duct (aberrant right hepatic duct) that is not communicating with the common bile duct
- *Type D*—lateral injury of biliary system, without loss of continuity
- *Type E*—circumferential injury of biliary tree with loss of continuity.

Results from various centers and individual authors have reported excellent short-term results after surgical repair and long-term follow-up with good functional outcome in more than 90%.[14,15] However, the definition of long-term follow-up is not standardized. Many of these patients demonstrated good outcome on initial follow-up only to show up years later with delayed complications, which at a different center is not well studied.

CONCLUSION

Though the often quoted 0.5 to 0.7% incidence of bile duct injury, incidence of laparoscopic cholecystectomy may seem unalarming, when considered in light of the voluminous LC that is performed worldwide, the number of patients with short and long-term adverse consequences of this injury are immense. Unfortunately, there are no prospective, controlled, randomized trials to guide the surgeon on the issue of whether early repair is better than a late one. Based on experiences reported by various authors, deciding when to repair should be individualized depending on the physiologic status of the patient, presence or absence of co-morbid conditions, experience of the surgeon and the type of injury. When in doubt, it seems prudent to minimize further damage by draining and waiting for the inflammatory process to resolve before attempts at repair. Immediate repair in the right hands is better than intermediate repair (in 3 to 14 days), and delayed repair in 6 to 8 weeks is probably the most appropriate course to follow.

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REVIEW ARTICLE

Immunological Response of Postcholecystectomy: Single Incision Laparoscopic Surgery (SILS) *vs* Natural Orifice Transluminal Endoscopic Surgery (NOTES)

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ABSTRACT

Introduction: Surgery evokes complex metabolic, neuroendocrine and immunological responses. These are reparatory but when exaggerated may cause immunosuppression with morbidity and mortality. It is well-known that these responses are attenuated in laparoscopic cholecystectomy, which is the gold standard for treatment of cholelithiasis. Current novel minimal access techniques of natural orifice transluminal endoscopic surgery (NOTES) and single incision laparoscopic surgery (SILS) consolidate on the gains of better cosmesis, reduced postoperative pain and rapid recovery; however, they are yet to be fully evaluated in terms of comparative advantage on immunological basis.

Aims: This study aims to compare the immunological changes following the techniques of NOTES and SILS in cholecystectomy with a view to ascribe relative advantage.

Methods: Literature review of immunological changes following NOTES and SILS from Medline, Cochrane Database, Google and SpringerLink. Cross references from list of major articles on subject were read with other relevant journals from a laparoscopic research institute library.

Results: Pneumoperitoneum affects the local peritoneal immune environment resulting in alterations in cytokine production and phagocytic function. Interleukin-1 (IL-1), tumor necrosis factor and particularly IL-6 are potent systemic mediators of the immune and acute phase response following surgery. Various animal model studies have shown that NOTES and SILS evoke similar levels of inflammatory cytokine profiles but for a late-phase tissue necrosis factor-alpha (TNF-alpha) depression with NOTES.

Conclusion: Minimal access techniques of cholecystectomy have reduced immune response compared to open surgery. There is limited immunological data available comparing NOTES and SILS postcholecystectomy. Large randomized studies are needed to ascribe immunological advantage between these two techniques of cholecystectomy.

Keywords: Single incision laparoscopic cholecystectomy, NOTES, Immune response.

INTRODUCTION

Surgery evokes complex metabolic, neuroendocrine and immunological responses. These are reparatory but when exaggerated may cause immunosuppression with morbidity and mortality. It is well-known that these responses are attenuated in laparoscopic surgery. Cholelithiasis is a major cause of morbidity in the Western world with 500,000 and 21,000 cholecystectomies performed annually in the USA and Netherland respectively.[1,2] Open cholecystectomy was popularized by Carl Langenbuch in the nineteenth century.[3] This practice has undergone a paradigm shift in the last two decades heralded by the efforts of Eric Muhe and Phillipe Mouret in 1985 and 1987 respectively, by performing laparoscopic cholecystectomy.[4,5] Laparoscopic cholecystectomy is widely accepted and presently the gold standard for the treatment of cholelithiasis. Conventionally, this procedure is carried out through four ports but more recently through a single incision (SILS). Rapid advances in technology have led to a novel technique of gallbladder removal through a transluminal endoscopic device. The first description of natural orifice transluminal endoscopic surgery (NOTES) is credited to Kallo et al.[6] This has evoked much enthusiasm with the prospect of consolidating on the gains of cosmesis, reduced postoperative pain and rapid recovery. The need to compare the various aspects of both techniques thus exists.

AIMS

This study is designed to compare the immunological responses following the techniques of NOTES and SILS in cholecystectomy with a view to ascribe relative advantage.

MATERIALS AND METHODS

Literature search was conducted using Medline, Cochrane database, Google and SpringerLink. Search words were "NOTES surgery", "single incision laparoscopic cholecystectomy" and "immune response". A selection criterion for further reading was literature written in English language. Cross references,

from list of major articles on this subject and relevant journals from Laparoscopic Research Institute, India, were read.

RESULTS

Pneumoperitoneum affects the local peritoneal immune environment resulting in alterations in cytokine production and phagocytic function. Interleukin-1 (IL-1), tumor necrosis factor (TNF) and particularly interleukin-6 (IL-6) are potent systemic mediators of acute phase response following surgery, thus, are useful parameters for studying immune response following these advanced methods of cholecystectomy. Various animal model studies have shown that NOTES and laparoscopy evoke similar levels of inflammatory cytokine profiles.[7-9] There is insufficient immunological data comparing SILS and NOTES post-cholecystectomy in human studies.

OVERVIEW OF IMMUNE RESPONSE

Immunity is the body's defense system against foreign bodies and is either innate or acquired (adapted). The acquired mechanism is highly specific for a stimulus, improving on successive exposure; however, the innate mechanism is non-specific for the antigen with no protective memory. Immune responses are generated by cellular or noncellular (humoral) mechanisms. Studies of immune response previously conducted involved peripheral blood, cytokines, C-reactive protein, histamine response and other useful parameters, including leukocyte and function, macrophage activation and delayed-type hypersensitivity.[10]

Systemic Immune Response

Immune response following surgery is a complex process that follows a specific pattern and has been defined based on clinical and laboratory observations. A proinflammatory immune response mediated primarily by the cells of the innate immune system is followed by a compensatory anti-inflammatory or immunosuppressive phenotype that is mediated primarily by cells of the adaptive immune system with host predisposition to septic complications.[11] Immune dysfunction induced by surgical trauma may comprise either an inappropriately exaggerated inflammatory response or a profound suppression of cell-mediated immunity. However, careful surgical technique by the use of a minimally invasive approach, adequate fluid replacement, and antibiotic therapy attenuate these responses. Notable mediators of immune response studies are cytokines. These are glycosylated and nonglycosylated polypeptides that act as soluble immune messengers. They are of two types—proinflammatory and anti-inflammatory. Proinflammatory cytokines include tumor necrosis factor-alpha (TNF-α), interleukin-1-beta (IL-1β), interleukin-6 (IL-6), interleukin-8 (IL-8) and interferon-γ (IFN-γ). The anti-inflammatory cytokines are interleukin-10 (IL-10), IL-1 receptor antagonist (IL-1 RA), and soluble TNF binding proteins 1 and 2 (TNF-BP1 and TNF-BP 2). The major mediators of the acute-phase response are known to be interleukin-1 (IL-1), tumor necrosis factor (TNF) and interleukin-6 (IL-6).[12] The tumor necrosis factor (TNF) and IL-1 are responsible for nonhepatic acute-phase response, including fever and tachycardia, while interleukin-6 primarily regulates the hepatic component resulting in the production of acute-phase proteins. It is suggested IL-6 also influences polymorphonuclear leukocyte-mediated inflammation via its role in stimulating the proliferation of polymorphonuclear leukocyte progenitors in the bone marrow.[13] High levels of IL-6 have been associated with an increased severity of tissue trauma. Studies demonstrate that it affects the production of prostaglandin E, a strong immunosuppressant which induces the chemotaxis response of the lymphocytes and macrophages at the damage site.[14,15] The other acute-phase proteins include C-reactive protein, complement factor 3, haptoglobin and serum amyloid A.

Postconventional cholecystectomy, a transient rise in pro-inflammatory cytokines, has been noted unlike in laparoscopic surgery which is characterized by a decreased acute-phase pro-inflammatory response of TNF-α, IL-1, C-reactive protein levels and IL-6.[16,17] A case study showed a late-phase tissue necrosis factor-alpha (TNF-alpha) depression with NOTES.[10] Extensive studies, both in animals and humans, have demonstrated better preservation of the immune system in minimal access laparoscopic procedures with attenuation of the fall in lymphocyte count, abrogating the decrease of monocytic HLA-DR antigen expression associated with major surgical trauma.[19] Minimally invasive approaches restore the decreased IL-2, IFN-γ, and TNF-α production by T-cells observed with open surgery.[20]

LOCAL PERITONEAL CHANGES FROM PNEUMOPERITONEUM

The prerequisite establishment and maintenance of pneumoperitoneum for minimal access cholecystectomy alters the interior milieu. Local peritoneal changes are dependent on the gas used, its pressure, duration of insufflation and temperature. These changes may be beneficial and adverse in effect. Carbon dioxide with the advantage of rapid absorption is the most common agent used for establishing and maintaining pneumoperitoneum in minimal access cholecystectomy. In an aqueous medium, carbonic acid is formed and a drop in pH after the induction of CO_2, pneumoperitoneum affects the biochemical and cellular immune function inherent to the peritoneal cavity.[21] Morphological changes to the peritoneal endothelium may result in denudation, migration of PMN leukocytes, mast cells and macrophages. The degranulation of mast cells effect an increase in vascular permeability with supply of complement factors and opsins. Activated leukocytes and macrophages release notably, TNF-α, IL-1 and IL-6. Carbon dioxide has been shown to decrease peritoneal macrophage

release of basal TNF-α. This significant reversible inhibition of TNF and IL-1 demonstrated in macrophages incubated in carbon dioxide are not seen with helium or air.[22]

Most studies on NOTES have been performed with room air to establish pneumoperitoneum. Insufflation of air through the flexible endoscopes used in performing NOTES currently is not pressure controlled. The flow rate used in the typical laparoscopy insufflators is higher. To date there is no randomized study that fully investigates the extent of immune responses following this advanced endoscopic procedures to know if physiology of pneumoperitoneum will behave in a similar way to the much studied carbon dioxide induced pneumoperitoneum of laparoscopy.

DISCUSSION

The evolutionary arc from open to laparoscopic and now no-scar cholecystectomy has facilitated improvement in patient recovery, cosmetic results and reduced pain medication. The wide acceptance of these novel therapies has fueled huge investment of time, effort and funds by researchers to indeed achieve a no-scar surgery. At present, it is advised that NOTES should be performed by a complementary team of a skilled therapeutic endoscopist and a laparoscopic surgeon, in view of the complex tasks required for its performance. Approach to the peritoneum in this experimental extension of conventional flexible endoscopy is via the stomach, colon, bladder and vagina. Laparoscopic instruments are often inserted through one or two abdominal ports to assist in the procedure (hybrid NOTES). In its pure form the transvaginal approach is used, thus making the procedure applicable to only women evoking among other issues ethical considerations. Patient acceptance between SILS and NOTES is in favor of the former.

Infection rate is an important issue for consideration. Contamination of the peritoneal cavity by enteric contents may render NOTES more immunologically invasive than previously thought with possible increased risk of infection. Few cases of intraperitoneal abscesses have been observed in some laboratory works though surgical measures of sterilization of gut prior to puncture and use of sterile overtubes are protective.[23] Bacteriostatic sterilization of equipment is generally sufficient for laparoscopy, however, bactericidal sterilization with ethylene oxide is advocated for transluminal surgery in some centres. Leakage from gastric (intestinal) closure is likely to increase the risk of infection in NOTES.

Pain is an important stimulus for immune response following surgery. Single incision laparoscopic cholecystectomy involves the use of a single skin incision which is supplied by somatic innervations. The character of this pain is sharp, stabbing and well-localized. Transluminal abdominal procedures require access to the peritoneum through viscus. Visceral pain is dull nagging and poorly localized. Viscera are sparsely innervated compared to dense and somatotopically oriented innervations of the skin. Fewer than 7% of afferent nerves entering the spinal cord project to the viscera, and only a small fraction of these transmit sensory input to the central nervous system.[24] These innervations, however, sparse spread to several segments of the cord precluding the prospect of spinal/epidural anesthesia. Studies are needed to evaluate the impact of somatic and visceral pain in the context of the overall immunological profile of these novel procedures in cholecystectomy. In contrast to conventional laparoscopy there is a reduction of shoulder tip pain from irritation of the diaphragm caused by trapped carbon dioxide following single incision laparoscopy.[25] The paucity of large population study for transluminal surgery commonly performed using room air for pneumoperitoneum is a limitation to understanding differences in pain induced immune responses.

Anesthetic considerations play a role in the multifactorial adverse immune response following surgery. Nonspecific defenses both cellular and humoral responses with anesthetic agents produce a combination of direct and indirect effects. These have significant impact on the function and regulation of immune response. Longer operating time means longer exposure to anesthetic agents and pneumoperitoneum with strong potentials for immune status alteration. Technical difficulties and a shortage of proper equipment lead to longer operating time in NOTES. Better equipment and adequate training and experience are likely to shorten operating time.

CONCLUSION

Minimal access techniques of single incision laparoscopy (SILS) and natural orifice transluminal endoscopic surgery (NOTES) are novel techniques in the surgical removal of the gallbladder. Compared to open surgery they have a more favorable immune response. There is limited immunological data available comparing NOTES and SILS postcholecystectomy. Further large randomized studies are needed to ascribe immunological advantage between these novel techniques.

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REVIEW ARTICLE

A Comparative Study of the use of Different Energy Sources in Laparoscopic Management of Endometriosis-Associated Infertility

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ABSTRACT

Background: Although there is controversy about the mechanism by which endometriosis causes infertility, laparoscopic treatment for endometriosis-associated infertility is becoming popular. However, the optimal modality of energy sources used for dissection and ablation in infertile women remains unexplored.

Objective: To study the best available evidence exploring the use of laparoscopic surgery in infertile women with endometriosis, compare various available energy sources, and their effect on surgical outcome and probability of pregnancy.

Methods: A retrospective review of literature was done to explore the role of laparoscopic surgery and various energy sources in managing endometriosis-associated infertility, using keywords—endometriosis, laparoscopy, infertility, electrosurgery and ultrasonic energy.

Results: Laparoscopic treatment of endometriosis using mechanical or electrical technologies was proposed in the 1980s. Later, use of lasers to vaporize endometriosis and to excise adhesions became popular. The invention of ultrasonic generator and tissue response electrosurgical generator has revolutionized laparoscopic surgery for endometriosis.

Conclusion: No prospective randomized double-blind controlled trial has been conducted to date in this area. Current evidence suggests that laparoscopic excision or ablation, either by electrocautery or laser, improves pregnancy rates. However, the impact of newer energy sources and tissue dissection techniques in this field is yet to be explored.

Keywords: Endometriosis, Infertility, Laparoscopy, Electrosurgery, Ultrasonic energy.

INTRODUCTION

Endometriosis is a severely debilitating condition among women of reproductive age group causing pain and infertility. It was first described in 1860 by von Rokitansky. In 1925, Dr Sampson described endometriosis as, "presence of ectopic tissue which possesses the histological structure and function of uterine mucosa".[1]

In the recent years, there has been a significant increase in the number of infertile patients with endometriosis. It is not clear whether this represents an increase, or simply reflects the more frequent use of laparoscopy. The incidence is 40 to 60% in women with dysmenorrhea and 20 to 30% in women with subfertility.[2-4]

Endometriosis is believed to cause infertility based on a higher prevalence of the disease in subfertile women (up to 50%) compared with women of proven fertility (5-10%).[5] In the current era, endometriosis is known to account for 10 to 15% of the cases of infertility.

The goal of treating pelvic and peritoneal endometriosis is to destroy the implants in the most effective and least traumatic way to minimize the formation of postoperative adhesions. Reproductive pelvic surgery procedures performed by laparotomy are frequently complicated by adhesion reformation and by *de novo* adhesion formation. However, endoscopic surgery fulfils the important microsurgical principles of gentle handling of tissue, constant irrigation, meticulous hemostasis, and precise tissue dissection. Operative techniques in endometriosis are dependent upon the type and extent of the lesions. Various technologies can be used, of which hydrodissection and the CO_2 laser appear to be the most efficient tool.[6,7]

This review explores the available evidence addressing the use of laparoscopic surgery in infertile women with endometriosis, and compares various available energy sources and their effect on surgical outcome and probability of pregnancy.

METHODOLOGY

This study entailed a retrospective review of literature using all available English databases, Cochrane register and Medline articles, which explored the role of laparoscopic surgery and various energy sources in managing endometriosis-associated infertility, using keywords—endometriosis, laparoscopy, infertility, electrosurgery and ultrasonic energy. A hand searching of relevant journals and conference proceedings was also done.

PATHOGENESIS AND THE MECHANISM OF INFERTILITY

Several factors are believed to be involved in the pathogenesis of endometriosis. Retrograde menstruation remains the dominant theory for development of pelvic endometriosis. Failure of immunological mechanisms, angiogenesis and production of antibodies against endometrial cells may also have a role. Endometriotic lesions secrete several pro-inflammatory molecules contributing to development of pain and infertility.[8-10]

The most common site of endometriosis is the ovary. Other common sites are peritoneum, ovarian fossa, uterosacral ligaments, uterovesical fold and Pouch of Douglas. It can present as dysmenorrhea, dyspareunia, chronic pelvic pain, infertility, irregular heavy periods, cyclical rectal bleeding, tenesmus, cyclical hematuria, ureteric obstruction, cyclical pain and swelling in the umbilicus or scars.

Although there is substantial evidence confirming an association between endometriosis and infertility, a causal relationship has not yet been established.[11] Nevertheless, the fecundity rate of infertile patients with minimal or mild endometriosis is not significantly lower than that of women with unexplained infertility.[12,13] Endometriosis may thus play a determinant role in infertility in more advanced forms only. In a series of 123 women with endometriosis-associated infertility undergoing expectant management, Olive et al[14] observed a pregnancy rate of 45% in patients with mild disease and 19.5% in those with moderate disease. No conception was achieved in patients with severe lesions.

Moderate-severe endometriosis is likely to result in infertility because of adhesions disrupting the anatomical relationships between fallopian tube and ovary. Severe dyspareunia preventing regular sexual intercourse could also affect fertility. Distal occlusion of the fallopian tube may result in hydrosalpinx, leading to a direct effect on embryos as well as an alteration in uterine implantation.[15]

Other mechanisms by which endometriosis may contribute to infertility include disorders of folliculogenesis or endocrine abnormality, inflammatory or immunological abnormality and increased miscarriage rate.[15] The presence of endometriosis affects multiple aspects of the reproductive cycle, including oocyte quality, embryogenesis, and receptivity of the endometrium. Further evidence of poor oocyte quality and reduced implanting ability of embryos is provided by studies showing no adverse effect on implantation rates in women with endometriosis using donated oocytes. Recipients of oocytes from donors with endometriosis have lower implantation rates.[16-18]

Thus, even though laparoscopic surgery has become the preferred treatment modality, it may not overcome the bio-molecular alterations associated with chronic inflammation and causing infertility. Furthermore, the anatomical insults to reproductive function due to endometriosis, such as tubal damage and severe adnexal adhesions, might be irreversible.

STAGING OF ENDOMETRIOSIS

The American Fertility Society (AFS) proposed its revised staging in 1996.[19] This remains the most widely used classification. This classification considers the size, site and depth of the lesions. Point scores were given depending upon severity. Four stages of the disease were suggested: Stage I (minimal), stage II (mild), stage III (moderate) and stage IV (severe).

The revised AFS score enables easy and clear communication through standardized reporting, but has a number of significant drawbacks:[20]

i. It does not help in comparison of different treatments
ii. It is unable to predict disease progression, impact on future fertility and disease recurrence rate
iii. It is prone to observational variation which impairs reproducibility
iv. It is also a poor indicator of severity as it does not consider bowel adhesions or multifocal nodular disease.

ROLE OF SURGICAL MANAGEMENT

Endometriosis can be treated medically or surgically by laparoscopy or laparotomy. Medical hormonal treatment has no role in the treatment of endometriosis-associated infertility in the absence of pain. This is because any hormonal treatment used to suppress endometriosis is contraceptive and does not improve pregnancy rates. In fact, postoperative hormone therapy in patients with endometriosis prevents pregnancy during what may be the optimal time for conception to occur following surgery.

The advantages of laparoscopic surgery are quicker recovery, shorter hospital stay, effective treatment of ovarian endometriomata and relief of pain. It also improves fertility without increasing the risk of multiple pregnancies associated with assisted conception treatment. The limitation of laparoscopy is the intraoperative risk of injury to adjacent structures. Appropriate surgical skill and availability of appropriate equipment is required. There is a 6.3% conversion rate to laparotomy associated with gynecological laparoscopy.[21] Otherwise laparotomy is indicated only in cases of severe endometriosis with extensive dense adhesions along with deeply infiltrating endometriosis.

Based on the results of a meta-analysis of cohort studies, 15 years ago surgical treatment of endometriosis was estimated to produce overall crude pregnancy rates 38% higher than non-surgical treatment.[22] Moreover, surgical techniques have evolved and instrumentation has improved tremendously.

More convincing evidence emerged from a randomized clinical trial comparing diagnostic laparoscopy alone or resection or ablation of visible lesions that included 341 infertile patients with minimal or mild endometriosis,[23] in whom surgery enhanced fertility.

Endoscopic surgery is precise enough that adhesions can be excised without destroying surrounding tissue or damaging vital structures, such as the ureters, bladder and bowel. Removal of all adhesions and restoration of the normal anatomic relationship of the pelvic organs enhances the fertility.

OPERATIVE TECHNIQUES

A variety of mechanisms, involving some form of physical energy, can be used to divide tissue and enable hemostasis.[24] The available modalities for dissection in minimal access surgery include:

- *Blunt dissection:* Can be done with a closed scissors tip, grasper, inactive suction cannula, heel of inactive electrosurgery hook or a pledget. Blunt dissection is used to open planes and expose structures, especially when the anatomy is obscured by adhesions. Insignificant hemostatic capability is the main disadvantage.
- *Sharp scissors dissection:* Implants are grasped and removed by precise dissection with scissors. This allows histological confirmation and avoids destruction of peripheral tissue. The main disadvantage is the risk of hemorrhage which can usually be controlled by bipolar cauterization.
- *High frequency radio wave electrosurgery:* This is the most convenient and most risky method of dissection in minimal access surgery. Most of the complications in laparoscopic surgery are due to use of energized instrument (1-2%).
  - *HF monopolar electrosurgery:* Monopolar electrosurgery has become the most widely used cutting and coagulating technique in minimal access surgery. This permits complete and deep coagulation of the nodules. Its main advantage is its efficiency and the absence of hemorrhage. Associated complications include thermal injury to nontargeted organs due to insulation failure, direct coupling or capacitive coupling, absence of biopsies and extensive destruction of the surrounding tissue. Other problems encountered include effect on pacemakers, return electrode burns and toxic smoke.
  - *Bipolar diathermy:* A bipolar system is safer as the current does not pass through the patient but instead returns to the generator via the receiving electrode after passage through the grasped tissue. Its main advantages are absence of hemorrhage and restriction of thermal injury to the surrounding tissue. The main disadvantages are superficial coagulation and, therefore, a potentially incomplete treatment of deeper implants. The primary electrothermal tissue effect is limited to desiccation, not cutting. It requires slightly more time than monopolar coagulation because of lower power settings and bipolar generator output characteristics. Hemostasis over a large area is not possible. Grasping dense tissue between both the active and return electrodes is difficult.
- *Ultrasonic surgical dissection (Harmonic scalpel):* This uses mechanical energy at 55,500 vibrations/sec, thus disrupting hydrogen bonds and forming a coagulum. It is ideal for dividing and simultaneously sealing small and medium vessels with less instrument traffic, reduction in operating time, less smoke and no electrical current.
- *High velocity and high pressure water-jet dissection:* This produces clean cutting of reproducible depth. Other advantages are the cleansing of the operating field by the turbulent flow zone. Problems encountered with the use of this modality include the 'hail storm' effect causing excessive misting which obscures vision, lack of hemostasis, difficulty in gauging distance and poor control of depth of the cut.
- *Hydrodissection:* Hydrodissection uses the force of pulsatile irrigation with crystalloid solutions to separate tissue planes. The operating field is kept clear. However, no hemostasis is achievable.
- *Argon beam coagulator:* The argon beamer is used in conjunction with monopolar electrosurgery to produce fulguration or superficial coagulation. Less smoke is produced because there is lesser depth of tissue damage. However, a significant drawback of this modality is an increase in intra-abdominal pressure to potentially dangerous levels due to high-flow infusion of argon gas.
- *Laser dissection:* The degree and extent of thermal damage produced by laser depends on the structure, water content, pigmentation, optical and thermal properties, and perfusion of the tissue.

  Each of the various types of laser available has a specific clinical application.
  - The argon laser coagulator is the ideal method of treating small red endometriotic deposits.
  - *CO_2 laser vaporization:* This is the most efficient technique for superficial ablation permitting a complete, precise, controlled and bloodless destruction of the implants. It can be used on multiple and widespread disease even if the diagnosis of some lesions is doubtful, with minimal risk to adjacent organs, such as the ureter and bowel. Its major drawback is production of smoke. It is relatively inexpensive (compared to other lasers).
  - *CO_2 laser excision:* This method is preferred for large nodules as vaporization is a slow procedure. CO_2 laser excision is equivalent to sharp excision but avoids the problems of hemorrhage and is therefore faster. It is mainly useful for removing rectovaginal nodules.
  - *Other laser procedures:* Nd: YAG laser, KTP laser and holmium laser have also been used to treat endometriotic implants. These lasers are mainly coagulating, and therefore the destruction is less precise than with the CO_2 laser. They are more ergonomic as they can be

used with flexible fibers. However, they are more expensive.

The best therapy is performed with the CO_2 laser vaporization in association with an accurate dissection technique.[7]

- *Tissue response electrosurgical generator* (Ligasure™): This has unique vessel sealing ability. It can be used on vessels up to 7 mm. It precisely confines its effects to the target tissue with virtually no charring, and with minimal thermal spread to adjacent tissue. It senses body's collagen to actually change the nature of the vessel walls by obliterating the lumen.

ENDOSCOPIC SURGERY IN ENDOMETRIOSIS-ASSOCIATED INFERTILITY

Endometriotic Implants

The destruction of implants can be achieved using numerous techniques: Precise excision, bipolar coagulation, monopolar coagulation, CO_2 laser vaporization or excision, and different methods of coagulation using other types of laser. Superficial peritoneal endometriosis is vaporized with the laser, coagulated with monopolar or bipolar current or excised. Implants less than 2 mm can be coagulated, vaporized or excised. When lesion is greater than 3 mm, vaporization or excision is needed. Lesions greater than 5 mm must be excised or deeply vaporized[15] (Fig. 1).

Current guidelines for the treatment of stages I and II endometriosis-associated infertility recommend ablation of endometriosis lesions plus adhesiolysis to improve fertility.[25,26] The beneficial effect of surgical removal of the lesions in mild endometriosis is small and may be short-lived.[27] This may be due to the fact that a number of occult lesions may be left behind after removal of the visible lesions. These may develop into minimal endometriosis and grow further.

Thus, the optimal time for conception is within the first 18 months following surgical resection.[28] However, even after surgery, the monthly fecundity rate remains lower than that in fertile women. This suggests that the destruction of visible endometriotic implants does not affect all factors by which endometriosis contributes to infertility.[23]

Adamson[29] in 1997 proposed that surgery for endometriosis-associated infertility is more effective for severe than mild endometriosis.

Adhesions

Adhesiolysis is difficult in cases of endometriosis. Adhesions are thick and vascular, and often involve bowel, broad ligament, tubes, etc. Different techniques can be employed individually or in association. The best method involves dissection with forceps and/or dissectors, and aquadissection in conjunction with a CO_2 laser (in place of scissors) (Figs 2 and 3).

Endometriomas

There are two different surgical techniques to treat the endometrioma:

i. Cystectomy with excision of the endometriotic cyst (Fig. 4)
ii. Drainage/aspiration of the cyst content and ablation of the cyst capsule with laser or electrocoagulation (Figs 5 and 6).

Cystectomy

Any periovarian adhesions must be removed prior to cystectomy. An entry site is made in the endometrioma on the opposite side of the ovarian hilus. The endometrioma is evacuated and repeatedly washed. A 'cystoscopy' is then performed by introducing the laparoscope into the endometriotic cavity. The inner lining of the cyst is examined to confirm the diagnosis and to eliminate the presence of a malignant cyst. A forceps is used to grasp the ovary at the edge of the incision. A second pair of grasping forceps holds the lining of the cyst. Then, by applying countertraction to the two forceps, cleavage is performed. Generally, the best approach is to pull the cyst away from the ovary.

When the cyst has been completely cleaved, it must be removed from the abdomen using an 'endoscopy bag' or through a suprapubic trocar or the umbilical trocar. A thorough

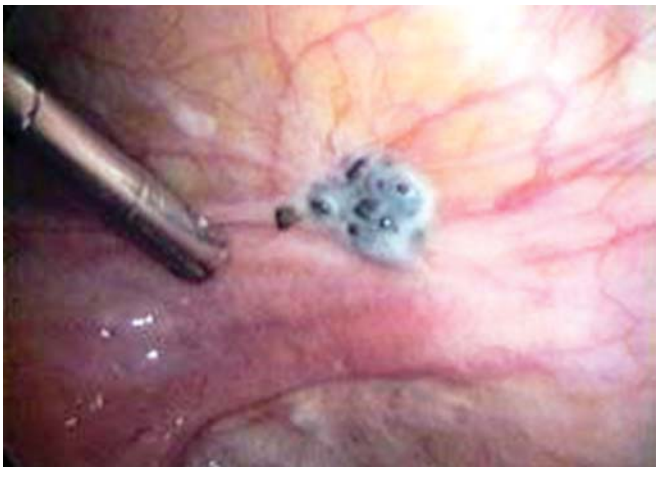

Fig. 1: Endometriotic implants can be excised with scissors or deeply vaporized with bipolar or harmonic scalpel

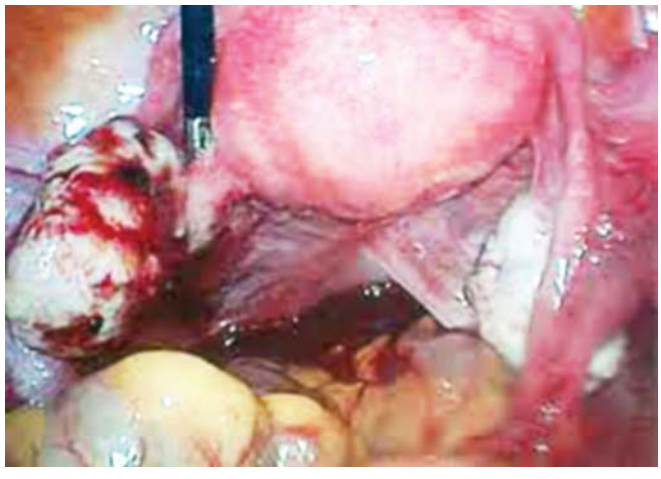

Fig. 2: Dense adhesions may be vascular and are coagulated with bipolar electrocautery before cutting

peritoneal washing is given and hemostasis achieved. The ovary is left unsutured since sutures can cause adhesion formation. However, when necessary, suture is placed within ovarian stroma and the knot is tied inside the ovary to minimize adhesion formation. Alternatively, biological glue can be applied and edges of the incision brought together.

Draining the endometrioma or partially removing its wall is inadequate because the cyst lining remains functional leading to reoccurrence of the symptoms. Two randomized controlled trials reported that laparoscopic ovarian cystectomy for endometriomata results in a better pregnancy rate than drainage alone.[30,31]

Another advantage of excision over ablation is that the cyst can be examined histologically and a diagnosis of ovarian cancer excluded.

Hemorrhage: Any bleeding from the intraovarian vasculature is minimal and is self-controlled within a few minutes. Hemorrhage from the hilus may occur during the dissection of the inferior pole of the cyst. This can be difficult to locate. The immediate solution is to evert the entire ovary in order to localize it and then control hemostasis using bipolar electrocoagulation. Monopolar electrocoagulation must be avoided because of the risks of accidents and complete coagulation of the ovarian vascularization.

Laser Vaporization of Endometrioma

The endometrioma is opened, aspirated and washed. It is then largely incised to evert the internal layer which is destroyed by vaporization with a CO_2 laser, introduced through the laparoscope. The results are apparently equivalent with different types of lasers, but Argon or KTP lasers induce less bleeding and are easier to use since they can travel through flexible fibers. This is easily done with small cysts (< 3 cm), but in cases of larger cysts it is impossible to be sure that all the internal layer has been destroyed.

Rectovaginal Septum and Uterosacral Ligaments Endometriosis

Deep endometriosis exists when the lesions penetrate 5 mm or more.[32] In addition to pain, most of these patients suffer from associated infertility. Operative laparoscopy for these lesions

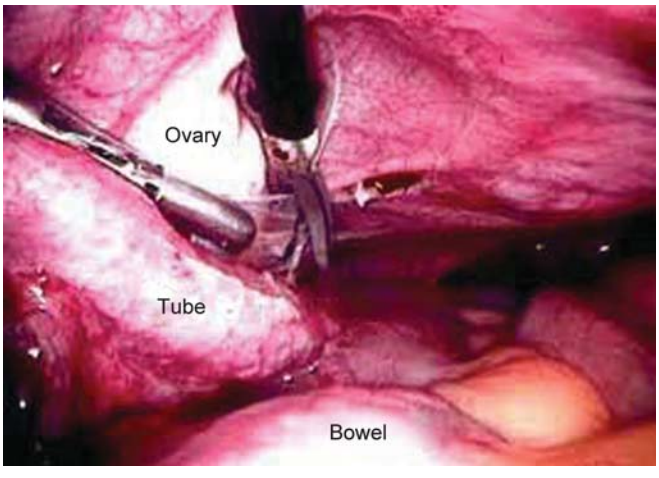

Fig. 3. Flimsy adhesions can be directly cut by sharp dissection with scissors

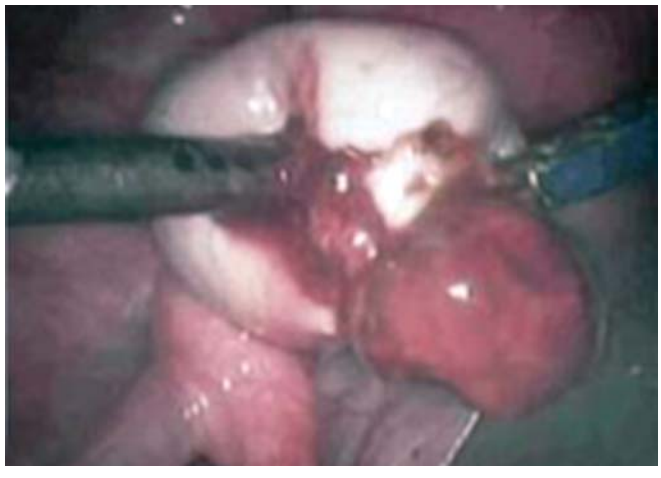

Fig. 5: Puncture of endometriotic cyst using monopolar with tritome for drainage and aspiration of the cyst contents

Fig. 4. Excision of the endometriotic cyst wall can be done with monopolar current using electrosurgical hook, or the vibrating jaw of the harmonic scalpel or bipolar coagulation, followed by sharp dissection with scissors

Fig. 6: Stripping of the cyst capsule from ovarian cortex

often involves considerable dissection. It is, thus, necessary to establish precisely the impact on fertility of this type of surgery (Fig. 7).

Either laser or aqua dissection can be used, separately or combined. Dissection must be performed with care to avoid any injury to organs, such as the rectum or ureters. In some cases it may be safer to catheterize the ureter in order to facilitate this dissection.

POSTSURGICAL FERTILITY OUTCOMES

A 50% pregnancy rate was obtained after laparoscopic management in a series of 814 women with endometriomas.[33] The removal or destruction of endometriomas may provide more benefit than simply restoring the normal anatomy and ovarian structure.

In another study, CO_2 laser was used laparoscopically for removal of endometriotic implants.[34] Of 102 infertile patients, 60.7% conceived within 24 months after laparoscopy. The rates of conception after surgery were: 75% for patients with mild endometriosis, 62% for moderate endometriosis, and 42.1% for patients with severe endometriosis.

However, it has been suggested that ovarian surgery for endometriomas could be deleterious for the residual normal ovarian tissue, either by removing ovarian stroma with oocytes together with the capsule or by thermal damage provoked by coagulation.[15] However, a recent histological analysis revealed that the ovarian tissue surrounding the cyst wall in endometriomas is morphologically altered and possibly not functional. Thus, a functional disruption may already be present before surgery.[35] Therefore, the decreased ovarian response observed in patients previously treated for a large ovarian endometrioma, may also be a consequence of the disease.

EFFECT OF ENDOSCOPIC SURGERY ON IVF CYCLES

With advances in IVF, a number of patients opt for IVF without undergoing adequate surgical treatment of endometriosis. The success rate of IVF in women with endometriosis is lower compared with that of women undergoing IVF for other indications. Laparoscopic excision of endometrioma before IVF reduces the risk of worsening endometriosis during ovarian stimulation, reduces the risk of infection during oocyte retrieval and allows histological diagnosis avoiding occult malignancy.

Thus, laparoscopic diagnosis and treatment of endometriosis is believed to be useful in increasing the probability of conception either spontaneously or with IVF treatment.

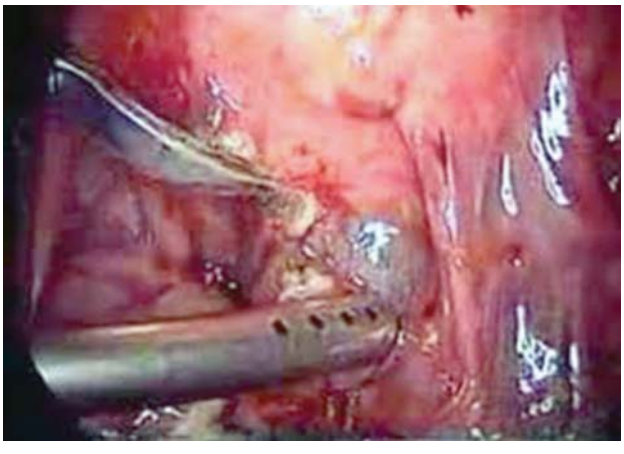

Fig. 7: Excision of deep rectovaginal endometriosis with bipolar electrocautery and scissors. Harmonic scalpel or CO_2 laser may be used alternatively

STRATEGY OF MANAGEMENT IN INFERTILITY

Three different situations may be encountered:[24]

i. Clinical diagnosis of endometriosis is suspected. Diagnostic laparoscopy, staging and treatment are performed in the same operative sitting.
ii. Clinical diagnosis of endometriosis is suspected. Diagnostic laparoscopy reveals extensive endometriosis for which laparoscopic treatment appears extremely difficult. Medical treatment may be administered for 3 to 6 months, followed by laparoscopic surgery performed as a second step.
iii. When severe endometriosis can be diagnosed without laparoscopy according to clinical findings or ultrasound scan, medical therapy is given before laparoscopic treatment. In the last two situations, GnRH analogs are prescribed for 3 to 6 months prior to laparoscopic treatment.

In women with stage I/II endometriosis-associated infertility, expectant management or superovulation/IUI after laparoscopic excision or ablation of all visible disease can be considered for younger patients. Women, 35 years of age or older, should be treated with superovulation/IUI or IVF-ET. In women with stage III/IV endometriosis-associated infertility, conservative surgical therapy with laparoscopy and possible laparotomy are indicated.[11]

Based on a literature review, the most realistic intrauterine pregnancy rate achieved is ~ 40%.

There is no advantage of repeating surgery within a short interval as this may reduce ovarian reserve and increase the risk of a poor response to ovarian hyperstimulation for IVF.

CONCLUSION

Current evidence suggests that laparoscopic excision or ablation, either by electrocautery or laser improves pregnancy rates. The dissection technique and energy source required depends on the type and constituency of the tissue and the extent of the lesions. The ideal dissection technique requires a modality that can accomplish meticulous hemostasis and will be tissue selective without causing inadvertent tissue damage. In actual practice, a combination of energy forms is applied with selection of the most appropriate one at each particular phase of the operation.

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REVIEW ARTICLE

Risk of Pneumoperitoneum in Obese: Old Myths and New Realities

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ABSTRACT

Objective: To provide an overview of difficulties encountered during laparoscopic entries in obese patients and the contemporary methods used to establish the safest possible laparoscopic entry in obese.

Methods: Twenty-six articles related to laparoscopy procedures, in general, and associated difficulties in obese patient, in particular, were examined.

Results: Obesity imposes a challenge for the minimal access surgery procedures; particularly those related to the primary access of peritoneal cavity. However, closed and open peritoneal entry using blunt or optical instruments, through different sites, have been used to prevent entry failures or possible complications if difficulties are encountered whenever the surgeon cannot safely use his/her preferred entry procedure.

Conclusion: Induction of pneumoperitoneum can be a difficult, time-consuming and occasionally hazardous task in a morbidly obese patient. Different alternatives are possible according to differences in the method of entry, the site or the instruments used. The risk-benefit and the alternative options must be examined individually by the healthcare provider.

Keywords: Laparoscopic entry, Obesity, Complications, Gynecological laparoscopic surgery, Pneumoperitoneum, Veress needle.

INTRODUCTION

Overweight and obesity are both labels for ranges of weight that are greater than what is generally considered healthy for a given height. The weight and height are used to calculate the body mass index (BMI), which correlates with the amount of the body fat.[1]

Obesity is an ever-increasing problem. It is now considered an epidemic in the United States. According to a study from the Center for Disease Control and Prevention, 30.5% of Americans are considered obese with a body mass index (BMI) greater than 30 kg/m^2, and 4.7% of Americans are considered morbidly obese (BMI 40).[2] Prevalence of obesity in India is up to 50% in women in the upper strata of the society. In Delhi, the prevalence of obesity stands at 33.4 % in women.[3]

The prevalence of obesity in USA and throughout the industrialized world is such that the practicing surgeon cannot reasonably expect to avert its many implications for patient care.[4]

Laparoscopic surgery has developed rapidly over the last few years, and many surgical procedures formerly carried out through large abdominal incisions are now performed laparoscopically. Laparoscopic techniques have revolutionized the field of surgery with benefits that include decreased postoperative pain, earlier return to normal activities following surgery and fewer postoperative complications (e.g. wound infection, hernia).[5]

Reduction of the trauma of access by avoidance of large wounds has been the driving force for such development.[6] However, the insertion of needles and trocars necessary for the pneumoperitoneum and the performance of the procedure are not without risk.[7] The technical modifications imposed by surgical laparoscopy are obvious (e.g. number and size of trocars, location of insertion sites, specimen retrieval), and therefore morbidity may be substantially modified. Complications such as retroperitoneal vascular injury, intestinal perforation, wound herniation, wound infection, abdominal wall hematoma, and trocar site mestastasis have been reported.[8]

Laparascopic surgery may be of particular benefit to obese patients for prevention of postlaparotomy complications.[9] Nevertheless, in women who are overweight, and even more so in those who are obese, every aspect of laparoscopy becomes more difficult and potentially more risky. Placement of laparoscopic instruments becomes much more difficult and often requires special techniques. Bleeding from abdominal wall vessels may become more common since these vessels become difficult to locate. Many intra-abdominal procedures become increasingly difficult because of a restricted operative field secondary to retroperitoneal fat deposits in the pelvic sidewalls and increased bowel excursion into the operative field. This second problem probably is related to increased volume of bowel, decreased elevation of a heavier anterior abdominal wall by the pneumoperitoneum, and the inability to place many obese patients in steep trendelenburg because of ventilation considerations.[10] Unique complications are associated with gaining access to the abdomen for laparoscopic surgery, resulting in an inadvertent injury to the internal organs.[5]

Generally, laparoscopic surgery has a complication rate of 5.7 per 1000; about one-half of these complications are associated with initial entry into the peritoneal cavity and this happens within the first few minutes of the laparoscopic

procedure.[11] The frequency of entry complications reported in the international literature is very low (1-3%). The most serious complications may be life-threatening, but are very rare with the incidence of major vascular perforation reported as being 0.9 per 1000 procedures and the incidence of bowel perforation reported as being 1.8 per 1000 procedures.[12] Even if the reported prevalence is very low, the mortality rate arising from these lesions reportedly ranges between 8 and 17%.[13]

Challenges with the Laparoscopic Entry Techniques in Obese

Although abdominal thickness correlates with patient weight, short stature or truncal obesity may increase abdominal wall thickness out of proportion to patient weight. Routine evaluation of the abdominal wall prior to laparoscopy is important because the success of trocar insertion may depend on altering the technique based on abdominal wall thickness.[7]

Standard gynecologic laparoscopic entry is through the umbilicus. Blindly passing a sharp Veress needle, insufflating, and then blindly passing a sharp trocar is the traditional technique for laparoscopic entry. Although it has been suggested that the angle of Veress needle entry should vary between 45º and 90º according to the BMI of the patient, it is reasonable to state that, for obese, a controlled 90º angle entry of the Veress needle with insertion of not more than 2 cm of the needle tip with selective umbilical stabilization or elevation of the abdominal wall is the safest route of Veress needle insertion for the vast majority of cases.[12] The angle of insertion is more critical as the adipose layer limits free rotational movement of working ports. Patients who are grossly obese are at a significantly greater risk of complications when undergoing laparoscopic surgery. In most women, the aortic bifurcation rests between the 4th and 5th lumbar vertebrae, or within 1.25 cm above or below a line drawn between the iliac crests. Nevertheless, due to anatomic variation it may be located either above or below these disk spaces. The umbilicus is most commonly located between the 3rd and 4th lumbar vertebrae. However, this relationship is quite variable. The position of the umbilicus relative to the aortic bifurcation is negatively correlated with body mass; it more commonly rests caudal to the bifurcation in overweight and very obese women.[14] If a Veress needle approach is used in the patient who is morbidly obese, an ultralong Veress needle may assist, also it is important to make the vertical incision as deep as possible in the base of the umbilicus, since this is the area where skin, deep fascia and parietal peritoneum of the anterior abdominal wall will meet. In this area, there is little opportunity for the parietal peritoneum to tent away from the Veress needle and allow preperitoneal insufflation and surgical emphysema. If the needle is inserted vertically, the mean distance from the lower margin of the umbilicus to the peritoneum is 6 cm (± 3 cm). This allows placement of a standard length needle even in extremely obese women. Insertion at 45°, even from within the umbilicus, means that the needle has to traverse distances of 11 to 16 cm, which is too long for a standard Veress needle.[7] Using MRI and CAT scans (on unanesthetized women in the supine position) to measure the thickness of the abdominal wall and critical distances to the great vessels. Hurd et al reported that the position of the umbilicus was found, on average, 0.4, 2.4 and 2.9 cm caudally to the aortic bifurcation in normal weight (BMI < 25 kg/m^2), overweight (BMI 25-30 kg/m^2) and obese (BMI > 30 kg/m^2) women respectively (Fig. 1). In all cases, the umbilicus was cephalad toward the left common.

Iliac vein crossed the midline at the sacral promontory. Preperitoneal placement and vascular injury with a standard Veress needle (11.5 cm in length) is least likely using the standard approach in nonobese women. In the overweight patient, however, similar outcomes require modifying the point of needle insertion to the base of the umbilicus. Preperitoneal insufflation is least likely to occur in very obese women only if the needle is placed through the base of the umbilicus at a 90º angle. The fact that the umbilicus is usually caudal to the bifurcation in this weight group helps support the relative safety of this modified approach.[14,15]

Moreover, the saline drop test should be used to confirm intraperitoneal Veress needle placement. Entry related complications may be reduced by filling the peritoneal cavity with carbon dioxide (CO_2) to a predetermined pressure level rather than to a preset volume. Trocars may be placed angled towards the operation site to avoid torquing the instruments. They can be sutured in place to prevent slippage and longer cannulas should be used. Finally, long instruments and extra ports along with routine bowel preparation will improve bowel manipulation, decrease bowel excursion into the operative field and ultimately better visualization.[16]

Alternative methods of entry for insufflation may be required when faced with the very obese patient or when conventional methods are contraindicated or fail to produce an adequate pneumoperitoneum. Accordingly, the initial entry can also be performed through other sites in the abdominal wall, as 9th or 10th intercostal space or upper-left quadrant insertion site

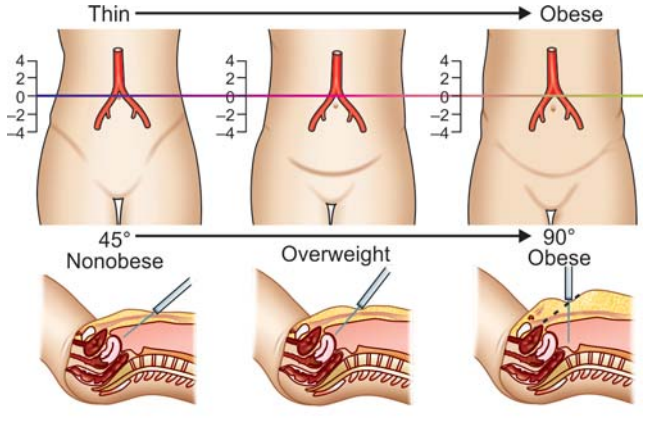


Fig.1: Effect of obesity on location of great vessels

(Palmer's point). Percutaneous induction of a pneumoperitoneum with the Veress needle in the left upper quadrant is a safe and effective technique in morbidly obese patients.[17]

Other approaches have been advocated as suprapubic entry, and access through the natural orifices as uterus or posterior vaginal fornix (cul-de-sac) by using a long Veress needle (17 cm).[11,15] The technique of vaginal approach should not be used in the presence of a cul-de-sac mass, severe rectovaginal endometriosis, fixed uterine retroversion, or whenever vaginal vault surgery has been performed. Regarding uterine approach, it has been found that the safety is maximized by directing this step with the aid of intraoperative sonography. This technique should not be used in the presence of leiomyomata, possible pelvic infection or pregnancy, and whenever there is a risk of adhesions between the bowel and fundus of the uterus (e.g. prior myomectomy or hysterotomy).[14]

On the other hand, it is generally recommended that an open (Hasson) technique should be performed for primary entry in patients who are morbidly obese, although even this technique may be difficult.[7]

Optical access trocars have been first introduced in 1994, and developed as an alternative method of peritoneal entry to decrease the risk of injury to intra-abdominal organs. The theoretical advantage of these trocars is that each layer can be identified prior to transection.[7, 18]

Obesity had generally been thought to increase the risk of laparoscopic surgery.[4] Primary prevention of entry complications is beneficial to the patient, the treating physician and the society, given the negative health implications, the fear and costs of litigation and the negative economic impact on the health care budget.[12]

METHODOLOGY

The study was carried out through a literature search from the electronic library using the following search engines: Google, Springer online, PubMed and other linked references. Publications used were searched by using relevant combinations of medical subject headings (laparoscopy; obesity; gynecological surgical procedures; intraoperative complications; postoperative complications) and free text words. The literatures were critically appraised according to a standardized grading scheme used by the RCOG.

Findings

Technical obstacles associated with open pelvic surgery in the obese are primarily those related to exposure of the operative field and access to deep pelvic structures. These obstacles present similar challenges when laparoscopy is attempted, as have been previously described.[19,20] Loffer and Pent discussed at length the additional, unique difficulty of establishing pneumoperitoneum in obese patients. Together, all of these limitations place the obese patient undergoing laparoscopy at an inherently increased risk of conversion to laparotomy, as confirmed by several authors. In a subsequent review of 2,530 attempted gynecologic laparoscopic surgeries, Sokol et al determined that a BMI greater than 30 kg/m^2 placed patients at a more than two-fold risk of unintended laparotomy. Eltabbakh et al noted similar findings in a review of 47 obese patients who underwent operative gynecologic laparoscopies.

Despite these challenges, a laparoscopic approach is well suited to the obese patient, who is inherently less mobile and, therefore, more susceptible to thromboembolic events and suboptimal wound healing following laparotomy. One randomized, prospective trial comparing outcomes of laparoscopic with abdominal hysterectomy found less operative blood loss, less postoperative pain, and shorter hospital and convalescence times for patients undergoing laparoscopic hysterectomy. These same authors concluded that total laparoscopic hysterectomy may afford significant benefit to society in the form of indirect costs related to recovery time, when compared with abdominal hysterectomy.[4]

Jansen et al in a study on 25,764 patients found that 83 of 145 complications were related to primary access.[21] Similarly, Champault et al in a French survey of 1,03,852 laparoscopic operations found that 83% of vascular injury, 75% of bowel injury and 50% of local hemorrhage were caused during primary trocar insertion.[22] The impact of Veress needle injury has been highlighted in another big literature review. Thirty-eight selected articles included 6,96,502 laparoscopies with 1,575 injuries (0.23%), 126 (8%) of which involved blood vessels or hollow viscera (0.018% of all laparoscopies). Of the 98 vascular injuries, 8 (8.1%) were injuries to major retroperitoneal vessels. There were 34 other reported retroperitoneal injuries, but the authors were not specific as to which vessel was injured. Of the 28 injuries to hollow viscera, 17 were considered major injuries, i.e. 60.7% (0.0024% of the total cases assessed).[13]

In an attempt to facilitate access to peritoneal cavity in obese patient which can help in decreasing the entry complications; Phillips et al[23] reported a peritoneal hyperdistention to 25 mm Hg as against 12 to 15 mm Hg, noting that a downward force of 3 kg umbilically with an intra-abdominal distension pressure of 10 mm Hg resulted in a distance of only 0.6 cm between the trocar and abdominal contents. However, this distance increased to 5.6 cm with insufflation pressure of 25 mm Hg. Reich et al reported no specific or vascular complications in 3,041 cases using this technique. Tsaltas et al, in 1150 consecutive operative laparoscopies using the 25 mm Hg hyperdistention technique, similarly reported no entry complications or adverse clinical events.

Prediction of laparoscopy outcome in obese patient had been made by Lamvu et al through a Tilt Test, which involves placing the patient in steep trendelenburg for 2 to 5 minutes following intubation and positioning, observing the patient's cardiac and respiratory indices. Patients who remain

normotensive and maintain respiratory pressures at 30 to 40 mm Hg during the Tilt test before and after insufflation are very likely to have a positive clinical result.[16]

The role of alternative peritoneal access has been evaluated by a retrospective review of 918 insufflations through the 9th intercostal space which found one entry into the stomach and one into the pleural space (causing a pneumothorax) by the Veress needle.

Transuterine Veress CO_2 insufflation using a long Veress needle for pneumoperitoneum has been found to be especially helpful in obese women. In one study of 138 women weighing 250 to 400 lbs, failure to establish pneumoperitoneum occurred in 13.8% (5/36) through the umbilicus, in 3.6% (3/83) through the uterus, in 8.3% (1/12) subcostally and in 28.6% (2/7) through the open (Hasson) technique. A prospective randomized study compared the conventional infraumbilical route with a transuterine route in 100 overweight and obese women (BMI > 25 kg/m^2) in establishing pneumoperitoneum. In the infraumbilical group, pneumoperitoneum was achieved at a ratio (punctures/pneumoperitoneum) of 56/49 (1.14) with one failure, but in the transuterine group the ratio was 53/51 (1.04).[15] Similar results were obtained by Wolfe et al. A Veress needle was inserted through the uterine fundus to establish a pneumoperitoneum in 100 women undergoing laparoscopy for sterilization or diagnostic purposes. The transuterine approach was chosen for 86 women because of obesity and for 14 because a previous abdominal insertion had been unsuccessful. There were no complications associated with the transuterine Veress needle placement.[24]

Several studies on the benefits and complications of the various laparoscopic entry techniques have been published. Hasson reviewed 17 publications of open laparoscopy by general surgeons (9 publications, 7,205 laparoscopies) and gynecologists (8 publications, 13,486 laparoscopies) and compared them with closed laparoscopy performed by general surgeons (7 publications, 90,152 patients) and gynecologists (12 publications, 5,79,510 patients). Hasson reported that for open laparoscopy the rate of umbilical infection was 0.4%, bowel injury 0.1% and vascular injury 0%. Hasson advocated the open technique as the preferred method of access for laparoscopic surgery. Further analysis of Hasson's review suggests that the prospective studies and surveys indicate that general surgeons experience higher complication rates than gynecologists with the closed technique, but experience similar complication rates with the open technique. Using the closed technique, the visceral and vascular complication rates were 0.22 and 0.04% for general surgeons, and 0.10 and 0.03% for gynecologists. In a published record of his own 29-year experience with laparoscopy in 5,284 patients, Hasson reports only one bowel injury within the first 50 cases.

The open entry technique may be utilized as an alternative to the Veress needle technique, although the majority of gynecologists prefer the Veress entry. There is no evidence that the open entry technique is superior to or inferior to the other entry techniques currently available.

The visual entry cannula system may represent an advantage over traditional trocars, as it allows a clear optical entry, but this advantage has not been fully explored. The visual entry cannula trocars have the advantage of minimizing the size of the entry wound and reducing the force necessary for insertion. Visual entry trocars are nonsuperior to other trocars since they do not avoid visceral and vascular injury.[15]

To identify which of the various laparoscopic entry techniques is the safest and/or most effective in the obese woman undergoing gynecological laparoscopic surgery, Sarah and Josette (2008) reviewed seven individual studies (Fig 2), with a total target population of 461 obese women, BMI across selected studies ranging between 28 and 44 (Fig. 3), who underwent five different laparoscopic methods of entry

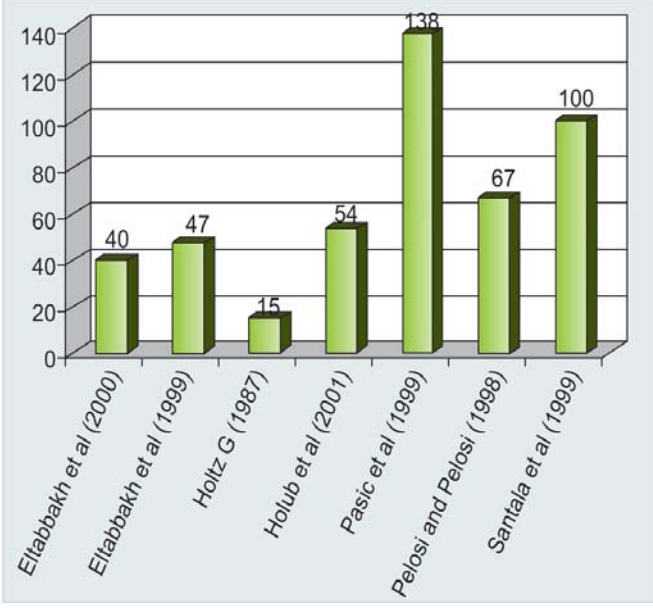


Fig. 2: Number of obese women in selected studies (n = 461)

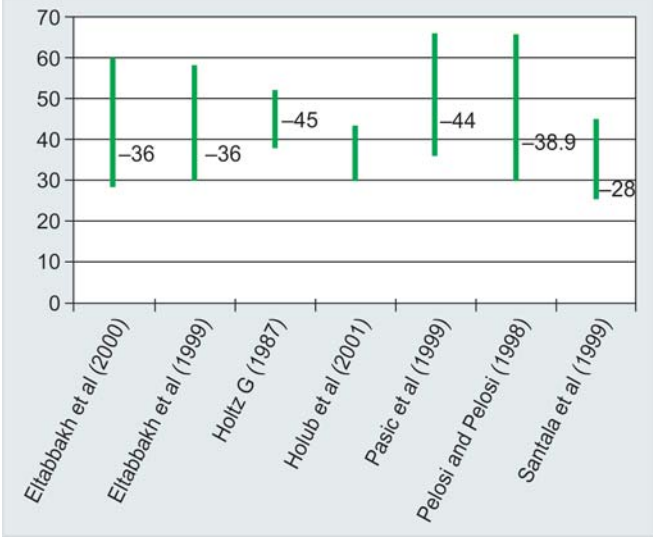


Fig. 3: Range of BMI across selected studies (with mean where possible)

(Fig. 4); they found that the subcostal approach carried the minimal failure rate in comparison to the closed/infraumbilical access (Fig. 5). Failed laparoscopy due to unsuccessful pneumoperitoneum or secondary to it was noticed to be higher with the infraumbilical route (Fig. 6). The major findings of this review were not conclusive in providing decisive evidence that could influence a change in practice from one method of entry to another in the obese woman.[25]

It has been argued that it is not only the method of entry that matters, proper selection of patients, site of entry, previous abdominal surgery, obesity, expertise of the surgeon are the factors which determine the increased or decreased primary access related complications in laparoscopic surgery. So, it has been concluded that no method of primary access is superior to the other in terms of primary access related complications and the closed primary access is as safe as open access and it is recommended that surgeons must continue with the primary access technique in which they are expert.[26]

CONCLUSIONS

Laparoscopic surgery in obese patients presents a variety of challenges and potential complications. The traditional view suggested that this approach was unsafe and should be avoided in such patients. However, as laparoscopic surgery and skills have progressed in recent years, it has become apparent that this approach is safe and effective in many obese patients and indeed has potential advantages over traditional open surgery. Obese patients will continue to present an increasing challenge to laparoscopic surgeons. It is imperative that we understand the dynamics of this condition and develop techniques to deal effectively and safely with such patients.

Gaining safe and accurate access is the first and most important step in achieving a safe and efficient laparoscopic surgery.

Minor technical difficulties are more common among obese women during diagnostic and operative laparoscopy.

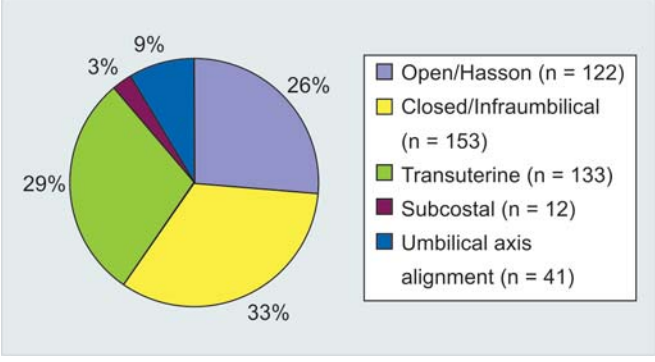


Fig. 4: Percentage of different entry techniques in review from selected papers (n = 461)

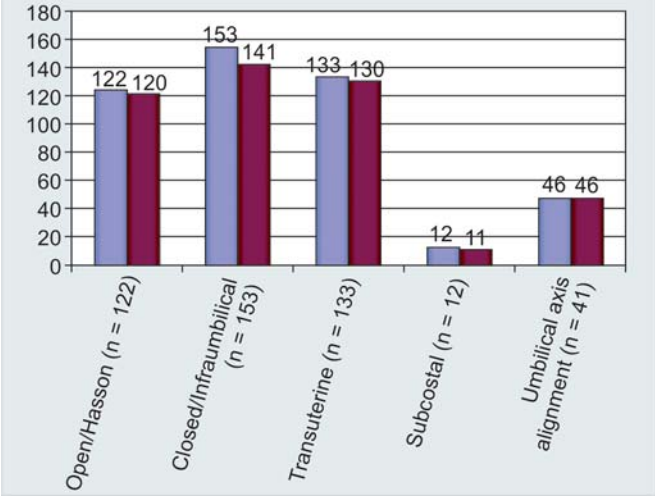


Fig. 5: Number of failed laparoscopies by entry technique

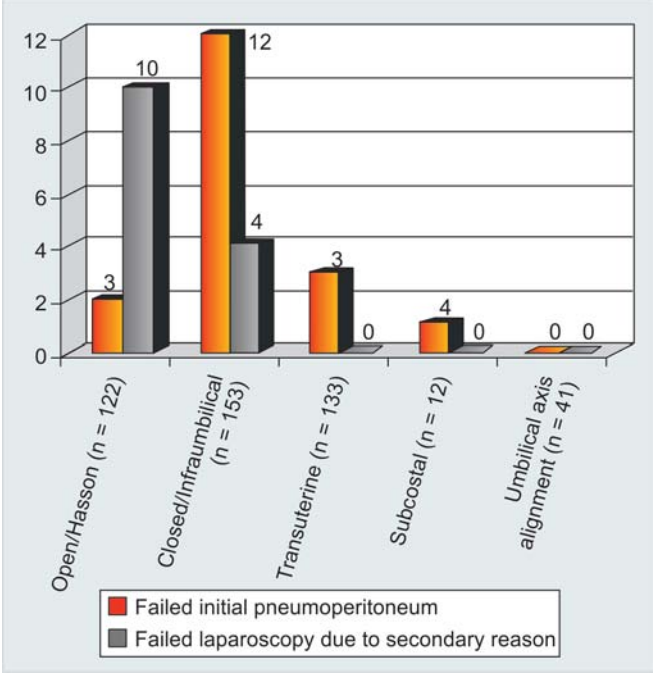
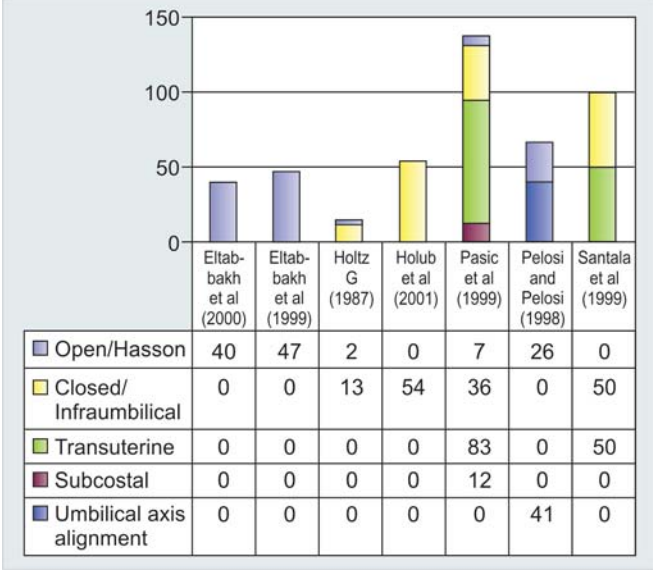


Fig. 6: Failed laparoscopy due to unsuccessful pneumoperitoneum and reasons secondary to pneumoperitoneum



	Eltab-bakh et al (2000)	Eltab-bakh et al (1999)	Holtz G (1987)	Holub et al (2001)	Pasic et al (1999)	Pelosi and Pelosi (1998)	Santala et al (1999)
Open/Hasson	40	47	2	0	7	26	0
Closed/ Infraumbilical	0	0	13	54	36	0	50
Transuterine	0	0	0	0	83	0	50
Subcostal	0	0	0	0	12	0	0
Umbilical axis alignment	0	0	0	0	0	41	0

Fig. 7: Number of entry techniques within selected papers

While obesity was considered a relative contraindication to laparoscopy, it should no longer be considered a contra-indication to laparoscopic surgery.

RECOMMENDATIONS FOR PRACTICE

On the basis of the available evidence, there appears to be no benefit in terms of safety of one technique over another. No definitive conclusions can be drawn to confirm the relative safety of any particular technique.

In everyday clinical practice, the individual laparoscopic may continue his preferred entry technique. Furthermore, it is recommended that every laparoscopic surgeon requires additional skills in the practice of at least one alternative entry method, site or instrument as a backup in case the preferred method, site or instrument cannot establish an uneventful entry in the abdominal cavity.

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REVIEW ARTICLE

Laparoscopic Surgery for Colorectal Cancers: Current Status

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ABSTRACT

Background: Minimal access surgery short-term benefits of laparoscopy for colorectal cancer, such as faster bowel function recovery, less postoperative pain and shorter hospitalization based on data organized according to levels of evidence.

Purpose: To understand the long-term benefits of laparoscopy for colon cancer with regard to recurrence and survival based on data organized according to levels of evidence. To review the literature of laparoscopic surgery for colorectal cancers and its current status in purely laparoscopic, laparoscopic assisted, hand-assisted laparoscopic surgery (HALS).

Materials and methods: A literature search was performed using search engine Google, HighWire Press and Online Springer Library facility available at World Laparoscopy Hospital. The following search terms were used: Laparoscopic surgery for colorectal cancer current status. Selected papers were screened for further references, operative procedure were selected, only if they are universally accepted procedures, and the institution where the study was done is specialized institution for laparoscopic surgery.

Conclusions: In selected patients, a laparoscopic resection for colorectal cancer produces acceptable intermediate to long-term oncologic outcomes and a low long-term complication rate.

Keywords: Laparoscopy, Colorectal, Colon, Cancer, Survival, Outcomes, Audit.

INTRODUCTION

Since Jacob's first laparoscopic colectomy in 1991, there are various reports in literature suggesting that minimal access surgery is probably the way forward in colorectal surgery.

We must discuss colonic and rectal cancers as two separate diseases though a lot of concerns are going to be common. Laparoscopy as a tool can be used in two ways:

a. Thorough abdominal cavity exploration with simultaneous staging of disease with the help of intraoperative ultrasound
b. Intraoperative ultrasound can diagnose liver metastasis which may have been missed by routine preoperative imaging techniques. This may not alter the plan of resection of primary disease but intent of resection may change.

Laparoscopic colorectal surgery can be done in three ways:

a. Purely laparoscopic
b. Laparoscopic assisted
c. Hand-assisted laparoscopic surgery (HALS).

SURGICAL PROCEDURE

An empty digestive tract facilitates the layering of intestinal loops. It is achieved by a strict, fiber-free diet 8 days prior to surgery. Polyethylene glycol is prescribed 2 days before surgery to complete the intestinal preparation.

The patients were placed in a modified lithotomy position, and a pneumoperitoneum was established with a Veress needle, maintaining intra-abdominal pressure at 12 to 15 mm Hg. Four or five trocars were placed (Fig. 1). The descent of the splenic flexure was first carried out after placing the patient in the antitrendelenburg position with inclination to the right. After the patient was placed in the trendelenburg position, dissection was performed with ligature of the inferior mesenteric vessels at the site of origin, respecting the left colic vein, whenever possible (Fig. 2). Dissection was then made by the avascular plane, performing rectosigmoid dissection with total mesorectal excision (TME) in tumors of the middle and lower thirds (LAR) and mesorectal excision up to 5 cm below the lesion in tumors of the upper third (AR). After completion of the pelvic dissection, the distal end was sectioned using an EndoGIA-type mechanical suturing device. The assistance incision was made at the suprapubic level (Pfannenstiel incision) with a length of 5 to 7 cm, according to the size of the tumor. Intracorporal

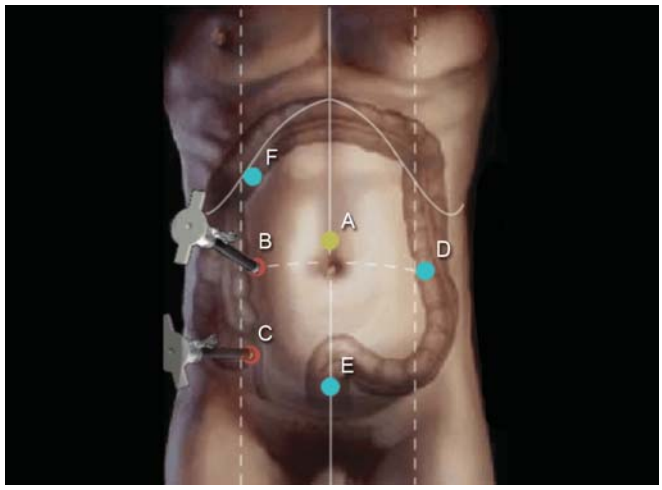

Fig:1: Working port

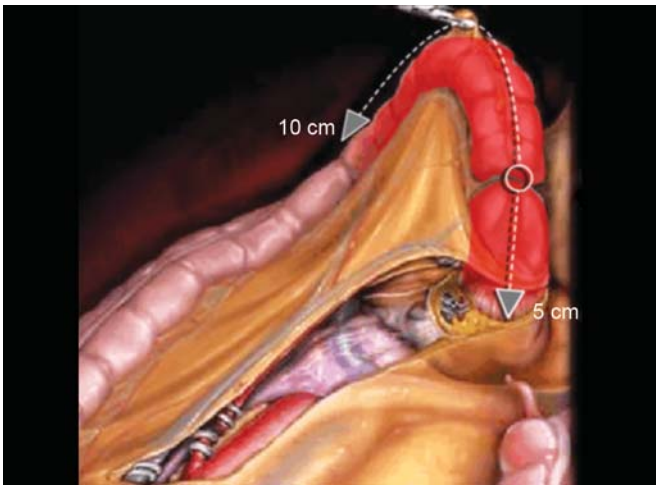

Fig. 2: Dissection, opening of peritoneum, initial vascular approach, mobilization of sigmoid colon

Fig. 3: Extra-abdominal preparation for proximal segment EndoGIA-type mechanical suturing device

anastomosis was made in all cases under laparoscopic control, and a low-pressure aspirative drain was placed next to the anastomosis. Protective ileostomy was performed in cases with very low anastomoses and in patients who had undergone previous neoadjuvant treatment, although this was always done at the discretion of the surgeon. Conversion was defined as the need to carry out an unplanned incision or an incision of greater than normal size to complete the dissection and/or section of the distal end of the rectum. A Pfannenstiel incision or infraumbilical middle laparotomy was performed at the discretion of the surgeon (Fig. 3).

A successful TME starts with the proper ligation of the SHA or IMA. As one dissects down toward the sacral promontory, the sympathetic nerve trunks are identified. The dissection plane is just anterior or medial to these nerves. Using the cautery or scissors, the nerves are reflected toward the pelvic sidewall while the mesorectal fascia surrounding the mesorectal fat is kept as an intact unit. The dissection starts posteriorly and then at each level proceeds laterally and then anteriorly (Fig. 4). In the midrectal area along the lateral sidewalls, one can sometimes see the parasympathetic nerves tracing anteriorly toward the hypogastric plexus. The plexus is usually on the anterolateral sidewall of the pelvis, just lateral to the seminal vesicles in the man and the cardinal ligaments in the woman. There is often a tough ligament that traverses the mesorectum at this point. It theoretically contains the middle rectal artery. However, in a study by Jones et al this artery is only present to any significance about 20% of the time. The anterior dissection is perhaps the most difficult. In men, one should try to include the two layers of Denonvillier's fascia. This fascia is composed of peritoneum that has been entrapped among the seminal vesicles, prostate anterior and the rectum posterior. In woman, the peritoneum at the base of the pouch of Douglas is incised and the rectovaginal septum is then separated.

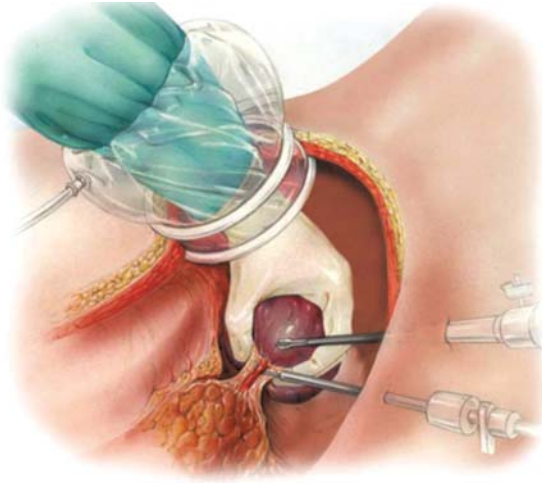

Fig. 4: Hand-assisted surgery

Fig. 5: HALS and colorectal surgery

Colorectal surgeries are nicely performed through hand-assisted technique (Fig. 5). In hand-assisted surgery, the surgeon can insert a hand through the small incision via a special pressurized sleeve. In this procedure, the surgeon makes a small incision in the abdomen and inserts his hand into the patient's

body, using it for sensory perception and to guide the surgical instruments. He manipulates with his other hand while observing the entire procedure on a TV screen overhead. With both hand and laparoscopic instruments doing the work, the surgeon has more control over the operation and sense of depth and sensation of touch that cannot be gained through the lens of a camera.

POSTOPERATIVE PAIN

Numerous randomized controlled trials have demonstrated a significant reduction in pain or analgesic requirements in the immediate postoperative period. In a meta-analysis, Abraham et al found significant advantages for the laparoscopic colectomy group in pain levels at rest and during coughing.

QUALITY OF LIFE

Quality of life (QOL) has primarily focused on postoperative pain and intravenous analgesic requirements. While it may be expected that laparoscopy results in decreased pain and consequently less intravenous analgesic use, this assessment may be subject to bias in nonrandomized trials since patients undergoing laparoscopy tend to start oral feeding/analgesics earlier. The few case control and cohort studies that addressed postoperative pain have reported inconsistent results possibly due to the small number of patients in these studies. In contrast, randomized trials have shown laparoscopy to be associated with less pain at some point in the postoperative recovery period, pain with coughing and fatigue were significant less in the laparoscopy group up to postoperative days. Exact QOL between two groups is difficult to measure because of lack of more sensitive and appropriate instruments.

RECOVERY OF BOWEL FUNCTION

Faster recovery of bowel function is another significant advantage seen in the laparoscopic group. Schwenk et al found that first passage of flatus was 1 day earlier in the laparoscopic colectomy group ($p < 0.0001$) and the first bowel movement was 0.9 days earlier ($p < 0.0001$). Lacy et al demonstrated faster initiation of peristalsis and oral intake in laparoscopic group.

LENGTH OF HOSPITAL STAY

Length of hospital stay is a common variable assessed in most laparoscopic studies. It reflects the rapidity of physiologic recovery and has economic implications with regard to operative and hospital costs.

Results from numerous retrospective and prospective series demonstrate a mean duration of hospitalization of 10.5 days, with one series reporting a mean as high as 16.6 days. However, it is difficult to make sense of this data as the length of hospitalization is significantly influenced by the health care system in which the patient is treated as by the condition of the patient himself.

It is often dependent upon bowel function recovery and severity of postoperative pain. There is high level of evidence suggesting laparoscopic group has shorter stay compared with laparotomy group.

COST

Experience with laparoscopy for the treatment of benign disease has suggested that the short-term benefits gained with the laparoscopic approach may compensate for the higher costs related to a laparoscopic procedure. Although laparoscopy was associated with increased operating times and increased costs associated with disposable equipment, the total overall cost was less than for the open group. The most convincing evidence comes from a recent prospective, randomized study, in which cost analysis was performed on a subset of patients (98 laparoscopic, 111 open) participating in the Swedish colon cancer laparoscopic or open resection. The study period included 12 weeks after surgery and the analysis examined direct medical costs (hospital costs and cost of outpatient care) and indirect costs, such as loss of productivity, because of time absent from work. The authors found that the total cost to society was similar for laparoscopic and open procedures but the total cost to the health care system was significantly higher for the laparoscopic group. The main contributors of this higher cost included higher operating room costs, costs resulting from complications and reoperations which occurred more frequently in the laparoscopic group. However, it is critical to note that in this study there was no difference in hospital length of stay to offset the higher costs of short-term care. However, early recovery resulted in less loss of productivity such that the two approaches did not differ in economic impact.

LONG-TERM OUTCOMES

Long-term outcomes among the various studies may be impaired due to the lack of homogeneity in patient selection, radiation therapy, site and stage of the tumor, time of follow-up and violation of the "intent-to-treat principle" in some trials, which can impact recurrence and reported survival rates. Additionally, most of these studies are non-controlled, non-randomized trials with a short-term follow-up and/or a small number of patients.

DISEASE-FREE SURVIVAL AND OVERALL SURVIVAL

Different studies have reported 3 to 5 years survival (Kaplan-Meier curve) data. Retrospective and prospective reviews have demonstrated a 5-year survival rate ranging from 72 to 80.9%, after curative resection with better outcomes associated with early stage carcinomas.

Comparative case control and cohort studies have not demonstrated any differences in 5-year survival between patients who underwent laparoscopy and those individuals who had laparotomy with rates ranging from 64 to 93% in both

groups published one of the largest nonrandomized studies. Data from 102 consecutive patients who underwent laparoscopic colorectal resection were reviewed and compared to 641 patients who had an open procedure at the same institution and with the National Cancer Data Base (NCDB), including 36,947 patients during a similar time period; complete 5-year survival data were attained for 93% of the laparoscopically treated patients. Overall, the mean follow-up time was 64.4 months; patients who died were excluded. The 5-year relative survival rates in the laparoscopic group were 73% for stage I, 61% for stage II, 55% for stage III and 0% for stage IV disease. These results were comparable to the open group and the NCDB data which showed a survival rate of 75% and 70% for stage I, 65% and 60% for stage II, 46% and 44% for stage III, and 11% and 7% for stage IV disease respectively. Finally, the overall Kaplan-Meier 5-year survival curve for patients treated by laparoscopy was 54%, including all stages of disease, and 64% for stage I to III diseases.

RECURRENCE RATES

Large number of retrospective and prospective series have reported recurrence rates after curative resection. These studies have had a mean/median follow-up time from 16 to 71 months; recurrence rates varied from 7.2 to 16.1%, including local recurrences from 1.5 to 4.1% and distant recurrences from 6.1 to 10.3%. In contrast to earlier reports, port/extraction site recurrence rates do not seem to surpass 1% after curative resection in the majority of recent studies.

Comparative studies have found equivalent recurrence rates between laparoscopy and laparotomy with an overall rate of approximately 4.6 and 20% for both groups. Local recurrences have reached up to 14.8 and 26% and distant recurrences up to 15 and 18.6% in the laparoscopic and open groups respectively.

PORT SITE METASTASIS AND TUMOR DISSEMINATION

In 1993, Alexander et al reported a case of wound recurrence after 3 months following laparoscopic right hemicolectomy for a Dukes C adenocarcinoma. After this, there were flood of reports of increased port site metastasis with laparoscopy for malignancy.

In a critical review of the literature from 2001, Zmora et al analyzed total of 16 series of laparoscopic colorectal resections for carcinoma, published between 1993 and 2000, each comprising of greater than 50 patients and found an incidence of port site metastasis of less than 1% among 1,737 patients. More recently, the data from well-designed randomized controlled trials have provided definitive evidence against a higher incidence of port site metastasis in laparoscopic colon surgery compared with traditional resection. The clinical outcomes of surgical therapy (COST) study reported a wound recurrence rate of 0.5% in laparoscopy group compared with a 0.2% in the open group ($n = 872$, $p = 0.50$). Lacy et al found a single case of port site recurrence in the laparoscopic group ($n = 106$) as compared to none in the open group ($n = 102$), after a median follow-up of 43 months. Early high incidence of port metastasis was probably because enthusiastic laparoscopic surgeons ignored oncological principles.

Another concern is regarding the accidental tumor spillage during laparoscopic colorectal resections that is caused by grasping and manipulating the bowel in the narrow pelvis. The prevalence of intraoperative tumor cell dissemination that is caused by iatrogenic tumor perforation or transaction during laparoscopic APR has been reported to be as high as 5%. At the moment, there are few large studies more than 50 patients and 3 years follow-up. In two series, where patients underwent laparoscopic rectal resection for advanced tumor, local pelvic recurrence rates were 19% and 25%, quite similar to recurrence rate in the open group.

In CLASICC trial, 7,242 rectal resections were performed and conversion rate ranges from 34% for rectal cancer as opposed to 25% for colonic cancer. Rate of positive margins were not statistically difficult. This clearly demonstrates that laparoscopic rectal resection even in the hands of experienced surgeons is more technically demanding than laparoscopic colonic surgery. Although large randomized, prospective trials may show that experienced laparoscopic colectomists can achieve good outcomes for patients who have curable intraperitoneal colon adenocarcinoma, these results cannot be extrapolated immediately to patients who have rectal cancer. Thus, it is critical to evaluate immediate pathology and long-term oncological results of laparoscopic proctectomy prospectively, before recommending the technique for mass consumption.

SUMMARY

Laparoscopy for colorectal cancer has shown to be superior to laparotomy in regard to short-term benefits, including pain, length of ileus, length of hospitalization, cosmesis, morbidity and disability. When performed by appropriately skilled surgeons in properly selected patients, these short-term benefits are almost always demonstrated. Since the publication of the COST trial, it appears that laparoscopic colectomy and conventional open colectomy have similar long-term outcomes. Fundamental differences exist between the Lacy trial and the COST trial. The former study included patients all of whom were operated upon by a single highly skilled surgeon with a team devoted to laparoscopic resection. The latter study included a myriad, if surgeons with a wide range of backgrounds entering a variable number of cases per surgeon. The COST trial may therefore better reflect the typical community standard than the Lacy trial. However, the Lacy trial which found superiority relative to recurrence and survival in favor of laparoscopy suggests that, in the hands of skilled laparoscopic surgeons performing a high volume of this technique in the

setting of a dedicated team, laparoscopy may be superior to laparotomy. The fact that this difference was not detected in the COST trial may be more due to study design than to case selection. In addition, other benefits, may be conferred by laparoscopy, including reduced rates of ventral incisional hernia and bowel obstruction. Unfortunately, none of the randomized, controlled trials to date have included these variables for analysis.

CONCLUSION

The COST trial prompted the American Society of Colon and Rectal Surgeons and the Society of American Gastrointestinal Endoscopic Surgeons to jointly endorse an approval statement on laproscopic colectomy for curable cancer.

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REVIEW ARTICLE

Transanal Endoscopic Microsurgery: Where it Stands as of Today?

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ABSTRACT

Objective: To review the present role of transanal endoscopic microsurgery (TEM) in the treatment of rectal neoplasms.

Methods: Literature search was conducted with restriction to english language and only published material was considered. Search was performed at Medline, Google, Cochrane library and SpringerLink. Search terms were: transanal endoscopic microsurgery, TEM, rectal cancer, rectal adenoma and carcinoid tumor.

Results and conclusion: The review of the present literature is confirming the increasing acceptance of TEM, as a primary modality, over conventional surgery in the management of early rectal cancers, especially pT1 lesions. As far as pT2 is considered, it has to be combined with either adjuvant chemoradiation or salvage surgery. For locally advanced pT3, lesions, it is not preferred unless neoadjuvant therapy is successful in downstaging the tumor or in patients who refuse or are unfit for major surgery. However, the cost of equipment and steep learning curve are restricting this therapy to few specialized centers around the world.

Keywords: Transanal endoscopic microsurgery (TEM), Rectal adenoma, Early rectal cancer, Locally advanced rectal cancer, Carcinoid tumor.

INTRODUCTION

In 1980s, Buess in Germany described for the first time the alternative endoluminal surgery to low rectal neopalsms in order to circumvent the disadvantages associated with conventional local techniques.[1] TEM was the first attempt at minimally invasive surgery, through a natural orifice using laparoscopic instruments and a rigid operating proctoscope. This involved minimally invasive excision large endoscopically irretrievable rectal polyps and T1 rectal cancers; some extended uses for more advanced disease.

The advantages of TEM, such as a better visibility, improvised optics, longer reach permit a more complete excision and precise closure. TEM is more precise than traditional transanal excision and more likely to get clean margins with less manipulation of the mass.[1]

Only lesions within 20 cm from the anal verge and, especially, below the peritoneal reflection are suitable for TEM. As the peritoneal reflection is approximately 12 cm against the anterior rectal wall, this is the anterior limit (Fig. 1). After assessment of the exact topography of the tumor and histological assessment, adenomas are planned for TEM excision.[2]

The aim of this review was to study the present place of TEM in the armamentarium of surgeons dealing with colorectal cancers. And compare it with existing techniques, such as low anterior resection and abdominoperineal resection.

MATERIALS AND METHODS

Literature search was conducted with restriction to English language and only published material was considered. Search was performed at Medline, Google, Cochrane library and SpringerLink. Search terms were: Transanal endoscopic microsurgery, TEM, early and locally advanced rectal cancer and primary modality therapy. Patient age, gender, tumor distance from the anal verge, lesion size, operative time, blood loss, complications recurrence and survival rates were studied.

TECHNIQUE

The patient undergoes a full bowel preparation and general anesthesia. Patient is positioned on the table in such a way that the lesion is at 6'O clock at the time of dissection (Fig 1). Dilatation of the anus is required for the passage. Special design 40 × 200 mm proctoscope is inserted (Fig. 2). Carbon dioxide is preferred for gas insufflation. With the use of a binocular stereoscopic eyepiece for three-dimensional view or a forward oblique telescope, a magnified view is created for visualization of the lesion (Fig. 3). The proctoscope has three channels for instruments, including dissecting forceps, needle holder and suction cannula. A 40º optic enters through the fourth port and is connected to a video camera that transmits the image to a conventional monitor (Fig 4). Due to the narrow working space TEM requires expertise and special training. Moreover, distal rectal lesions are more challenging to resect due to difficulties in maintaining the gas seal and maneuverability of the instrumentation.

Lesions can be excised with partial or full-thickness of rectal wall. Following establishment of pneumorectum, a margin of at least 5 mm for adenomata and 10 mm for cancers is scored around the tumor with diathermy (Fig. 5). With various instruments (e.g. ultracision harmonic scalpel, needle diathermy, tissue handling forceps, needle holder, suction probe, injection needle, clip applicator) the lesion can be dissected by means of an *enbloc* full-thickness rectal wall excision until the perirectal

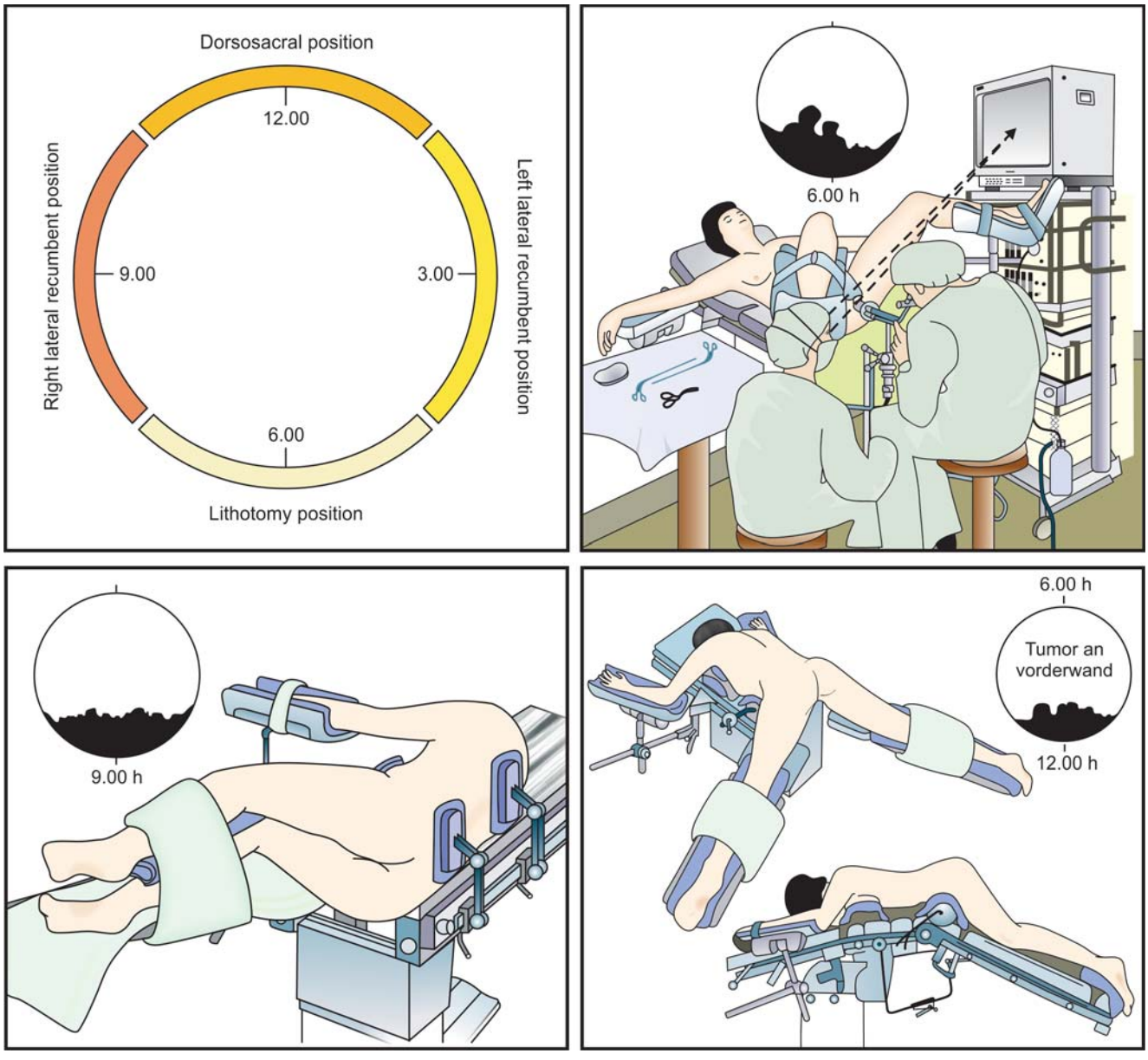

Fig. 1: Positioning of the patient for TEM

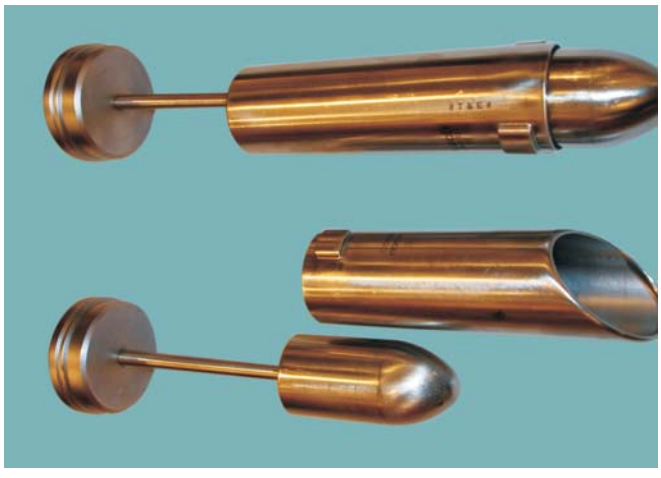

Fig. 2: Special proctoscope

Fig 3. Binocular stereoscopic eyepiece for three-dimensional view

fat. A full-thickness excision of the tumor with negative margins is performed, including the adjacent perirectal fat. For anteriorly localized lesions, the plane of dissection was the vagina septum or the prostate capsule, whereas for posterior lesions it was the so-called "holy plane". The final specimen preferably has the shape of a "truncated pyramid"[2] (Fig. 6). The injection of saline solution in the submucosa in a mucosectomy fashion may be used to facilitate the removal of benign lesions. Wound closure can be achieved with clips or suture stitches. The surgical specimen is pinned out and oriented for pathological analysis of the margins (Fig. 7).

DISCUSSION

Low lying rectal lesions whether benign or malignant have always been a subject of debate among the older conventional surgeons as well as the new breed of minimally invasive surgeons. The current gold standard treatment for any stage of the disease is conventional rectal resection, which is accompanied with significant morbidity and mortality. These relative drawbacks of conventional surgery have led to the development of local excision through transanal techniques.[3-5] Conventional radical surgery (low anterior resection and abdominoperineal resection) proudly claims the success in good oncological clearance, which is virtually impossible by the newer local approaches (including the transanal resection and TEM). However, the complications associated like urinary and sexual dysfunction (30-40%), anastomotic leak (5-10%), requirement of colostomy, local recurrence rate (7-14%) and mortality (2-6%). The 5-year survival rate after APR is 60%; the failure and death after radical surgery for T1 and T2 are also high.[6] Local approaches like transanal resection and TEM were the alternatives to circumvent these disadvantages. The present goal of therapy of these cancers is optimal chance of cure and better quality of life.

In terms of local recurrence and survival rates, the long-term results for patients with early-stage rectal cancer treated using TEM procedure are comparable with those after radical surgery quoted till now in literature.[6,7] Resection of the rectum, a major surgery procedure associated with significant morbidity (7-68%) and mortality (0-6.5%), is avoided.[8] Though for lesions T2 and above it is undoubtedly superior, for T1 and T2 is a radical procedure accompanied by its morbidity and mortality. Patient acceptance of colostomy is a major cause of concern.

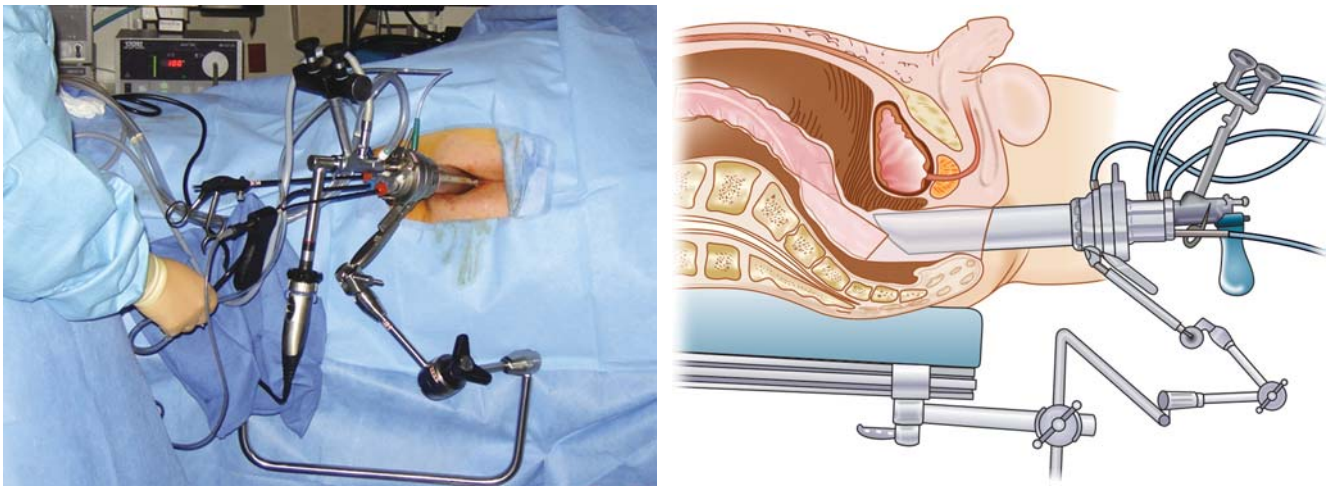

Fig 4. Instrument assembly for TEM

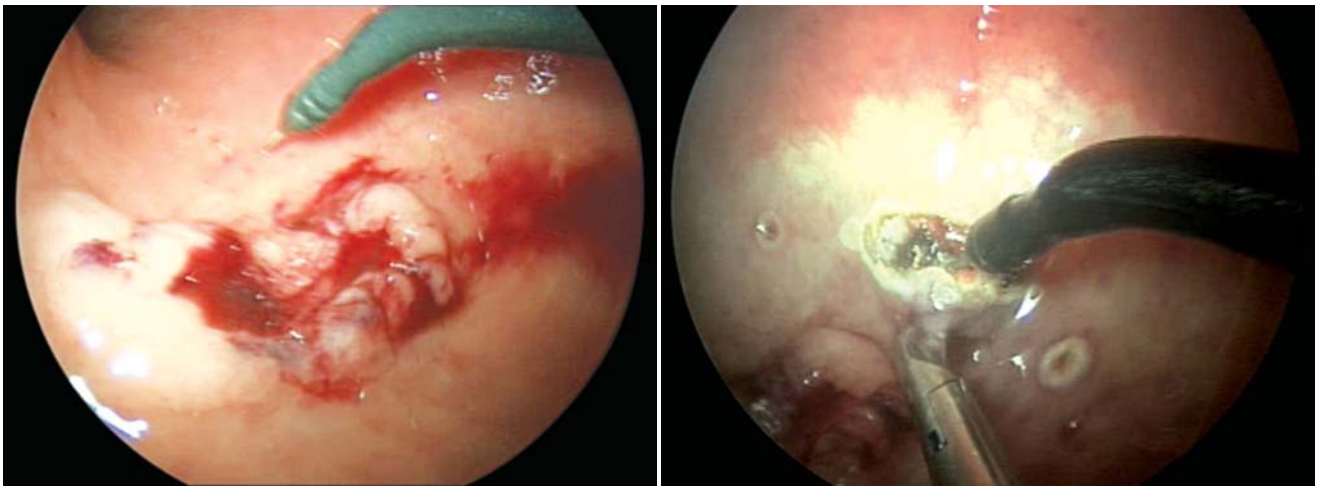

Fig. 5: Margin scoring for tumor with diathermy

TEM as a curative option, are for early rectal cancers which are histologically pT1, i.e. small (< 3 cm), well-to-moderately differentiated adenocarcinomas, with no lymphovascular space invasion and minimal (sm1) invasion of the submucosa (Table 1).[2]

Hence, it is crucial to confirm the T stage before embarking on TEM. The two preferred imaging approaches are endorectal ultrasound (ERUS) (accuracy 82-93% in distinguishing T1 from T2) and when it comes to detection of lymph node metastasis MRI with accuracy of 72 to 92% (65 to 81% for ERUS) is preferred. Hence in totality, for both T and N staging, both ERUS and MRI are used.[6,7]

Table 1: T1 tumors and risk factors for lymph node metastases[2]

	Low-risk	*High-risk*
Degree of differentiation	Well/moderate	Poor
Histological	Grades 1 and 2	3
Histological subtype	–	Mucinous adenocarcinoma
Lymphovascular space invasion	–	+
Kikuchi level	sm1	sm2 and sm3
Tumor diameter	< 3 cm	≥ 3 cm

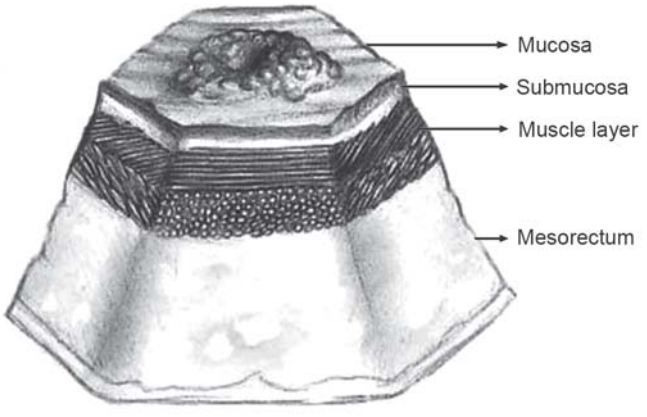

Fig. 6: Truncated specimen after resection

Fig. 7: Pinned out specimen for pathological analysis

TEM for Benign Lesions

It is now widely accepted that TEM is an excellent option in managing rectal adenoma and polyps which are not amenable to treatment by colonoscopic approach. Low recurrence rate, low conversion rate, low complication rate and lower cost are the favoring aspects.

TEM is now confirmed in many studies to be safe and effective for rectal adenomas, in comparison to conventional transanal approach.[8,9]

TEM for Malignant Lesions

Low anterior resection or abdominoperineal resection encompasses removal of the mesorectum with or without preoperative combined modality therapy (CMT). Though recurrence and survival rates are improved, long operative time and postoperative complications, such as bleeding, anastomotic dehiscence, need for colostomy, sexual or urinary dysfunctions, pneumonia and thromboembolic events are prohibitive.[10] TEM surpassed TME (total mesorectal excision) in all these aspects. But most notably, TEM does not address the mesorectal lymphnodes. Hence, proper patient selection is mandatory to optimize results.

TEM for pT1—Is TEM Alone Sufficient ?

Early rectal cancer refers to T1or T2N0M0. Till now TEM has been usually indicated for patients with low-risk T1 adenocarcinomas. A low-risk T1 lesion is the one with favorable prognostic factors, such as small size (less than four centimeters), absence of invasion of the sm2 or sm3 levels of the submucosa, well-differentiated histology, absence of vascular, lymphatic or perineural invasion.[10] When these criteria are fulfilled survival and local recurrence rates achieved by TEM are similar to those of radical treatment but with limited morbidity and mortality.

Heintz et al[11] compared the results of TEM and radical surgery in 103 patients with T1 rectal carcinomas. TEM had significantly lower morbidity and mortality rates (3.4% *vs* 18% and 0% *vs* 3.8% respectively). Regarding 5-year survival rate, no difference was observed between the procedures in those patients with low-risk T1 lesions. Borschitz et al[12] observed that R0 resection in cases with low-risk pT1 carcinomas by TEM can be oncologic adequate with similar results when compared to primary radical surgery for pT1N0M0 rectal lesions.

Other studies have also demonstrated good results with low recurrence and high survival for selected pT1N0 rectal adenocarcinomas treated by TEM alone. In the advent that pathological examination reveals a pT1 lesion with unfavorable features or a more advanced lesion the authors recommend complementary treatment with radical surgery and/or CMT.[13-16]

What is the Role of TEM in pT2?

Local excision alone for T2 rectal cancer is inadequate with a high risk for recurrence in spite of complete (R0) resection. Neoadjuvant or adjuvant therapy are combined with TEM in this scenario,[17] as noted earlier, due to the greater risk of lymph node involvement in T2 as compared to T1. The study done by Lee et al[18] and Lezoche et al[19] has proven increased risk of local recurrence but it is interesting to note that there was no difference noted in 5-year survival rate in the patients with T2N0 treated by TEM alone. Preoperative combined modality therapy (CMT) than TEM is preferred by many authors. When compared with CMT + TME, local recurrence, distant metastases and survival are same.[17-19]

Can TEM be done after Chemoradiotherapy for Locally Advanced Rectal Cancers?

Inspite of the technological advancement (EURS, CT, MRI, PET-CT) even today it is difficult to confirm the downstaging of locally advanced rectal cancer after neoadjuvant therapy. However for patients who respond to neoadjuvant therapy, TEM is technically feasible as noted in study done by Lezoche et al.[19] Here, the role of TEM is both as therapeutic and diagnostic tool that allows histologic confirmation of downstaging. TEM allows pathologic evaluation of the rectal area involved with low morbidity. Only when there is complete clinical response and negative biopsy TEM is recommended. In case of any doubt radical resection remains the therapy of choice.

Can TEM be used in Advanced Malignancy?

Palliative role of TEM is in those patients who present with advanced disease or those who are unfit for major surgery. The absence of painful abdominal incision and short length of hospital stay and faster recovery is favorable in many such patients.

When to Resect Carcinoid Tumor by TEM?

TEM is safe for the local excision of rectal carcinoid tumors. The depth of invasion followed by the size of the tumor plays a vital role in the response to local treatment. With a diameter < 1 cm and 1 to 2 cm with free margins, 5-year survival is reported at 100% after local excision. If rectal wall is involved then prognosis is poor with 5-year survival of 73%. TEM is not recommended for lesions more than 2 cm diameter and total mesorectal excision preferred.[20,21]

Recurrence is nil as seen in many studies when tumor is less than 1 cm. Another role of TEM is in complete removal of residual tumors, after endoscopic polypectomy.[22]

What is New?

In order to improve the diagnosis of early rectal cancers confocal chromolaser endomicroscopy (cCLEM) has been utilized by Borschitz et al (2009). cCLEM utilizes optical transversal sections at 103 magnification and at this magnification mucosal microarchitecture and differentiation of normal mucosa from adenomas and carcinomas become clear. This has been recommended in cases with rectal tumors having conflicting or unclear findings. An improvized topography showing suspicious areas even in a case of suspected adenoma helps in precise resection of tumor with negative margins. Hence, repeat surgeries are avoided by selective use of cCLEM.[23]

Waleg P et al[24] (2010) have added endoscopic posterior mesorectal resection (EPMR) to TEM. This makes it possible to remove the important lymph nodes draining the lower-third of the rectum in the minimally invasive way, which can help with adequate tumor staging. The increased local recurrence noted with TEM alone can be prevented in this way. They also studied the influence of combined TEM and EPMR treatment on the anorectal functions of this group of patients. EPMR and TEM is reported to be a safe and feasible technique, which does not have influence on basic anorectal functions. However, further studies are required to assess the oncological efficacy of this technique.

COMPLICATIONS

Though a sophisticated approach, a specialized instrument and relatively less working space TEM in experienced hands has complication rate of approximately 10%. The duration of surgery quoted in many studies is around 70 to 80 minutes.[25,26] Common complications listed by many authors are fever, urinary retention, rectal bleeding and pain. Abdominal perforation, transitory fecal incontinence and suture dehiscence with pelvic abscess are rare. The overall complication rate after radical surgery was 48%.[27]

Mortality noted in few studies is due to advanced malignancy in the late postoperative when TEM was done as palliative procedure. Complication rates are same whether TEM is done for benign or malignant cause.[28] The hospital stay is short and reoperation rates are lower. Fecal incontinence is temporary and returns to normal over period of time.[29] In fact, quality of life and even continence are improved after tumor removal.[30]

Why is TEM not Available in all Centers?

The considerable cost of the equipment, the specialized training required, steep learning curve and high cost of surgery are some of the reasons. Absence of screening programs to pick up the lesion early, the late presentation of many patients and restricted availability in specialized centers only are other notable causes.

TEM using two-dimensional visualization and standard endoscopic instruments has been proposed by Nieuwenhuis et al (2009) instead of using three-dimensional equipment (Wolf) (Fig. 8) so they have used two-dimensional (Storz) equipment

(Fig 9). The use of two-dimensional optic capacities has been shown to be more economical and has better ergonomics, though the visibility is superior with three-dimensional equipment. Use of standard laparoscopic equipment reduces the costs even more because of fewer costs for the equipment than for the 3D system (€15,000 *vs* €44,000). The total expense of the procedure using this equipment is €6,000, though the cost of procedure using the conventional one has not been mentioned.[31] Hopefully with technological advancement, the cost of equipment and the procedure becomes affordable.

CONCLUSION

TEM is a boon to patients of rectal cancer, especially for those who are diagnosed early. The low morbidity and practically nil mortality are the key factors. Now it is universally accepted treatment of choice for large rectal adenomas, low-risk pT1, and selected small neuroendocrine tumors localized in the rectum. The 5-year survival rate and frequency of recurrence is similar to that in abdominal surgery. Complications are minimal and mortality is practically nil. In more advanced stages of rectal adenocarcinoma, neoadjuvant/adjuvant therapy when combined with TEM has better outcome and a promising future perspective. Therefore, TEM is a added armamentarium for surgeons in managing rectal neoplasms.

Fig. 8: Wolf rectoscope including a binocular stereoscope

Fig. 9: Storz rectoscope

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REVIEW ARTICLE

Subfascial Endoscopic Perforator Surgery in Perforator Vein Insufficiency

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ABSTRACT

Surgical treatment of incompetent perforating veins of the lower leg performed by open method carries considerable morbidity and also associated with poor wound healing. Subfascial endoscopic perforator surgery (SEPS) is a new, minimally invasive endoscopic technique performed in patients with advanced chronic venous insufficiency. This technique offers an effective treatment alternative which avoids the lengthy incisions of the classical open Linton subfascial ligation techniques. The favorable ulcer healing rate and improvement in clinical symptoms suggest that SEPS is a feasible, safe and effective treatment of the incompetent perforator veins in patients with advanced chronic venous insufficiency.

Keywords: Subfascial endoscopic perforator surgery (SEPS), Minimal access surgery, Incompetent perforator, Chronic venous insufficiency.

INTRODUCTION

Patients with chronic venous insufficiency and venous ulcers were surgically corrected using long incisions through diseased skin and subcutaneous tissues already compromised by venous hypertension. This procedure involved ligation of incompetent perforator veins described by Linton,[1,2] Cockett[3] and Dodd,[4] this technique was often complicated by wound infections and poor healing.

But in 1985, G Hauer[5] demonstrated a new surgical technique where incompetent perforator veins were directly visualized using an endoscope in the subfascial space. This seminal contribution marked the advent of subfascial endoscopic perforator vein surgery (SEPS). The idea to use this approach was based on the possibility to create, using the laparoscopic instruments, a virtual space and seemed to be very interesting since it offered the possibility to avoid further damaging to the scarred tissues surrounding the ulcer and thus to eliminate the wound complications that affected Linton's technique.

In comparative studies, SEPS was associated with fewer wound complications compared with Linton's procedure.[6,7]

AIMS

The aim of the study was to study the role of subfascial endoscopic perforator surgery (SEPS) in perforator vein insufficiency. The following parameters were evaluated:

- Operative technique
- Operative time
- Intraoperative and postoperative complications
- Postoperative pain
- Postoperative recovery
- Patient acceptance.

MATERIALS AND METHODS

A literature review was performed using SpringerLink, HighWire press, BMJ, Journal of MAS and major search engines, like Google, MSN, Yahoo, etc. The search term was the role of SEPS in perforator vein insufficiency. 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), method of analysis (statistical or nonstatistical), operative procedure (only university accepted procedures were selected) and the institution where the study was done (specialized institutions for endoscopic procedure was given more preference).

EQUIPMENT FOR SEPS

Most of the instruments used in this procedure are usually used for laparoscopic cholecystectomy.

Instrumentation Includes

- Insufflator for introducing carbon dioxide to maintain the working space
- A rigid 5 or 10 mm endoscope
- A three-chip video camera preferably with xenon light source
- A TV monitor (Fig. 1)
- A 10 mm cannula, rigid endoscope is introduced into the subfascial working space
- 5 mm cannula is used for all other equipments.

Other additional instruments important for the successful performance of the operation are: A balloon dissector (General Surgical Innovations, Cupertino, CA, USA). Although dissection of the subfascial plane can be created via endoscopic instruments manually, the balloon dissector significantly expedites the dissection process and helps to create a large,

operative working space. The balloon dissector used in this technique (Fig. 2) has a capacity of 300 cc balloon with a protective removable cover, a guide rod to aid in introduction and placement and also a 10 mm laparoscopic cannula with skin seal.

A second important but optional instrument is the 5 mm roticulating endograsper (US Surgical, Norwalk, CT, USA) (Fig. 3A), where in the tip articulates and rotates which offers a high degree of maneuverability.

The 5 mm clip applier (Ethicon Endosurgery, Cincinnati, OH, USA) (Fig. 3B) needs a 5 mm port. Its small size also offers a high degree of maneuverability and visibility when working in a small endoscopic space. The applier delivers 8 mm long (medium/large) clip in a convenient and with multifire configuration.

PREOPERATIVE PREPARATION

Preoperative evaluation includes color Doppler scanning which can be used to document superficial, deep, or perforator incompetence and guide the operative intervention. Incompetent perforator on the skin is accurately mapped and marked which is mandatory as this assists the surgeon during surgery. Ultrasonologist can help by marking the sites of incompetent perforators and also that of an incompetent SP junction with the help of a skin marker.

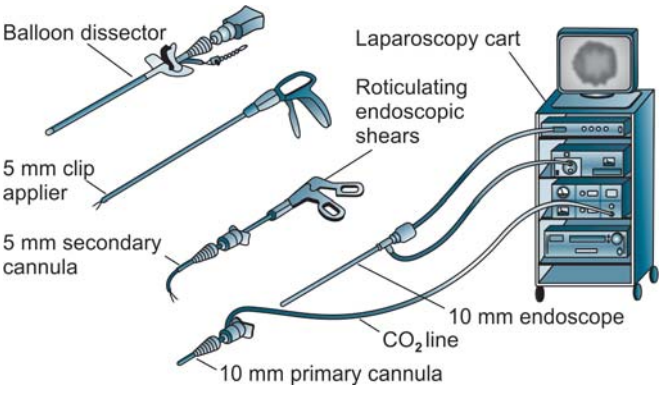
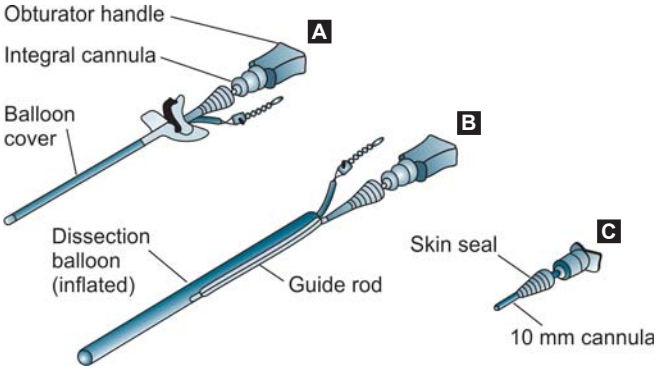


Fig. 1: Instrumentation overview for endoscopic subfascial perforator interruption



Figs 2A to C: Balloon dissector for subfascial perforator interruption: (A) Fully assembled (B) with cover removed and balloon inflated and (C) with balloon and obturator removed, leaving the 10 mm cannula

OPERATIVE TECHNIQUE

SEPS procedure is performed under general/spinal anesthesia with the patient supine and in the trendelenburg position with knee slightly flexed and elevated. In anticipation of concomitant stripping of superficial veins, the entire extremity is prepared circumferentially.

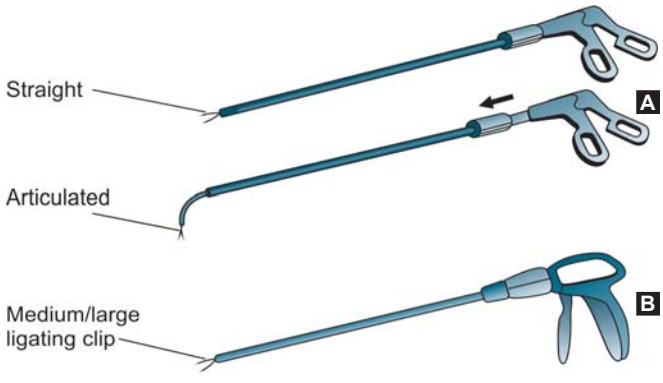
A 10 mm incision is made through the skin, which is 4 cm medial to the tibia and 10 to 12 cm below the popliteal crease. Subcutaneous tissue is dissected, the posterior compartment is identified and a 10 mm transverse incision is made into the fascia.

The subfascial space is identified and retractors are placed to keep it open.

The balloon dissector is introduced into the fascial incision and directed towards the medial malleolus (Figs 4A and 6A). After removal of balloon cover sheath, the dissection balloon is inflated with 200 to 300 cc saline. The balloon is designed in such a way that initial radial expansion occurs, followed by distal expansion towards the malleolus (Fig. 4B), as the balloon everts distally. Dissection occurs along planes of least resistance by balloon, hence, the perforating veins are not disrupted in the dissection process.

The balloon is deflated and removed once the dissection is accomplished, the rotating seal of 10 mm trocar is secured to the fascial incision. The cannula is introduced into the space dissected, and the guide rod and obturator are removed. The skin seal is rotated into the fascial incision to provide a gas seal. CO_2 is then insufflated at a pressure of 15 mm Hg to create the working space. A 0º 10 mm rigid laparoscope with attached video camera and light cable are introduced (Figs 5A and 6B), and the subfascial space is visualized (Fig. 6C) on the video monitor.

A working 5 mm laparoscopic port is then inserted in the mid calf under direct endoscopic guidance. This trocar is placed as posteriorly as possible to make a wide working axis. This arrangement of trocar aids visualization of the working instrument and facilitates instrument manipulation (endograsp dissector or clip applier) in the confines of the calf (Figs 5B and 6D).



Figs 3A and B: 5 mm instrumentation for subfascial perforator interruption: (A) Roticulating grasper facilitates exposure of perforating veins. (B) Clip applier delivers 8 mm long clip for interruption of perforators

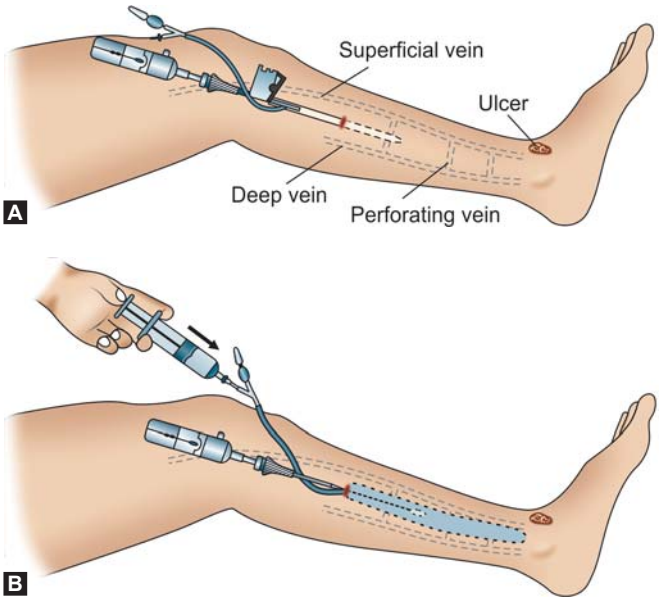
The perforating veins may be visible immediately or may require some amount of blunt dissection and exploration. Skin markings done with the help of duplex venous studies are useful in guiding the surgeon to the location of the perforators. Once identified, each perforating vein is double clipped with the 8 mm titanium clips with a 5 mm clip applier. Generally, all perforating veins which can be identified are clipped (Fig. 6D).

As the perforator continuity is interruped by the clips, the veins are usually not divided. However, division of the perforator between the clips can be performed, when desired, with endoscopic shears to facilitate distal exposure.[8-12]

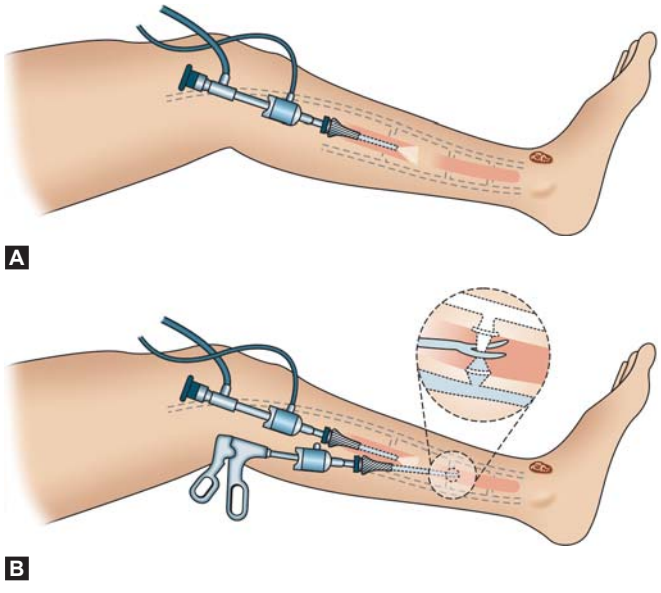
When interruption and/or division of the perforators is complete, the trocars are removed, the skin incisions are closed with interrupted mattress stitches using monofilament sutures. Superficial ligation and stripping can be performed in the standard fashion in patients with superficial venous insufficiency, nonadherent dressing are covered to all wounds, and the operated leg is wrapped with a compression bandage extending from the forefoot to the upper calf or leg. Usually, patients are discharged on the same day of surgery and advised routine follow-up in outpatient department 1 week after surgery.

POSTOPERATIVE MANAGEMENT

Once the effect of anesthetic wears off, the patients are encouraged to ambulate and are discharged on the same day or the day after surgery. Patients receive two postoperative doses of antibiotics in addition to the intraoperative intravenous antibiotic. First 24 hours after surgery, they are provided with adequate parenteral analgesia, this is changed to oral analgesia upon discharge. Postoperative instructions stress on the need for active ambulation, elevation of the operated limb and maintenance of the elastic bandage regularly. Patients are seen for removal of skin sutures in the outpatient department a week



Figs 4A and B: The balloon dissection technique: (A) Introduction and advancement along the subfascial plane. (B) The balloon cover is removed, and the dissection balloon is filled with saline



Figs 5A and B: The endoscopic instrument technique: (A) After balloon removal, the video endoscope is inserted into insufflated subfascial working space. (B) Perforating veins are clipped via a secondary 5 mm port

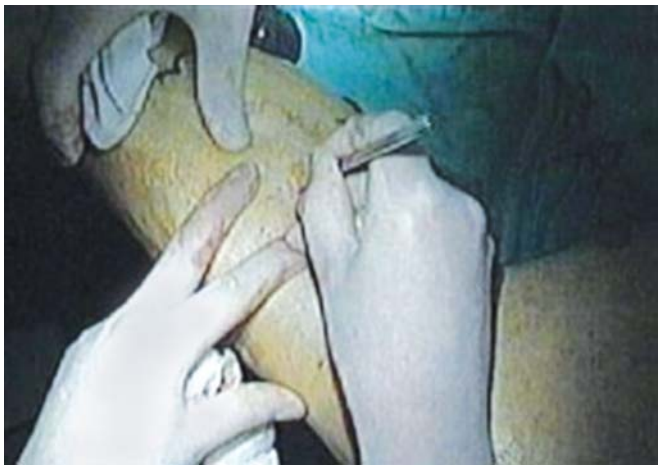


Fig. 6A: Incision of muscularis fascia

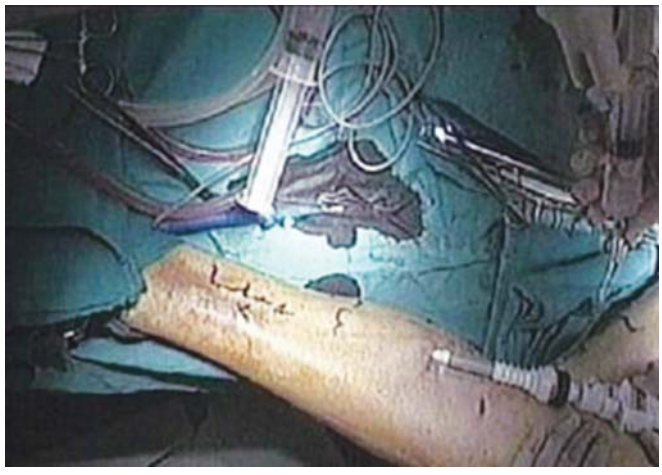


Fig. 6B: Creation of subfascial space

to 10 days after surgery. Those patients with an active ulcer need regular further dressings till the ulcer heals. Class II graduated compressive stockings are prescribed to all patients in a long-term basis.

DISCUSSION

SEPS has gained a lot of attention around the world. A lot of controlled trails have been conducted; many are in favor of SEPS. The goal of this review was to ascertain that if the SEPS procedure for perforator incompetence is superior to convention open (Lintons) surgical procedure, and if so what are the benefits and how it could be more widely instituted. There is lot of diversity in randomized controlled trails. The main variables in these trails are:

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

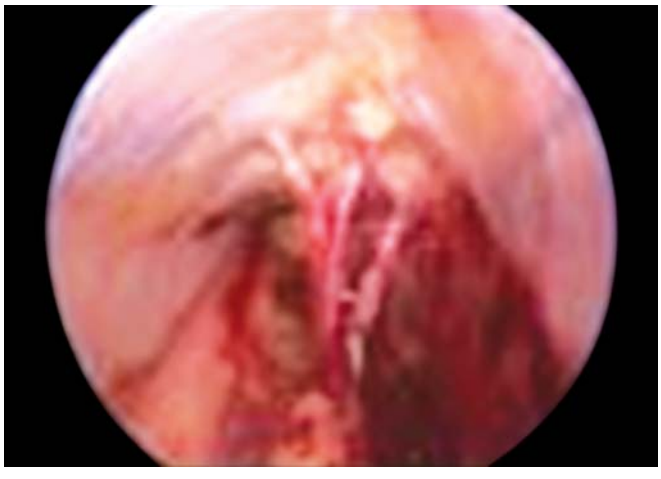


Fig. 6C: Perforator vein seen after creation of subfascial space

Without proper detail to all these parameters, it is difficult to draw a conclusion. One should always think that SEPS and open conventional procedure as being complementary to each other.

A successful outcome requires greater skill of the operating surgeon adequate training in the field of minimal access surgery. SEPS requires different skills and technological knowledge. In fact many studies have shown that the outcome of SEPS was influenced by experience and technique of the operator.

In a study done by Anjay Kumar[13], 21 patients of varicose veins with an incompetent perforator underwent SEPS using a harmonic scalpel. Various parameters were studied. The result of their study was that, all ulcers healed in 8 weeks with no recurrence in 11.9 months follow-up period. There was one case of wound infection and one saphenous nerve neuropraxia as complications noted postoperatively. They concluded that using ultrasonic scalpel in SEPS is technically feasible, causing less tissue damage as the thermal effect it generates is very low, and also the study was associated with minimal morbidity.

In another study by T Luebke and J Brunkwall[14], a meta-analysis of subfascial endoscopic perforator vein surgery (SEPS) for the treatment of chronic venous insufficiency was done. Here, a multiple health database search was performed, including Medline, Embase, Ovid, Cochrane Database of Systematic Reviews and Cochrane Database of Abstracts of Reviews of Effectiveness, on all studies published between 1985 and 2008, that reported on health outcomes in patients with CVI treated with SEPS and comparing this therapy with the conventional Linton procedure. Three studies, which compared SEPS with conventional surgery, were included in the meta-analysis. Results of the study was that between SEPS and Linton groups, there was a significant lower rate of wound infections in the SEPS group [odds ratio (OR) 0.06 (95% confidence interval (CI) 0.02 to 0.25)] and a significantly reduced hospital stay for SEPS [OR: 8.96 (95% CI: 11.62 to – 6.30)]. In addition, there was a significant reduced rate of recurrent ulcers in SEPS group (mean follow-up 21 months) [OR 0.15 (95% CI 0.04-0.62)]. There was no significant difference between the groups in the

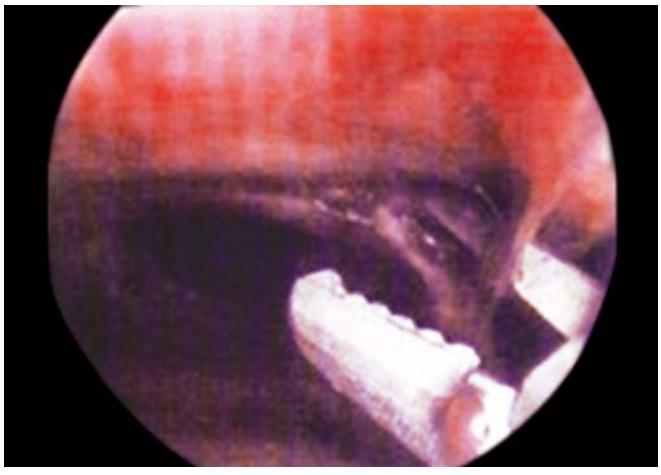


Fig. 6D: Clipping of perforator

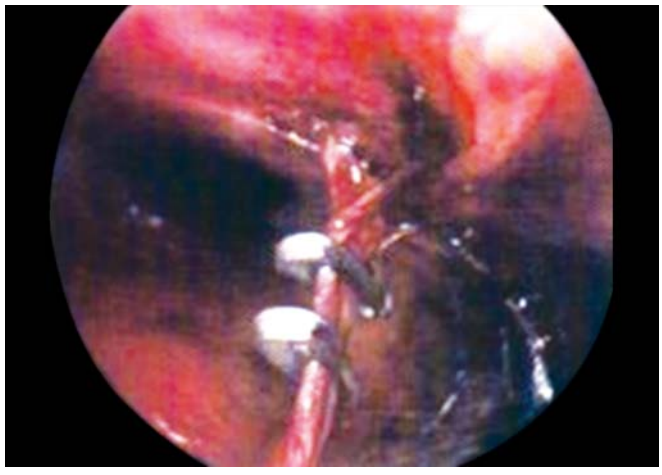


Fig. 6E: After clipping of perforator

following dimensions: Death at 6 months [OR 3.00 (95% CI 0.11-78.27)], rate of hospital readmission [OR 0.21 (95% CI 0.03 - 1.31)], healing rate of ulcer at four months [OR 0.44 (95% CI 0.09-2.12)], and the rate of deep vein thrombosis (DVT) [OR 0.35 (95% CI 0.01-8.85)]. Conclusion drawn from the study was that when SEPS used as a part of a treatment regimen for severe CVI benefits most patients in the short term regarding ulcer healing and also prevention of ulcer recurrence. And SEPS, if safely performed, has less early postoperative complications compared with the Linton procedure. However, still further prospective randomized trials are required to define the long-term benefits of SEPS.

In a randomized study by Kianifard B, Holdstock J and Allen C et al,[15] the effect of adding subfascial endoscopic perforator surgery to standard great saphenous vein stripping was studied. The authors studied the fate of incompetent perforating veins (IPVs) in patients undergoing standard varicose vein surgery *vs* those treated with standard varicose vein surgery and SEPS. Patients were included in this study, if they were undergoing surgery for varicose veins and also had venous reflux (0.5 seconds) in the great saphenous vein (GSV). All patients in the study also had IPVs. Patients were randomly allocated to standard surgery (saphenofemoral ligation, stripping and phlebectomies alone) or standard surgery with the addition of SEPS. Patients were excluded from the study, if they had recurrent varicose veins, deep venous reflux, deep venous thrombosis, ulceration or saphenopopliteal reflux. Using duplex ultrasound, incompetent perforating veins were determined preoperatively, and at 1 week, 6 weeks, 6 months and 1 year after surgery. Visual analogue scores for pain and quality of life questionnaires were obtained at the same time periods.

There were 34 patients in the no SEPS group and 38 patients in the SEPS group. During the follow-up period, the groups did not differ with respect to quality of life scores, pain, or mobility, but at 1 year, there was a higher proportion in the no SEPS *vs* SEPS group that had IPVs (25 of 32 *vs* 12 of 38; p = 0.001). The conclusion drawn was that subfascial endoscopic perforator surgery (SEPS) when used as an adjunct to standard varicose vein surgery reduces the number of incompetent perforating veins at 1 year but has no effect on quality of life or recurrence of varicose vein at 1 year.

Florian Roka[16] et al in their study, they investigated the mid-term (mean, 3.7 years) clinical results and the results of duplex Doppler sonographic examinations of subfascial endoscopic perforating vein surgery (SEPS) in all patients with mild to severe chronic venous insufficiency (clinical class 2 to 6) and also assessed the factors associated with the recurrence of insufficient perforating veins (IPVs). Around 80 patients with mild to severe chronic venous insufficiency undergoing SEPS were evaluated, duplex findings as well as clinical severity and also disability scores before and after the operation, were compared. Those patients with prior deep vein thrombosis (< 6 months) or prior to SEPS procedure were excluded from their study. Results of the study was that there were 27 men and 53 women with a median age of 59.8 years (range: 34.3-80.0 years). The distribution of clinical classes (CEAP) were: Class 2, 13.1% (12 limbs); Class 3, 22.8% (21 limbs); Class 4, 19.6% (18 limbs); class 5, 21.7% (20 limbs); and Class 6, 22.8% (21 limbs). The etiology of patients with venous insufficiency was primary valvular incompetence in 83 limbs (90.2%) and secondary disease in nine limbs (9.8%). Concomitant superficial vein surgery was performed in 89 limbs (95.7%). For 20 patients (95%), leg ulcers healed spontaneously within 12 weeks after operation, whereas one patient required an additional split-thickness skin graft. Eighteen patients had previous surgery of the great and/or short saphenous vein before SEPS. During a mean follow-up of 3.7 years, recurrence of 22 IPVs was observed in 20 (21.7%) of 92 limbs, and recurrent leg ulcers were observed in two (9.5%) of 21 limbs. They also performed univariate and multivariate analyses to predict factors which influencing the recurrence of IPVs [recurrent superficial varicosis, secondary disease, active or healed leg ulcer (C5/6), compression treatment, and previous operation]. The multivariate analysis showed that patients with previous surgery (p = 0.014) were identified as the only significant factor for the recurrence of IPVs. Conclusion of the study was SEPS is a safe and highly effective treatment for IPVs. In the study, within a median follow-up period of 3.7 years, only two of 21 venous ulcers recurred, both in patients with secondary disease. Nevertheless, they observed recurrence of IPVs in 21.7% of the operated limbs. The multivariate analysis showed that patients who had undergone previous surgery were found to have a significantly higher rate of recurrence.

CONCLUSION

SEPS is a feasible, safe and effective treatment of the incompetent perforator veins in patients with advanced chronic venous insufficiency.

In our review, it has been found that SEPS is a promising technique for treatment of patients with perforator incompetence. It may be optimally utilized in cases with failure of conservative therapy or those with advanced chronic venous insufficiency. The favorable ulcer healing rate and improvement in clinical symptoms suggest that SEPS plays a considerable role in correcting the underlying pathology in chronic venous insufficiency caused by incompetent perforating veins.

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CASE REPORT

Mayer-Rokitansky-Kuster-Hauser Syndrome

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ABSTRACT

The Mayer-Rokitansky-Kuster-Hauser (MRKH) syndrome is characterized by congenital aplasia of the uterus and the upper part (2/3) of the vagina in women showing normal development of secondary sexual characteristics and a normal 46, XX karyotype. It affects at least one out of 4,500 women. MRKH may be isolated (type I) but it is more frequently associated with renal, vertebral and, to a lesser extent, auditory and cardiac defects (MRKH type II or MURCS association). The first sign of MRKH syndrome is a primary amenorrhea in young women presenting otherwise with normal development of secondary sexual characteristics and normal external genitalia, with normal and functional ovaries, and karyotype 46, XX without visible chromosomal anomaly. The phenotypic manifestations of MRKH syndrome overlap with various other syndromes or associations and thus require accurate delineation. For a long time, the syndrome has been considered as a sporadic anomaly, but increasing number of familial cases now supports the hypothesis of a genetic cause. In familial cases, the syndrome appears to be transmitted as an autosomal dominant trait with incomplete penetrance and variable expressivity. This suggests that the involvement of either mutations in a major developmental gene or a limited chromosomal imbalance. However, the etiology of MRKH syndrome still remains unclear. Treatment of vaginal aplasia, which consists in creation of a neovagina, can be offered to allow sexual intercourse. As psychological distress is very important in young women with MRKH, it is essential for the patients and their families to attend counseling before and throughout treatment.

Keywords: Mayer-Rokitansky-Kuster-Hauser syndrome, Congenital anomalies of uterus.

CASE REPORT

A 24-year-old female patient presented with primary infertility after 7 years of marriage and primary amenorrhea. History of undergoing vaginoplasty 7 years back .

There was no history of delayed menarche in the mother and sisters. Secondary sexual characters were normal.

The significant findings were on vaginal examination which showed a blind-ended vagina with 3 cm depth. The clitoris, labia majora and minora, and the vestibule were normal.

A clinical diagnosis of primary amenorrhea was made. Abdominopelvic ultrasound revealed normal liver, spleen and both kidneys. However, no uterine tissue was seen in the pelvis. The ovaries were visualized bilateraly. A diagnosis of congenital absence of the uterus was made. Hormonal assay was normal.

MRI reveals absent uterus with bilateral ovaries present.

The karyotype result also came out to be 46, XX and laparoscopy demonstrated ovoid, pearly white structures (in keeping with the ovaries) bilaterally. The fallopian tubes were also demonstrated bilaterally with hypoplastic mullerian buds (bipartite).

A diagnosis of mullerian duct anamoly was made subclassifed as Mayer- Rokitansky - Kuster-Hauser syndrome (type B—incomplete aplasia).

Thus, here we report one case of Type B Mayer- Rokitansky-Kuster-Hauser syndrome.

MULLERIAN DUCT ANOMALIES

Developmental anomalies of the mullerian duct system represent some of the most fascinating disorders that obstetricians and gynecologists encounter. The mullerian ducts are the primordial anlage of the female reproductive tract. They differentiate to form the fallopian tubes, uterus, uterine cervix and superior aspect of the vagina. A wide variety of malformations can occur when this system is disrupted. They range from uterine and vaginal agenesis to duplication of the uterus and vagina to minor uterine cavity abnormalities. Mullerian malformations are frequently associated with abnormalities of the renal and axial skeletal systems, and they are often the first encountered when patients are initially examined for associated conditions.

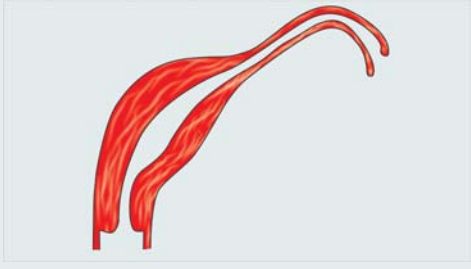
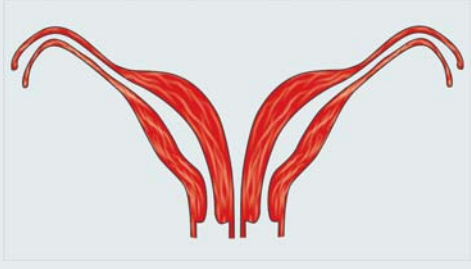
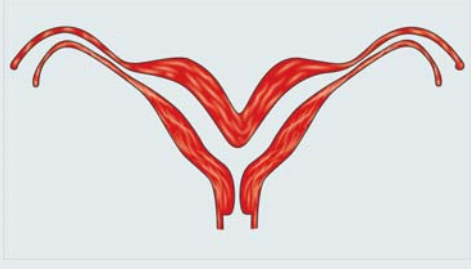
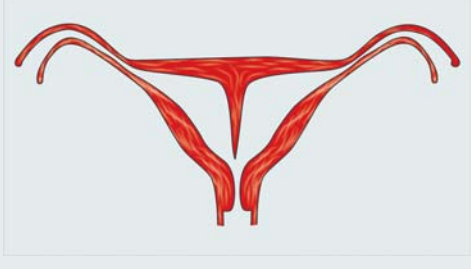
Most mullerian duct anomalies (MDAs) are associated with functioning ovaries and age-appropriate external genitalia. These abnormalities are often recognized after the onset of puberty. In the prepubertal period, normal external genitalia and age-appropriate developmental milestones often mask abnormalities of the internal reproductive organs. After the onset of puberty, young women often present to the gynecologist with menstrual disorders. Late presentations include infertility and obstetric complications.

Because of the wide variation in clinical presentations, mullerian duct anomalies may be difficult to diagnose. After an accurate diagnosis is rendered, many treatment options exist, and they are usually tailored to the specific mullerian anomaly. Refinements in surgical techniques, such as the Vecchietti and McIndoe procedures, have enabled many women with mullerian duct anomalies to have normal sexual relations. Other surgical advances have resulted in improved fertility and obstetric outcomes. In addition, developments in assisted reproductive technology allow some women with mullerian duct anomalies to conceive and deliver healthy babies.

Tarry and Duckett Classification

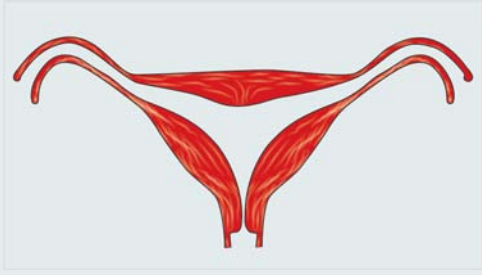
It is based on physical and ultrasound examinations or laparoscopy, and prognostic implications regarding fertility and

Table 1: AFS classification of anomalies of mullerian duct

Classification	*Clinical finding*	*Description*
I	Segmental or complete agenesis or hypoplasia	Agenesis and hypoplasia may involve the vagina, cervix, fundus, tubes or any combination of these structures. Mayer-Rokitansky-Kuster-Hauser (MRKH) syndrome is the most common example in this category
II	Unicornuate uterus with or without a rudimentary horn 	When an associated horn is present, this class is subdivided into communicating (continuity with the main uterine cavity is evident) and noncommunicating (no continuity with the main uterine cavity). The noncommunicating type is further subdivided on the basis of whether an endometrial cavity is present in the rudimentary horn. These malformations have previously been classified under asymmetric lateral fusion defects. The clinical significance of this classification is that they are invariably accompanied by ipsilateral renal and ureter agenesis[2-4]
III	Didelphys uterus 	Complete or partial duplication of the vagina, cervix and uterus characterizes this anomaly
IV	Complete or partial bicornuate uterus 	Complete bicornuate uterus is characterized by a uterine septum that extends from the fundus to the cervical os. The partial bicornuate uterus demonstrates a septum, which is located at the fundus. In both variants, the vagina and cervix each have a single chamber
V	Complete or partial septate uterus  	A complete or partial midline septum is present within a single uterus.

contd...

contd...

VI	Arcuate uterus		A small septate indentation is present at the fundus.
VII	DES-related abnormalities		A T-shaped uterine cavity with or without dilated horns is evident

menstruation.[5] The grade 0 to 4 refers to the extent of mullerian system affected. Each side is graded individually. The letter M refers to mullerian defects (Table 1). Fortuitously, the M stands for Mayer-Rokitansky as well. The grading is described as follows:

- M0-unilateral system normally formed but unfused or septum retained
- M1-vaginal agenesis alone
- M2-vaginal and uterine agenesis
- M3-mullerian agenesis total
- M4-mullerian and ovarian agenesis.

Our patient had Mayer-Rokitansky-Kuster-Hauser syndrome (type B—incomplete aplasia). Let us review the literature of MRKH syndrome.

MRKH SYNDROME

Introduction

Agenesis of the vagina in karyotypic female subjects may be accompanied by other defects of the urogenital and skeletal system. The combination of these anomalies has been designated as Mayer-Rokitansky-Kuster-Hauser syndrome (MRKHS) based on the findings reported by the various authors. We performed a computerized Medline search, Google search, SpringerLink search, HighWire search and manual bibliographical review of relevant articles on MRKHS, and the embryological, endocrinological, clinical, psychosocial, diagnostic and therapeutic features of this syndrome are discussed.

Embryology

Griffin (1988) described the embryological possibilities for the origin of MRKH syndrome. The Mullerian duct (MD, ductus paramesonephricus) develops independent of the celomic epithelium above the mesonephros. This part of the duct gives rise to the infundibulum with its fimbriated ostium abdominale. The part of the duct which lies along the mesonephros as far as its caudal pole makes a contribution to the ampulla and less often to the isthmus. In the area of the mesonephros, the MD fuses with the Wolffian duct (WD; ductus mesonephricus). The WD gives rise to the ampulla and the isthmus. Below the caudal pole of the mesonephros as well as beyond the attachment point of the inguinal ligament of the mesonephros, the later round ligament of the uterus, the MD develops as an outgrowth of the WD and no longer as an independent structure. The MRKH syndrome is, in its formal genesis, a non-fusion of the MD with the WD. This explains the fact that in a classic case of MRKH syndrome, the fallopian tube with a very small part of the cornu uteri extends only as far as the connection with the round ligament of the uterus. It is suggested that the cause of the development of MRKH syndrome could be the deficiency of gestagen and/or estrogen receptors. This would also explain the various forms of the rudimentary vagina.[6] Ghirardini et al (1982) described etiopathogenetical problems in MRKH syndrome, supporting Hauser's hypothesis of an inhibition of the mullerian duct development by MIF production, allowing to consider it as the slightest form of female pseudohermaphroditism. Moreover, the terms used to delineate this condition, like mullerian aplasia, mullerian duct aplasia,

mullerian duct agenesis and uterovaginal agenesis, may be misleading and the term of "mullerian dysgenesis syndrome" is proposed.[7]

Genetics and Molecular Basis of MRKHS

Pavanello et al (1988) stated that genetic problems are interwoven with unilateral or bilateral renal agenesis, especially that associated with mullerian anomalies as seen in MRKH syndrome. The gene is single and autosomal dominant with variable expression.[8] Ghirardini et al (1982) described the histological appearance of the rudimentary uterus, endometrium, uterine tube, Gartner's duct, round ligament, vagina and ovary in 10 cases of the MRKH syndrome. Their findings suggested that this syndrome is due to the deficiency of estrogen and gestagen receptors. This deficiency may inhibit the further development of the embryonic mullerian duct and account for the subsequent faulty differentiation of its existing elements. It is still undecided why, in cases of the MRKH syndrome, development of the mullerian duct ceases at the attachment of the caudal mesonephric ligament (later the round ligament).[9] Cramer et al (1996) reported that vaginal agenesis might be associated with decreased activity of galactose-l-phosphate uridyl transferase (GALT). They studied activity and genotype of GALT in 13 daughters with vaginal agenesis and their mothers. They concluded that fetal or maternal GALT mutations that decrease GALT activity may be associated with vaginal agenesis and have, as their possible biological basis, increased intrauterine exposure to galactose which has been demonstrated in rodents to cause decreased oocyte survival and delayed vaginal opening in offspring.[10]

Review of Literature

Mayer-Rokitansky-Kuster Hauser (MRKH) syndrome is a congenital malformation characterized by an absence of vagina associated with a variable abnormality of the uterus and the urinary tract but functional ovaries. In 1829, Mayer had described partial and complete duplication of vagina in four stillborns along with other anomalies, like cleft lip, limb and cardiac defects along with urinary tract anomalies.[11] Subsequently in 1838, Rokitansky reported 19 cases of uterovaginal agenesis along with renal agenesis in three cases.[12] Kuster (1910) described several cases of similar anomaly with various musculoskeletal defects. Hauser et al (1961), emphasized the importance of distinguishing this syndrome from that of testicular feminization in both of which vaginal development is defective.[13] The various mullerian defects described are agenesis of vagina or uterus, rudimentary/atretic vagina or uterus. Unilateral renal and skeletal anomalies are associated in 50% and 12% of cases respectively.[14] The skeletal abnormalities reported are fusion anomaly of vertebrae, congenital scoliosis and limb deformities, like brachymesophalangy of digits, small distal phalanx of digits, long proximal phalanx of digits and long metacarpals of digits. In addition, some patients might have distinct radial dysplasia and abnormalities of the carpals.[15] It has been analyzed whether the MRKH syndrome can be considered as a single clinical entity or whether two or more syndromes lie behind the title of MRKH syndrome. Two different syndromes in these patients have been described, namely an isolated form of congenital agenesis of the vagina and uterus (typical) and a more generalized condition, in which agenesis of the vagina and uterus is a major and perhaps even obligatory characteristic (atypical). Heidenreich et al (1988) observed that the patients with the Mayer-Rokitansky-Kuster (MRK) syndrome had the typical findings of vaginal aplasia and bipartite solid uterine buds but they proposed that the term "MRKH syndrome" should no longer be used for cases with extragenital malformations.[16] Strubbe (1992) described that the typical form (type A) is characterized by symmetrical nonfunctioning muscular buds (the mullerian duct remnants) and normal fallopian tubes, and the atypical form by aplasia of one or both buds, one bud smaller than the contralateral one, with or without dysplasia of one or both fallopian tubes. Radiographs of the spine showed that congenital spinal abnormalities, especially the Klippel-Feil (KF) syndrome, were seen more in patients with the typical form. Renal agenesis or ectopia together with the MRKH and KF syndromes, known as the MURCS association (MU: Mullerian duct aplasia; R: Renal agenesis/ectopia; CS: Cervical somite dysplasia), was also diagnosed in patients in the atypical group. From their results, they concluded that additional cervical spine films in patients with the MRKH syndrome are indicated only in the atypical form of the syndrome. In those cases, where the MRKH syndrome is associated with the KF syndrome, the MURCS association should be considered.[17] Strubbe et al (1994) conducted a multidisciplinary study on a total of 100 women with congenital absence of vagina and uterus, the Mayer-Rokitansky-Kuster-Hauser (MRKH) syndrome. The purpose of this study was to discriminate typical (type A) from atypical (type B) Mayer-RokitanskyKuster-Hauser syndrome (congenital absence of vagina and uterus) and determine their association with renal anomalies and ovarian disease. Complete gynecological and laparoscopic data were available on all of the patients. The patients were divided into two groups on the basis of the laparoscopic data; a typical and an atypical form of the MRKH syndrome. Associated anomalies were most common in the group with the atypical form of the MRKH syndrome. These findings suggest that there might be two different syndromes in this patient group, namely an isolated form of congenital agenesis of the vagina and uterus (typical/type A) and a more generalized condition, in which agenesis of the vagina and uterus is a major and perhaps even obligatory characteristic (atypical/type B). Hence, they proposed that the term MRKH syndrome should no longer be used for the atypical group. A suggestion has been made to call this type the GRES [genital (G), renal (R), ear (E), skeletal (S)] syndrome.[18] Strubbe et al

(1993),[19,20] emphasised that discrimination between type A and type B of MRKH syndrome is important because associated renal and ovarian abnormalities occur only in type B. Laparoscopy is still needed to discriminate between these two forms.[26]

Urinary Tract Anomalies in MRKHS

Unilateral renal anomalies are associated with 50% of the patients. The various urinary tract anomalies reported are renal agenesis, pelvic kidney, fusion anomaly, like horse-shoe kidney and vesicoureteric reflux.

Endocrine Function in MRKHS

In most of the cases, both ovaries are normal and affected women have normal sexual activity. Occasionally, one ovary with ipsilateral fallopian tube may be absent. Hormone profile and secondary sexual characteristics are normal in the cases of Mayer-Rokitansky-Kuster-Hauser syndrome.[21]

Karyotype and Familial Syndrome

Smith et al (1982) reported that patients with MRKH have a normal female karyotype and normal secondary sexual development.[22] Cabra el (1998) and Orozco-Sanchez et al (1991), performed blood genetics tests and biopsy of ovarian tissue which showed 46, XX karyotype with no structural anomalies.[23] Smith used the appellation "Rokitansky malformation sequence" to designate the mullerian agenesis in any clinical setting and stated that about 4% of the cases in which ovaries and fallopian tubes are present but which lack the body of the uterus and upper vagina are familial with affected female siblings.[22]

Other Syndromes and Anomalies in Association to MRKHS

The various other associated anomalies reported are Klippel-Feil syndrome, Sprengel's deformity, and congenital stapedial ankylosis and ovarian cysts.[24]

Investigations

These tests included general physical examination, radiographs of the vertebral column, the upper extremities and intravenous urography (IVU), general otorhinolaryngological and ossicular chain examinations. Ultrasound (US) of the abdomen and pelvis, which might show a dilated uterus with hematometra, the lesion with functioning uterine anlage, cervical dysgenesis and an obstructed uterine horn besides the delineation of kidneys and ovaries. Many investigators feel that transabdominal ultrasound (US) may not provide a completely reliable picture in Mullerian duct anomalies. Hence, magnetic resonance imaging (MRI) is now gaining wide acceptance in imaging congenital abnormalities of the genital tract.[25] Genitography can further provide anatomical details specially in cases of partial vaginal agenesis or coexistent genitourinary fistula.

Management

The management of vaginal agenesis in Mayer-Rokitanksy-Kuster-Hauser syndrome has always been a controversial topic. The choice of procedure and patient age at reconstruction depend upon individual anatomy, fertility potential and psychological and social factors. Initially, the arguments centered on whether to do surgery or try passive dilation as well as at what age to intervene. As surgical techniques have recently become refined, the question is, if surgery is selected, what type of tissue should one use (bowel *vs* skin graft) and, if skin graft, from what area to select. The aims are satisfactory sexual activity with good anatomical and functional vagina along with mechanical long-term outcomes. Until now, the recommended treatment, when resection of a rudimentary horn was indicated, was laparotomy. The same goal can now be achieved by laparoscopy. Laparoscopy is not only useful for diagnosis of uterine malformations but can also be valuable for any treatment required for this type of malformation along with creation of an artificial vagina (laparoscopic assisted vaginoplasty).[26,27]

Psychological Aspect

Patients with MRKH syndrome might suffer from severe distortions of body image, anxiety, depression, interpersonal sensitivity and face a lot of psychological distress at diagnosis. Langer et al (1990) studied psychosocial sequelae of and coping with malformation and treatment with semistructured interviews and the Giessen test. Anatomical and functional results of the vaginoplastic operation were excellent and sexual satisfaction correlated with coping. 7/11 MRKH patients were capable of good to fair adaptation to the malformation. The malformation caused narcissistic damage in all cases.[28] Behavioral problems of the adolescent patients can be avoided by early appropriate guidance and reassurance.

Can a Woman with MRKHS and Absent Uterus have a Child? Its Medicolegal Implications

Until recently, treatment for patients with vaginal agenesis (Mayer-Rokitansky-Kuster-Hauser syndrome) has centered on the creation of a functional vagina. The technology of *in vitro* fertilization and embryo transfer, allowing for collection of oocytes from the genetic mother. Fertilization by the genetic father and placement into a gestational carrier, enables a woman without a uterus to have her own genetic child. The specific medical and legal issues involved in facilitating genetic offspring in these instances must be considered; these include the initial matching of the genetic parents with the gestational carrier, cycle synchronization for *in vitro* fertilization and embryo transfer, anatomic difficulties of oocyte retrieval, birth certificate documentation and the current legal status of a gestational carrier.[29,30]

CONCLUSION

Mayer-Rokitansky-Kuster-Hauser syndrome (MRKHS) is a congenital malformation characterized by an absence of vagina associated with a variable abnormality of the uterus and the urinary tract, but functional ovaries. It is not only worthwhile to be alert for urinary tract anomalies in patients with the MRKH syndrome but also to study the skeletal and auditory systems in these patients. Psychological consideration of patients with uterovaginal agenesis may dictate the need for early vaginoplasty, which hitherto has been delayed until just before marriage. Surgical correction many times requires the creation of a neovaginal canal by the performance of a neovaginoplasty which can be done by open surgical or laparoscopic assisted techniques. The technology of *in vitro* fertilization and embryo transfer, allowing for collection of oocytes from the genetic mother, fertilization by the genetic father and placement into a gestational carrier enables a woman without a uterus to have her own genetic children.

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