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# Short-term Results of Laparoscopic Transabdominal Preperitoneal Inguinal Hernioplasty in a Developing Country

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## ABSTRACT

**Introduction:** Inguinal hernias have plagued mankind for its upright gait since evolution. Around 16% of the patients presenting to surgery outpatient department have inguinal hernias. Various procedures like the use of patients' own tissues or prosthetic meshes have been used in the past to repair inguinal hernia with varying degrees of success. Laparoscopic hernioplasty is the latest technique with several advantages over open procedures like reduced postoperative pain and shorter recovery period. However, steeper learning curve and cost of the procedure have been cited as limiting factor.

**Aim:** To study the outcome of laparoscopic transabdominal preperitoneal (TAPP) inguinal hernia repair in terms of operating time, postoperative pain, wound complications, and recurrence.

**Materials and methods:** This is an analysis of patients that underwent TAPP inguinal hernia repair, from January 2013 to May 2015. Case records of 90 patients between 18 and 60 years that underwent TAPP by a single surgical team were followed prospectively. Data regarding operative time, complications, immediate postoperative pain, chronic groin pain, recurrence, and sensory disturbance were recorded and evaluated.

**Results:** All the patients were males aged from 18 to 60 years. Mean operative time was 60 minutes (40–120 minutes). Postoperative pain as assessed by visual analog scale (VAS) 6 hours after has been low (mean: 2). Chronic pain occurred in 2 patients (2.22%), but that has not affected routine work or mobility.

**Conclusion:** Short-term results of TAPP hernia repair using mesh demonstrated to be an effective and safe procedure with low prevalence of chronic pain that was generally of a mild, infrequent nature. Intraoperative bleeding and use of postoperative analgesia were considerably less. There was no incidence of early recurrence. Learning curve is not so steep as claimed, and considering advantages, the cost of the procedure should not be a limiting factor even in a developing country.

**Keywords:** Laparoscopic hernia repair, Lichtenstein hernioplasty, Stoppa repair, Total extraperitoneal hernioplasty, Transabdominal preperitoneal hernioplasty.

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**Conflict of interest:** None

## INTRODUCTION

Inguinal hernia repair is the most frequently performed operation in general surgery. The standard method for inguinal hernia repair had changed until the introduction of mesh and minimal access laparoscopic technique. The concept of hernia repair underwent evolution from Bassini's repair to Lichtenstein tension-free repair with the introduction of polyethylene mesh.<sup>1</sup> Prosthetic biomaterials have been combined to form composite mesh in order to minimize the undesirable side effects. Mesh placement can be achieved by both open and laparoscopic techniques.<sup>2</sup> There are two main approaches for the laparoscopic repair of inguinal hernia.<sup>3</sup>

Transabdominal preperitoneal repair involves access to the hernia through the peritoneal cavity. Mesh is placed in the preperitoneal space, after incising and dissecting parietal peritoneum. Total extraperitoneal (TEP) repair is the newer laparoscopic technique, in which preperitoneal is created without entering the peritoneal cavity. This TEP repair is technically more difficult than the TAPP technique, but it may reduce the risk of damage to intraabdominal organs.

The potential benefits of using a laparoscopic approach include reduced postoperative pain, earlier return to normal activities, and a reduction in long-term pain and numbness. The repair of bilateral hernias (including occult hernias detected during contralateral inspection at the time of a unilateral repair) may be undertaken during the same operation. Laparoscopic surgery is associated with additional costs, for the endoscopy system (video unit, monitor, endoscope, and CO<sub>2</sub> insufflator) and instruments (staplers, diathermy scissors, or ports), although these may be reusable.

Today, inguinal hernia repair is one of the most commonly performed general surgical procedures in the USA, accounting for 10 to 15% of all operations.<sup>3,4</sup> These

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numbers are largely attributed to the high incidence of the disease, which carries a lifetime risk of approximately 27% for men and 3% for women.<sup>5,6</sup> Considering the socio-economic impact of inguinal hernia repair, we discuss the advantages and disadvantages of TAPP laparoscopic inguinal hernia repair.<sup>7</sup>

**AIM**

The aim of the article is to study the outcome of laparoscopic TAPP inguinal hernia repair in terms of operating time, postoperative pain, wound complications, and recurrence.

**MATERIALS AND METHODS**

This is an analysis of patients that underwent TAPP inguinal hernia repair, from January 2013 to May 2015. Case records of 90 patients between 18 and 60 years that underwent TAPP by a single surgical team were followed prospectively. Data about operative time, intraoperative complications, immediate postoperative pain, chronic groin pain, recurrence, sensory disturbance, and limitation of activity were collected and compared.

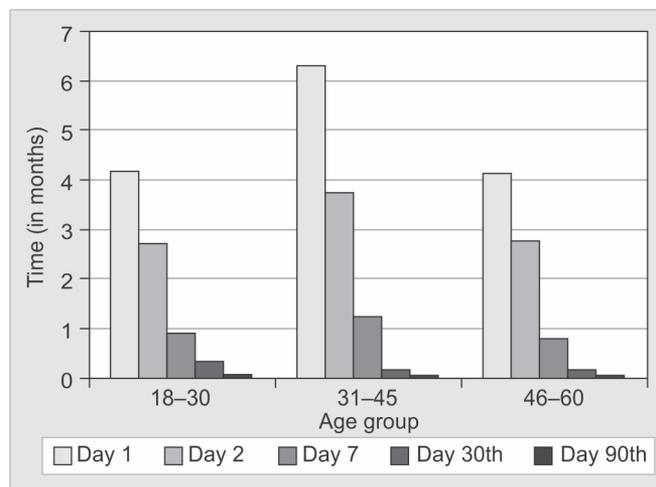
**RESULTS**

During initial learning period, we have included patients between 18 and 60 years of age under American Society of Anesthesiologist (ASA) grade I (Table 1). Mean operative time was 60 minutes (40–120 minutes). Postoperative pain as assessed by VAS 6 hours after has been low (mean: 2; Graph 1). Chronic pain occurred in 2 patients (2.22%), but that has not affected routine work or mobility; 98% of patients were satisfied with their repair and resumed their work on 14th or 15th postoperative day (Graph 2). No incidence of wound infection, seroma formation, or recurrence has been reported so far. In the beginning, we chose an arbitrary age limit. However, now we are

**Table 1:** Distribution of site and type of hernia

Age group	Site		Type	
	Right	Left	Direct	Indirect
18–30	13	8	4	17
31–45	20	14	14	20
46–60	19	16	22	13
Total	52	38	40	50

Right side inguinal hernia is more common than left side; Indirect hernia is more common in younger age group than direct hernia which is more common in older age group

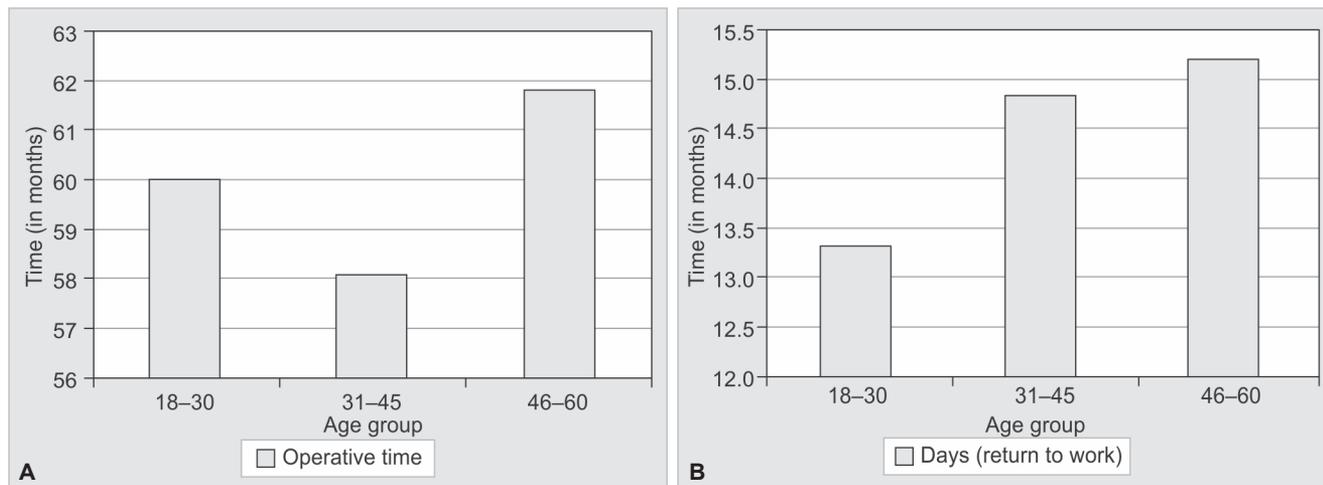


**Graph 1:** Postoperative pain (mean)

offering this modality to even patients aged 75 years old and above, accepted under ASA grades I and II. Average cost of the mesh and fixation material per procedure is approximately 15,000 INR, which is less than the Central Government Health Scheme rate.

**REVIEW OF LITERATURE**

Anatomical understanding of inguinal canal anatomy increased through the work of Camper, Scarpa, Cooper, Hassel Bach, and Hunter. Edoardo Bassini reported first



**Graph 2:** Operative time and return to work (days)

successful reconstruction of the inguinal floor. Then, in the late 20th century, the tension-free repair, introduced by Irving Lichtenstein, caused a dramatic drop in recurrence rates and became the procedure of choice.<sup>8,9</sup> However, the introduction of a laparoscopic technique in the early 1990s started a new debate over the best method of inguinal hernia repair.

Recurrence is the most important indicator of the success of a hernia procedure, which may occur in 15% of the cases or more. The frequency of hernia recurrence depends on many factors including the type of hernia repair, the comorbidities of the patient, and the experience of operating surgeon itself. Cochrane Database Systematic Review (2003) reported 86 recurrences among 3,138 patients who underwent laparoscopic repair and 109 among 3,504 patients who underwent open repair.<sup>10,11</sup> A separate meta-analysis published in the British Journal of Surgery in 2000 reported similar findings in that overall recurrences did not differ between the laparoscopic and open groups.<sup>12</sup> There is, however, some evidence in the literature demonstrating increased recurrences with laparoscopic repair. Neumayer et al,<sup>13</sup> in a randomized controlled study, found that laparoscopic repair resulted in significantly more recurrences at 2 years (10.1 vs 4.9%) and was associated with more complications (39 vs 33.4%) including life-threatening complications (1.1 vs 0.1%). Surgeons who have performed a high volume of hernia operations appear to have better results.<sup>13</sup> In an article published in the *Lancet*, all seven hernia recurrences occurred in the laparoscopic group, while there were no recurrences in the open repair group (1.9 vs 0.0%).<sup>14</sup> The largest reviews of inguinal hernia repairs suggest no apparent difference in recurrence between laparoscopic and open mesh methods of hernia repair. However, there are some evidences in the literature demonstrating increased recurrences with laparoscopic repair. In 2004, Neumayer et al.<sup>13</sup> found in a randomized, controlled study that laparoscopic repair resulted in significantly more recurrences at 2 years (10.1 vs 4.9%) and was associated with more complications (39 vs 33.4%) including more life-threatening complications (1.1 vs 0.1%). In another study published in the *Lancet*, all seven hernia recurrences occurred in the laparoscopic group, while there were no recurrences in the open repair group. When treating recurrent hernias laparoscopic repair of inguinal hernias was found to have a similar recurrence to open repair (10.0 vs 14.1%).<sup>15,16</sup> The laparoscopic approach to inguinal hernia repair is also associated with a steeper learning curve, probably due to the increased complexity and technical difficulty of the surgery. Surgeons who had performed more than 250 laparoscopic repairs had half

**Table 2:** Comparative data of various studies

Study	Duration of surgery	Complication	Return to work	Recurrence
Hamaza et al <sup>18</sup>	77.4 min.	25.0%	14.87 days	4%
Leibl et al <sup>19</sup>	66.0 min.			
Felix et al <sup>20</sup>		0.78%	16 days	
Master of surgery		10.7%		2%
Swanstorm et al <sup>21</sup>	92 min.			2%
Our study	60.0 min.	0.00%	14.63	0%

the rate of recurrence of surgeons who had performed fewer repairs.

Surgeons who have performed a high volume of hernia operations appear to have better results in terms of recurrence and operation time. Cochrane Database Systematic Review in 2003 demonstrated that the duration of operation was longer in the laparoscopic groups with mean difference 14.81 minutes. An article published in the British Journal of Surgery described a similar increase of 15.2 minutes with laparoscopic inguinal hernia repair.<sup>17</sup> With regard to operation length, most evidence in the literature points to a shorter operation duration with open repair (Table 2)<sup>18-21</sup>.

Postoperative pain is an important consideration when choosing between laparoscopic and open repair of inguinal hernias. Laparoscopic repair has been associated with less postoperative pain than open repair. Cochrane Database Systematic Review (2003) demonstrated less persisting pain (overall 290/2,101 vs 459/2,399), and incidences of numbness were less (overall 102/1,419 vs 217/1,624) in the laparoscopic groups. Similarly, another meta-analysis study from the EU Hernia Trialists Collaboration reported decreased postoperative pain with the employment of laparoscopic methods.<sup>22</sup> Bignell et al<sup>23</sup> reported a similar higher incidence in chronic groin pain in open vs laparoscopic inguinal hernia repair. However, the decrease in chronic groin pain with laparoscopic repair reported in this study did not translate into a significant improvement in the quality of life.

Another variable, i.e., used as a primary outcome in numerous studies comparing laparoscopic and open techniques is time to return to work. There is a consensus in the literature that patients who undergo laparoscopic inguinal hernia repair return to work and normal activities earlier than those with open repair. An earlier return to work and resumption of normal activity is associated with an earlier discharge from the hospital and fewer postoperative complications, both of which are associated with laparoscopic hernia repair. Liem et al reported that patients following laparoscopic inguinal hernia repair

resumed normal daily activity 4 days earlier and returned to work 7 days earlier than open repair. Patients with laparoscopic repair resumed athletic activities 12 days earlier than those who had open repair. Thus, a patient's work profile can play a role in the decision for laparoscopic or open inguinal hernia repair.<sup>24-26</sup>

## CONCLUSION

Short-term results of TAPP hernia repair using mesh demonstrated to be an effective and safe procedure with low prevalence of chronic pain that was generally of a mild, infrequent nature. Intraoperative bleeding and use of postoperative analgesia were considerably less. There was less occupational limitation, no recurrence, and high satisfaction rate. This modality can be offered to even patients more than 75 years old under ASA grades I and II. Learning curve is not so steep as claimed, and considering advantages, the cost of the procedure should not be a limiting factor even in a developing country.

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# Comparative Study of Tacker vs Glue Fixation of Mesh in Laparoscopic Intraperitoneal Onlay Mesh Repair of Ventral Hernias

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## ABSTRACT

**Aim:** To compare results of tacker and glue fixation of mesh in laparoscopic intraperitoneal onlay mesh repair of ventral hernias.

**Materials and methods:** Patients admitted to the General Surgery Department of Sir Jamshedjee Jeejeebhoy Group of Hospitals, Mumbai, India, from January 2015 to June 2016 for ventral hernia repair were included for the study. A total of 60 patients were enrolled, and each group consisted of 30 cases.

**Results:** In our study, the mean age of ventral hernia patients subjected for glue fixation was found to be 38 years and for tacker fixation it was found to be 38.77 years. There is no statistically significant difference among the age of cases in the two groups in terms of mean age ( $p = 0.75$ ). Out of 60 cases, 28 (46.66%) were females, whereas 32 (53.33%) cases were males. Maximum size of hernia defect was restricted to 6 cm. The mean size of hernia defect was  $2.84 \pm 1.02$  cm in the glue fixation group, while that in the tacker fixation group was  $3.15 \pm 0.731$  cm. Mean duration of surgery was 83.67 minutes in the glue fixation group and 64.50 minutes in the tacker fixation group. There was no intraoperative and postoperative complications with glue fixation. In tacker fixation, seroma was seen in 4 cases (13.33%), hematoma in 1 (3%), bowel ileus in 1 (3%), whereas there were no intra-abdominal complications, bowel obstruction, bleeding from trocar site, and enterocutaneous fistula. The mean pain [visual analog scale (VAS) score] of glue fixation and tacker fixation at 24 hours was 1 and 2.23 respectively. Mean postoperative hospital stay for patients with tacker fixation is 3 days, and 2 days in glue fixation. Mean time to return to normal activities was  $3 \pm 0.6$  days in tacker fixation group and  $1 \pm 0.58$  days in glue fixation group. No recurrence was found in both groups of fixation methods.

**Conclusion:** Mesh fixation with glue is better as compared with tacker in terms of cost, postoperative pain, and length of hospital stay; however, the use of tacker or glue depends on surgeon preference, patient affordability, and availabilities of facilities.

**Keywords:** Glue fixation, Intraperitoneal onlay mesh, Laparoscopic, Tacker fixation, Ventral hernia.

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**Conflict of interest:** None

## INTRODUCTION

An abdominal wall hernia, or a ventral hernia, often occurs at the weakest point of the abdominal wall and it includes umbilical, incisional, epigastric, supraumbilical, infraumbilical, etc. The intra-abdominal pressure forces the contents to move out from the defect. The protruded contents dilate the opening further, leading to increased diameter of the defect, and hence, more contents protrude. This positive feedback loop results in increase in size of hernia, and continues till either the hernia is operated, or it develops complications like obstruction, strangulation, or incarceration. The mechanism behind the continued progression of hernia can be explained by Pascal's law, which states that "A change in pressure at any point in an enclosed fluid at rest is transmitted undiminished to all points in the fluid." In this condition, the "fluid" can be taken as the abdominal cavity contents. So, a rise in pressure in the abdominal cavity is transmitted to all points along the abdomen equally.

The open technique of ventral hernia repair involved extensive dissection of surrounding tissues, which led to complications, such as wound infections, seroma formation, etc. To overcome these, laparoscopic techniques were devised. In 1991, LeBlanc and Booth described their experience with repair of incisional hernia using expanded polytetrafluoroethylene prosthetic graft using laparoscopic technique. Ever since its introduction, the trend is toward attempting a laparoscopic repair of ventral hernias. In this technique, the contents of the hernia sac are reduced and a prosthetic mesh is placed intraperitoneally/preperitoneally extending beyond the borders of the fascial defect and held in place by either staples sutures or glue.

The dilemma always persists regarding which technique is better, from a patient benefit point of view.

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So we conducted a comparative prospective study of laparoscopic intraperitoneal onlay mesh fixation using tacker and glue.

This study is aimed at comparing 60 patients of ventral hernias, selected randomly from patients admitted to the Sir Jamshedjee Jeejeebhoy Group of Hospitals, Mumbai, India, between the period June 2015 and June 2016.

**MATERIALS AND METHODS**

**Research Site**

Grant Government Medical College and Sir Jamshedjee Jeejeebhoy Group of Hospitals, Byculla, Mumbai, India.

**Sample Size**

A total of 60 cases; 30 cases assigned randomly to two groups, either tacker or glue fixation.

**Inclusion Criteria**

Patients diagnosed with ventral hernias clinically, patients who gave consent to undergo the procedure and be a part of the study, patients between 18 and 70 years of age, patients with ventral hernias and defect size <6 cm without any complications were included.

**Exclusion Criteria**

Patients with body mass index >35, patients with recurrence after previous repair, patients afflicted with chronic obstructive pulmonary disease, lower urinary tract syndromes, prostatomegaly with complaints of nocturia, patients unfit for general anesthesia, and patients with acute abdominal emergency were excluded.

**CONDUCTION OF STUDY**

Patients were selected for the study after taking careful detailed history, clinical examination, laboratory investigations, and ultrasound examination as described above. The patients eligible for the study were selected, informed, and explained regarding the above study and a proper informed, valid, written consent was taken for participation in the study.

Patients were kept nil by mouth after 10 pm the previous day of surgery. Patients were shaved and prepared, and informed, valid, written consent for surgery taken. All patients received preoperative dose of antibiotic. Patients were operated by experienced laparoscopic surgeons of the hospital with experience of >50 laparoscopic ventral hernia repair (LVHR) procedures done previously. All incisions were infiltrated with local anesthetic at the end of the procedure.

Duration of surgery was measured from the time of incision to the time of closure. Patients were started on liquid diet on the evening of surgery and full diet on the next morning of surgery. All patients were encouraged to mobilize as early as possible. Inj. Diclofenac sodium 50 mg intramuscular was given as analgesic postoperatively on demand by the patient as guided by the VAS in which the pain experienced by the patient was graded by the patient on a scale of 1 to 10 and recorded every 6 hourly for the first 24 hours postoperatively. Analgesics were given if VAS score was >5 (Fig. 1).

Postoperative hospital stay was measured from the date of surgery to the date of discharge. Patients were asked to follow-up on day 7, at 1 month, and 3 months postoperatively. Suture removal was on postoperative day 7 in all cases. Time to return to normal activity was noted in all patients. Patients were reassessed on all occasions and wound infection, port site herniation were checked, and all patients were followed up for minimum 6 months after surgery and were assessed for recurrence.

**OBSERVATIONS AND RESULTS**

The following facts and figures are observed from our study.

- In our study, 28 (46.66%) out of 60 cases were females, whereas 32 (53.33%) cases were males, which shows a higher incidence in males.
- In our study, the mean duration of surgery was 83.67 minutes in the glue fixation group, which was significantly more (p = 0.000) than the tacker fixation group where mean duration of surgery was 64.50 minutes.

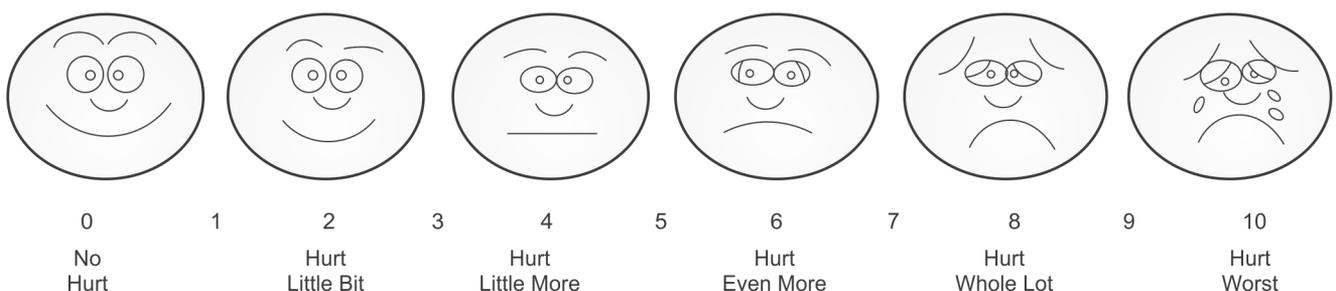


Fig. 1: Visual analog scale

There were no intraoperative and postoperative complications with glue fixation.

In tacker fixation, seroma was seen in 4 cases (13.33%), hematoma in 1 (3%), bowel ileus in 1 (3%), whereas intra-abdominal complications, bowel obstruction, bleeding from trocar site, and enterocutaneous fistula were 0 (0%). The glue fixation group did have a lesser complication rate 0/30 (0%) as compared with 6/30 (20%) in tacker group.

Pain is a reliable criterion in the assessment of any ventral hernia repair, due to the extent of dissection involved. The postoperative pain was recorded at 24 hours, 48 hours, and 1 month after operation by using VAS pain scoring system. The mean pain score of glue fixation and tacker fixation at 24 hours was 1 and 2.23 respectively ( $p = 0.00$ ) (Table 1 and Graph 1).

Median (range) postoperative hospital stay for patients with tacker fixation is 3 (2–4) days, which is more as compared with 2 (1–3) days in glue fixation, which is statistically significant ( $p < 0.0001$ ) (Table 2 and Graph 2).

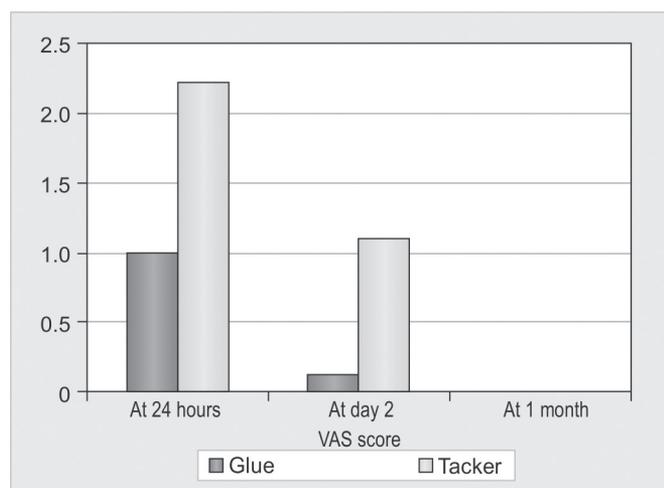
Patients with tacker fixation took more time to return to normal activities like ambulation, personal dressing, and toilet use, with mean of  $3 \pm 0.6$  days as compared with  $1 \pm 0.58$  days in glue fixation group, which is statistically significant ( $p < 0.005$ ).

Cost of glue fixation is 50% less as compared with tacker fixation owing to the added cost of tacker.

**Table 1:** Comparison of pain

VAS score	Groups			
	Glue		Tacker	
	Mean	SD	Mean	SD
At 24 hours	1.00	0.45	2.23	1.14
At day 2	0.13	0.35	1.10	0.31
At 1 month	0	0	0	0

SD: Standard deviation

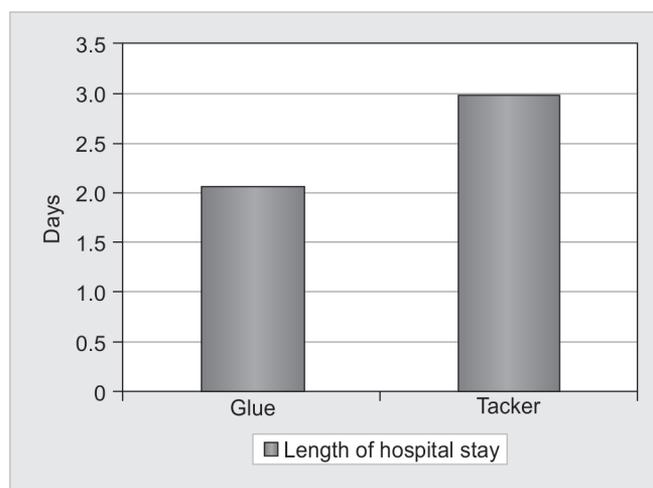


**Graph 1:** Comparison of pain in tacker vs glue fixation

**Table 2:** Length of Hospital Stay

	Glue		Tacker	
	Mean	SD	Mean	SD
		2.07	0.25	3.00

SD: Standard deviation



**Graph 2:** Length of hospital stay in tacker vs glue fixation

## DISCUSSION

Treatment for hernia is surgical repair, which has evolved continuously over several centuries. The concept of minimally invasive surgery has changed many aspects in the surgical care of the patients, regardless of the access techniques employed for a given patient. Most of the benefits are centered on improvements in the postoperative recovery period, including a shorter length of hospital stay and earlier return to normal activities. Recently, there has been an increasing demand for laparoscopic repair from the patient population, and it has also become part of the surgeon's choice.

The aim of this study is to apply to hernia surgery the advantages of laparoscopy: Less trauma, lesser postoperative pain, early discharge, and early renewal of the normal activity. Chevrel and Rath<sup>1</sup> first proposed fibrin sealant as an alternative means of mesh fixation in hernia repair.

In our study, the average operation time in tacker fixation as compared with glue fixation is lesser in our study, which is again comparable to the study of Eriksen et al,<sup>2</sup> which shows glue fixation took longer than tacker fixation.

The mean pain score of glue fixation and tacker fixation at 24 hours was 1 and 2.23 respectively ( $p = 0.00$ ). Olmi et al<sup>3,4</sup> from Zingonia, Italy, evaluated the efficacy and acceptability of glue in small- to medium-sized ventral hernias. In two clinical studies, they detected stable and uniform fixation of the prosthesis and minimized intra- and postoperative complications with a

low incidence of postoperative pain. Since the p-value for the t-test is less than that of 0.05, the VAS score at 24 and 2 days indicates significant difference and also more pain tacker. Median (range) postoperative hospital stay for patients with tacker fixation is 3 (2–4) days, which is more as compared with 2 (1–3) days in glue fixation, which is statistically significant ( $p < 0.0001$ ).

Eriksen et al<sup>2</sup> from the group of Prof. Rosenberg at the University of Copenhagen, Denmark, have performed and published an experimental study and a clinical randomized control trial on the fixation of mesh in ventral hernia with glue. They concluded that mesh fixation with glue in LVHR was associated with less postoperative discomfort and pain. In our study, no recurrence was found in both groups of fixation methods. In all studies evaluating hernia repairs, the most important benchmark is recurrence and the minimum period of follow-up, for assessing it till the date of completion of study.

## CONCLUSION

- Return to normal physical activity is earlier in patients with glue fixation.
- Tackers are used for fixation of mesh in LVHR and are available in absorbable and nonabsorbable. They

work by penetrating fixation mechanism and anchors the mesh; however, this leads to some amount of postoperative pain.

- Length of hospital stay was less in the glue fixation group.
- Cost of glue fixation is 50% less as compared with tacker fixation owing to the added cost of tacker.
- Postoperative follow-up up to 1 year does not show any recurrence; however, no data of efficiency with longer follow-up are available.

However, the use of tacker or glue depends on surgeon's preference, patient affordability, and availabilities of facilities.

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# Laparoscopic Management of Hirschsprung's Disease

KM Rita

## ABSTRACT

Laparoscopy has improved the outcome and management of Hirschsprung's disease. The most commonly seen Hirschsprung's disease with transition zone in the rectosigmoid is done in the neonatal period as one-stage transanal endorectal pull-through (ERPT) procedure. In all other children, it must be one-stage laparoscopy-assisted transanal pull-through procedure. Advantage of a laparoscopic procedure is that a biopsy report of the level of transition zone and the normal ganglionic segments is obtained before the dissection is begun. It allows peritoneal dissection and isolation of marginal artery under vision. Also adequate length of colon can be dissected free of the attachments under vision.

**Keywords:** Hirschsprung's disease, Laparoscopy, Transition zone.

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## INTRODUCTION

Twenty-five years back in the postoperative ward of our pediatric surgical unit, there would have been at least one child with both legs and arms tied to the four posts of a bed, and a pair of straight arteries, larger than the child, stuck into the anus, and the anxious and frightened mother standing beside the bed with her hand stuck to the chin. Anybody can read what is happening in that mother's mind. This was the situation of a child with Hirschsprung's disease. Thanks to the gastrointestinal stapler, this situation soon changed. In this article, I am reviewing various articles and studies to evaluate, further, how laparoscopy has influenced the treatment of these children.

## AIM

To assess whether laparoscopy has influence on the outcome of treatment of Hirschsprung's disease.

## MATERIALS AND METHODS

Research materials taken are the various articles published in PubMed, ScienceDirect, Journal of Paediatric

Surgery, Indian Journal of Paediatric Surgery, Seminars in Paediatric Surgery, and Annals of Surgery. The research gave a wide range of research material of which relevant articles were selected. The criteria for selection of papers were the number of cases included in the study and the duration of study.

Swenson and Bill<sup>1</sup> described surgery for Hirschsprung's disease. Ever since, surgery has remained the cornerstone for treatment of Hirschsprung's disease. At the outset, the surgical procedure was a three-stage procedure. It involved the formation of colostomy and after a period of colonic washouts, the second stage of anorectal pull-through was done, keeping a protective colostomy and later, in a third stage, closure of the colostomy was done.

Soave<sup>2</sup> described the endorectal pull-through procedure to exclude the disadvantages inherent to pelvic dissection.

Duhamel<sup>3</sup> described his procedure of rectal pull-through and anastomosing with a part of aganglionic rectum longitudinally. Later surgeons started removing the colostomy along with the pull-through procedure and the surgery became a two-stage procedure.

The open abdominal procedure with anorectal pull-through was associated with various complications. As it was the staged procedure and colostomy was done first, the complications inherent to colostomy like stenosis, prolapse, and abdominal excoriation were prone to occur even before the definitive procedure. The complications of laparotomy like wound infections, intra-abdominal and pelvic abscesses, wound dehiscence, leak at the anastomotic site, leading to long hospital stay, and delayed complications like intestinal adhesions and stenoses at the anastomotic site needed repeated hospital admissions. Enterocolitis was another major problem and patients developed enterocolitis before and after surgery.

Fontana et al<sup>4</sup> in a study of 82 infants who had undergone Soave or Duhamel open procedures were reviewed after 20 years. They found only 60 and 67% of the children had an uneventful recovery; 20 and 29% of them needed reoperation, and short-term continence for both was around 50% and became 100% continent about 15 years of age.

So et al<sup>5</sup> published that Hirschsprung's disease in the newborn does not mandate the performance of a preliminary colostomy. They treated enterocolitis by a precise regimen of colonic irrigations and then did the

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endorectal "pull-through" procedure. They found it was safe and effective when performed in the neonatal period.

Laparoscopy in Hirschsprung's disease<sup>6</sup> was being done from 1992, and it was limited to biopsy, followed by a minilaparotomy and pull-through procedure, as the anesthetic complications were very high. Georgeson et al<sup>7</sup> reported laparoscopy-assisted colon pull-through procedure.

Between November 1993 and September 1994, they did 12 primary laparoscopic colon pull-through procedures in infants and children. The patients' ages ranged from 3 days to 6 years. The primary diagnosis in all 12 patients was Hirschsprung disease. All children had their operations without construction of preoperative or postoperative colostomy. They mobilized sigmoid colon and proximal rectum laparoscopically. A submucosal sleeve was developed transanally to meet the dissection from above. The colon was then pulled down in continuity, divided above the transition zone, and secured to the anal mucosa 5 to 10 mm above the pectinate line. Mean postoperative stay was 4 days. Laparoscopic visualization provided clear delineation of pelvic structures even in small infants. He concluded that laparoscopic pull-through required no more time than similar open procedures, averaging just over 2 hours, and morbidities associated with colostomy formation and closure and the inconvenience of colostomy care were avoided with a one-stage technique. Postoperative sequelae like wound dehiscence and wound infection were avoided due to the laparoscopy.

Georgeson et al<sup>8</sup> again reported on laparoscopy-assisted pull-through for 80 children.<sup>9</sup> The age at surgery ranged from 3 days to 96 months. They discussed the outcome of primary laparoscopic pull-through in 80 patients performed at six pediatric surgery centers over 5 years. The average length of the surgical procedure was 2.5 hours. Almost all of the patients passed stool and flatus within 24 hours of surgery. The average time for discharge after surgery was 3.7 days. The transition zone was identified by seromuscular biopsies obtained laparoscopically. The colon pedicle preserving the marginal artery was also fashioned endoscopically. The rectal mobilization was performed transanally. They used the endorectal sleeve technique with the anastomosis performed transanally 1 cm above the dentate line.

Sixty-nine (86%) of their 80 patients had a transition zone in the rectum or sigmoid colon. The remaining 11 patients had a transition zone proximal to the sigmoid colon; one of these patients had total colonic aganglionosis. Seventy (87.5%) of the children were younger than 6 months of age at the time of the pull-through procedure. Operative time averaged 147 minutes. Blood loss was <10 cc per patient; only one patient had blood transfusion. They found that there was rapid postoperative recovery

and bowel movement started within 24 hours except for six patients. The mean time to discharge was 3.7 days.

They did not find any instances of anastomotic stricture, postoperative bowel obstruction, wound infection, prolonged ileus, pelvic or intra-abdominal abscesses, or wound dehiscence. Ten (12.5%) of the 80 patients were readmitted to the hospital for complications. Four of these 10 patients required postoperative diversion of the gastrointestinal tract.

Teitelbaum et al<sup>10</sup> published a paper describing a single-stage primary ERPT procedure. Their study included 78 infants who underwent a primary ERPT procedure. Study duration was from May 1989 to September 1999.

Mean age at the time of ERPT was 17.8 days of life. They compared primary ERPT with a two-stage approach. Their study showed a trend toward a higher incidence of enterocolitis in the primary ERPT group compared with those with a two-stage approach (42.0 vs 22.0%). Other complications they found were either lower in the primary ERPT group or similar, including rate of soiling and development of a bowel obstruction. Median number of stools per day was two at a mean follow-up of  $4.1 \pm 2.5$  years, with 83% having three or fewer stools per day. They found that performance of a primary ERPT for Hirschsprung's disease in the newborn is an excellent option. Results were comparable to those of the two-stage procedure. They also found a greater incidence of enterocolitis as compared with the two-stage procedure, but the multistage pull-through had higher incidence of readmissions than an ERPT. They found the ERPT procedure left no scars and was associated with less postoperative pain and discomfort, and shortened hospital stay. Short-term function was reported to be very similar to that after open or laparoscopic procedures. They suggested that one-stage neonatal repair of Hirschsprung's disease was associated with less cost and demand of resources without jeopardizing functional outcome.

Westler and Rintala<sup>11</sup> did a study in 40 patients who had undergone transanal ERPT for Hirschsprung's disease between January 2000 and February 2003. Here, they divided patients into three groups: Patients with neonatal primary pull-through (group I, 15 patients), patients operated on beyond the neonatal period (group II, 11 patients), and patients with a previous colostomy (group III, 14 patients). All colostomies except one were taken down and pulled through concomitantly with the transanal procedure.

They found no difference in median hospital stay (group I, 5 days; group II, 4 days; group III, 5 days) and median time to full oral feedings (group I, 4 days; group II, 2 days; group III, 3 days) between groups. Two patients (group III) had immediate postoperative prolapse of the

pulled-through colon that was reduced without further sequels; one (group III) had infection of the stoma closure wound. Perianal skin rash was more often in neonatal patients (group I, 10 of 15; group II: 4 of 11; group III: 8 of 14). Anastomotic dilatation regimen was required more often in neonatal cases (group I, 6 of 15; group II, 1 of 11; group III, 2 of 14). Enterocolitis requiring hospital care occurred in two patients (group I), and five further patients (group II, 1; group III, 4) were treated as outpatients for symptoms, suggesting mild enterocolitis or bacterial overgrowth. They concluded that transanal ERPT in neonatal patients was as feasible and safe as in older children. Temporary postoperative skin rash occurred more frequently in neonatal patients, and postoperative dilatations were required more often than in older children.

In another article, Minford et al<sup>12</sup> compared the outcome of Duhamel's operation and transanal ERPT. In their study, 70% were neonates (Duhamel, 24 of 34; transanal endorectal coloanal anastomosis, 26 of 37). They assessed the functional outcome. Functional outcome was similar in the two groups. They found that ERPT and Duhamel procedures had similar medium-term functional outcomes. The ERPT had a high incidence of postoperative enterocolitis and transient stricture formation but was suitable for single-stage neonatal treatment of Hirschsprung's disease.

Lu et al<sup>13</sup> also found a high rate of postoperative enterocolitis in neonates undergoing transanal pull-through.

Teeraratkul<sup>14</sup> in an article described the limitation of the procedure of transanal pull-through. Retroperitoneal fixation of the descending colon could not be dissected by the transanal route, especially if it needed mobilization of the splenic flexure. The length of bowel that could be dissected varied from 9 to 25 cm.

Langer et al<sup>15</sup> compared transanal Soave with the open approach to see whether it offers any advantage and whether routine laparoscopic visualization is necessary. He studied 37 children. They had children with open Soave 13, transanal Soave with laparotomy 9, and transanal Soave with selective laparotomy or minilaparotomy 15.

In two patients with transanal Soave, they had to do laparoscopy for a long segment in one and small umbilical incision for mobilization of the splenic flexure in another.

There were no differences in operating time, and intraoperative complications, such as enterocolitis, stricture, or cuff narrowing, but hospital stay was longer in open Soave and there were four reoperations in open Soave, adhesion obstruction, twisted pull-through, and recurrent aganglionosis being the causes. They concluded that transanal pull-through had shorter hospital stay and low incidence of intra-abdominal adhesions. Laparoscopic visualization was needed for children who are at high

risk for long segment disease. Transanal approach was also supported by Dela Torri with shorter hospital stays and fewer complications.

Schofield and Ram<sup>16</sup> compared between open Duhamel's (OD) and laparoscopy-assisted Duhamel's (LD) procedure.

From 11 articles, 456 patients were included (253 OD, 203 LD), with no significant difference in age at surgery and length of follow-up ( $p > 0.05$ ). The open group had a significantly greater incidence of soiling/incontinence (11 vs 4%;  $p = 0.02$ ) and further surgery (25 vs 14%;  $p = 0.005$ ), longer hospital stay (9.79 vs 7.3 days;  $p < 0.00001$ ), and time to oral feed (4.05 vs 3.27 days;  $p < 0.00001$ ). Operative time was significantly longer in the laparoscopic group (3.83 vs 4.09 hours;  $p = 0.004$ ). There was no significant difference in incidence of enterocolitis (15 vs 10%;  $p = 0.14$ ) and constipation (23 vs 30%;  $p = 0.12$ ). They have compared the quality of life and Fecal Continence Index in children with Duhamel's operation and transanal pull-through and normal children. They have found that both quality of life and Fecal Continence Index were lower than normal children in both groups and transanal pull-through had still a lower score.

## DISCUSSION

Open laparotomy and transanal pull-through procedures whether Duhamel's or Swenson's or Soave are associated with immediate and delayed complications and morbidity. This includes wound infections, intra-abdominal and pelvic abscesses, wound dehiscence, anastomotic leak, stricture at the anastomotic line, intestinal adhesions and intestinal obstructions, constipation, incontinence problems, and perineal excoriations in addition to the enterocolitis. Colostomy in addition has its own complications like prolapse, herniation, stenosis, abdominal wall excoriation in addition to the stoma management problems.

But the transanal pull-through procedures were associated with fewer complications even though various authors have reported increased episodes of enterocolitis. So the endorectal dissection became the dominant minimal access procedure, which could be done easily in the neonates without entering the peritoneal cavity. The peritoneal dissection is avoided and hence, its early and late complications.

Number of days of hospital stay was reduced, but the level of resection was an arbitrary choice of visualized transitional zone. The resected ends could be sent for biopsy, but necessitated opening up of the abdomen if the level was higher up. Also if the transition zone was above the usual rectosigmoid junction, peritoneal dissection especially at the splenic flexure needed laparotomy or a minilaparotomy at the umbilicus. Some studies

noted an increased number of episodes of enterocolitis postoperatively, and perineal excoriation also was noted as a major problem that gradually resolved.

These difficulties were overcome by the laparoscopy-assisted transanal pull-through approach. The laparoscopy-assisted transanal ERPT allows early biopsies to determine the extent of aganglionic and dysfunctional bowel before dissection of the rectum and mesocolon begins. Frozen section biopsies are taken from multiple sites before the dissection begins. Dissection of the peritoneal attachments from the left colon and isolation of the marginal artery can be done laparoscopically. Total colonic aganglionosis is managed by a laparoscopy-assisted Duhamel procedure.

The International Pediatric Endosurgery Group prepared the guidelines for laparoscopic approach in 2004 and summarized that the implementation of laparoscopy allowed the surgeon to safely use the concept of pull-through while eliminating the major source of morbidity, which consists of colostomy and its consequences, postoperative immediate and late complications like wound dehiscence, wound infection, and intestinal adhesion obstruction. Laparoscopic technique avoids internal and external scarring. There is rapid recovery and less perianal excoriation. It has also been mentioned about the excessive stretching and damage of the anal sphincter during rectal dissection especially in the neonates, which gradually recover in time, and this can be avoided by a laparoscopic rectal dissection.

But in neonates with classical rectosigmoid transition zone, endorectal dissection has become the dominant minimal access procedure because of ease and reliability. Creation of pneumoperitoneum can be avoided and Surgery can be done by any surgeon without laparoscopic skills makes it universal. Also, there is no abdominal scarring and the postoperative complications are minimized.

## SUMMARY

Laparoscopy has improved the outcome and management of Hirschsprung's disease to a large extent. The duration of postoperative recovery and hospital stay has decreased. Also it avoids the immediate and late complications of a laparotomy and peritoneal dissection like wound dehiscence and postoperative adhesion obstruction.

The most commonly seen Hirschsprung's disease with transition zone in the rectosigmoid is done in the neonatal period as one-stage transanal ERPT procedure.

In all other children, it must be one-stage laparoscopy-assisted transanal pull-through procedure. This will deal with the issue of getting a biopsy report of the level of transition zone and the normal ganglionic segment. It allows peritoneal dissection and isolation of marginal artery

under vision. Adequate length of colon can be dissected. Total colonic aganglionosis must be treated with laparoscopically assisted transanal pull-through procedure.

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# Two-port Mini vs Conventional Four-port vs Single-incision Laparoscopic Cholecystectomy: An Update with Review of Literature

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## ABSTRACT

**Introduction:** Laparoscopic cholecystectomy (LC) is the gold standard for the removal of gallbladder stones. In an attempt to reduce the invasiveness of the procedure, surgeons have done various modifications like reduction of port size and/or number, which is used in conventional LC. The main objective of this review is to compare the two-port mini LC with other techniques of LC like conventional four-port laparoscopic surgery or single-incision laparoscopic cholecystectomy (SILC) in elective laparoscopic cholecystectomy and determine the outcome of two-port mini LC.

**Material and methods:** Literature review was performed on newly minimal invasive approach for LC, two-port cholecystectomy, variations in size and port of cholecystectomy and their advantages over one another, and SILC. The search was performed using the search engines like Google, PubMed.

**Results:** Postoperative pain was significantly low in the two-port group. The overall analgesia requirements and return to daily activity were significantly lower in two-port group. The cosmesis score of the two-port group was better than four-port group or SILC. However, the length of hospital stay and complications was similar between the two-port and four-port LC, but it differs in SILC.

**Conclusion:** Two-port mini LC resulted in reduced pain, need for analgesia, and improved cosmesis without increasing the operative time and complication rates compared with that in four-port LC or SILC. Hence, two-port mini LC can be tried firstly and can be converted to additional four-port LC when necessary.

**Keywords:** Cholecystectomy, Laparoscopic cholecystectomy, Lapchole, Mini-laparoscopy, Review, Single-incision laparoscopic cholecystectomy, Two-port laparoscopy.

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## INTRODUCTION

Laparoscopic cholecystectomy is now the gold standard for the removal of gallbladder.<sup>1</sup> The main advantages of laparoscopic surgery include better cosmetic results, decreased postoperative pain, and faster functional recovery.<sup>1</sup> Various innovations in the techniques of LC like natural transluminal endoscopic surgery,<sup>2</sup> single-incision laparoscopic surgery (SILS),<sup>3-5</sup> two-port,<sup>6</sup> and three-port<sup>7</sup> laparoscopic surgeries have been applied for removal of gallbladder as a step forward to even lesser invasive procedures than the conventional four-port surgery. These different newer techniques represent the advent of essentially scarless, more pain-free, better cosmesis, and early return of function for the patient with benefit to one another.

The evolution of surgery of gallbladder from Langenbuch's first cholecystectomy with a hospital stay of 6 weeks into a day-care specialty following the introduction of LC is indeed fascinating.<sup>8</sup>

In conventional four-port LC, one 10-mm optical port is placed in umbilical area and other 10-mm port is to be placed in the epigastrium to the left of the falciform ligament with two additional 5-mm ports in the right upper abdomen two finger breadths below the costal margin in midclavicular line and anterior/midaxillary line at the level or just below the umbilicus. Dissection of the gallbladder is performed by the standard technique by first grasping and lifting the fundus, followed by dissection of the cystic duct and artery. Once the "critical view" of these structures was obtained, these were clipped and divided. The gallbladder is then removed from its bed using electrocautery and retrieved through the epigastric port.

## FOREWORD TO LITERATURE REVIEW

### Four-port LC

Four-port laparoscopic surgery is also called as conventional laparoscopic surgery (CLC) for cholecystectomy performed with fourth port; 10-mm ports are placed at

umbilicus and epigastrium and 5-mm ports are placed at right midclavicular below subcostal margin and anterior/midaxillary line at level of umbilicus (Fig. 1). The main advantages of laparoscopic surgery include better cosmetic results, decreased postoperative pain, faster functional recovery, and less complications as compared with the open surgery.

### Two-port Mini LC

In two-port laparoscopic surgery, one 10-mm port is placed at umbilical area and one 5-mm epigastric port is placed to the left of the falciform ligament. One special 2.3-mm alligator graspers (Stryker Corporation, USA) (Fig. 2) is used transabdominally for grasping the Hartmann pouch of the gallbladder for its retraction and manipulation respectively. Using the standard Maryland laparoscopic instrument, the cystic duct and artery are dissected as in the four-port technique. For clipping the cystic duct and artery, a 5-mm clip applicator was used with 200-mm clips. In case of wider cystic duct, single hand suturing of the duct was done with 2/0 silk. The structures are divided and dissection proceeded by reversing the laparoscope and dissecting instruments to their original sites. Gallbladder specimen is retrieved through the umbilical port by railroad technique or using 5-mm 30° scope through the epigastric port and 10-mm jaw forceps from the umbilical port.

In two-port mini LC when compared with SILC, surgery becomes much easier due to restoration of triangulation, and learning curve becomes shorter; however, it causes minimal violation of anterior abdomen due to less number of port and sizes leading to lesser postoperative pain and less cosmesis when compared with SILC or four-port LC.<sup>9</sup> With the newer techniques, the need for more sophisticated instruments escalates the cost of

surgery and limits the use of these minimally invasive techniques to a few centers. Two-port mini LC scores over the conventional techniques as it requires minimal new instruments and can be performed at all laparoscopic centers without any new cost inputs and simultaneously to achieve the goal of minimal access surgery.

Operative time varies with different studies as few require less and few more than the conventional technique.<sup>10-14</sup> The operative difficulty is based on the status of gallbladder, adhesions around the gallbladder fossa, Calot's triangle, and cystic duct anatomy. The conversion rates from two-port mini LC to four-port LC and open cholecystectomy in many studies are in the range of 23 to 38%.<sup>13,15,16</sup> The main reasons for conversions are difficult anatomy due to dense inflammation from cholecystitis, common bile duct injury, and instrument failure. A planned two-port surgery must be given up in the event of such difficult anatomy on initial diagnostic exploration to proceed further with conversion.<sup>17,18</sup>

### Single-incision Laparoscopic Cholecystectomy or Single-port Access

It proposes a single site port placement, and it is in or around umbilicus using a special port devices. This usually requires a larger skin incision of 20 mm. However, the technique is more demanding as dissection becomes more difficult due to clashing of instruments, loss of normal triangulation, restricted vision, and depth of dissection. A special large port, angulated instruments, and scopes are needed for better dissection (Fig. 3). All these factors lead to a steeper learning curve and increase the risk of large scar due to 20-mm port than conventional port or two-port LC. It increases the postoperative pain as compared with SILC due to larger port size, and also there is increased wound-related complications including hernia formation.<sup>4</sup>

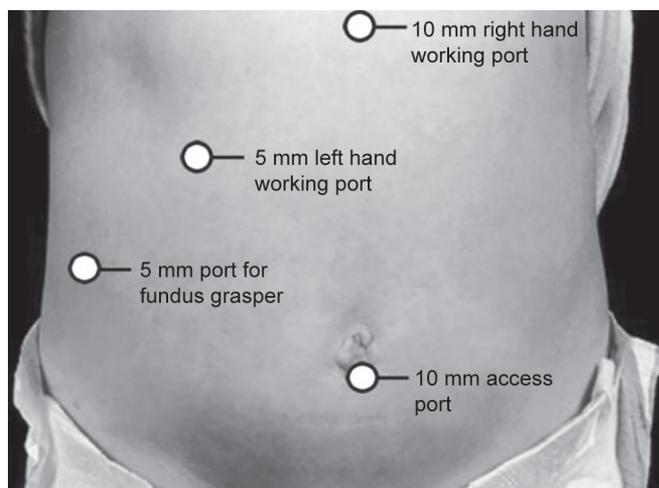


Fig. 1: Port placement in CLC



Fig. 2: Mini alligator for two-port LC

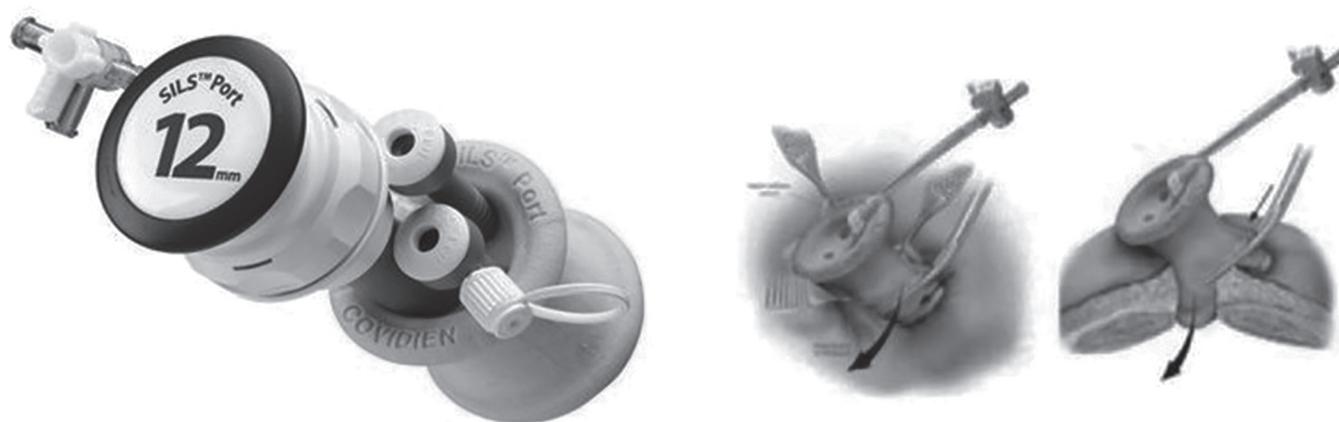


Fig. 3: SILS port and technique of insertion of SILS port

## CONCLUSION

In our conclusion, LC can be performed with two-port technique in properly selected cases and optimize the benefits of minimal access surgeries. Two-port mini LC resulted in reduced pain, need for analgesia, and improved cosmesis without increasing the operative time and complication rates compared with that in four-port LC or SILC. Hence, two-port mini LC can be tried firstly and can be continued with addition of fourth port if necessary.

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# Can Robotic Gastrectomy be considered as Gold Standard for Upcoming Surgeons? A Multi-institutional Comparative Review

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## ABSTRACT

Surgical techniques have evolved tremendously over this past century. Minimally invasive surgery for gastric cancer is not a new research field, but still an important problem remains regarding the selection of the appropriate technique for a given gastric cancer case. Although evidence is limited, the use of the robotic surgery platform is far assessed as a feasible and safe procedure, which is also easier to learn as less than 10 cases of robotic surgery are needed to become proficient therein. This review will however cover in-depth review of retrospective reports, analyzing the pros and cons of robotic surgery and highlighting the remaining study questions.

**Keywords:** Gastrectomy, Gastric cancer surgery, Minimally invasive surgery, Robotic surgery.

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## INTRODUCTION

Surgery is unanimously considered the mainstay curative treatment in gastric cancer. Technically, the possibilities range from open surgery to minimally invasive methods, such as laparoscopy or robotic surgery. Although minimally invasive surgery for gastric cancer has evolved rapidly, it has increased in popularity during the last two decades mainly in the Far East and for patients with early-stage tumors.<sup>1,2</sup> A number of trials and meta-analyses have confirmed that laparoscopic surgery for gastric cancer can

improve short-term results and the patient's quality of life when compared with open surgery.<sup>3-7</sup> While in the Western world, development of laparoscopic gastrectomy (LG) has been very slow and is not yet considered an acceptable alternative to standard open surgery.<sup>8</sup> This skepticism is basically due to the technical complexity of LG and concerns about the feasibility of an oncologically acceptable lymphadenectomy. For these reasons, LG is considered one of the most difficult operations, requiring a long learning curve of about 40 to 50 cases.<sup>9</sup>

Robotic systems include operator-controlled three-dimensional cameras that ensure steady and effective surgical fields of view with motion scaling and tremor suppression, multiple degrees of freedom with instrument flexibility, and improved ergonomics.<sup>10-13</sup> It is believed that this technological evolution can assist the surgeon with complex surgical procedures that are required in radical gastrectomy, such as precise lymph node dissection and intracorporeal anastomoses.<sup>4</sup>

However, the number of robotic gastrectomies performed per year has been increasing, particularly in East Asia where the incidence of gastric cancer is high and approximately half of the cases are diagnosed as early gastric cancer. The use of the robotic platforms in general surgery did not enjoy the same success as it did in urologic surgery, and the field of gastric cancer is no exception. Robotic surgery till now has only proven its safety and feasibility in early gastric cancer.<sup>11</sup> The current challenge for robotic surgery in gastric cancer is to prove its effectiveness and benefit as a treatment option, ideally in the form of a survival advantage and steep learning curve as compared with open and conventional laparoscopic surgery.

## MATERIALS AND METHODS

Literatures that published in English in years 2016 and 2017 were searched in PubMed and Knowledge Genie, using the search terms "robotic gastrectomy" (RG) and "gastric cancer" along with their synonyms or abbreviations. Then all titles, abstracts, or related citations were scanned and reviewed, and the references of each identified articles were also evaluated. Large-scale prospective cohort studies, retrospective case-control studies, and case series were also reviewed of which lastly five articles were selected for the review.

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**Table 1:** Summary of intraoperative outcomes in various studies

Intraoperative data	Cianchi et al <sup>15</sup>	Parisi et al <sup>16</sup>	Hong et al <sup>17</sup>	Shen et al <sup>18</sup>	Kim et al <sup>19</sup>
Operative time	RG > LG	RG > LG	RG > LG	RG > LG	RG > LG
Blood loss	RG < LG	RG < LG	RG < LG	RG = LG	RG < LG
Lymph nodes	RG > LG	RG > LG	RG = LG	RG > LG	RG = LG
Margin status	RG = LG	RG = LG	RG = LG	NA	NA
Surgeons ease	RG > LG	RG = LG	RG > LG	RG > LG	NA

NA: Not applicable

The data were extracted and critically appraised. Operative time, blood loss, number of harvested lymph nodes, proximal resection margin to assess the effectiveness of the procedures, and surgeons comfort to the type of procedure were extracted. The analgesic medication, first flatus day, first oral intake, and hospital stay were used to compare the postoperative recovery of the procedures. Lastly, the postoperative complications including wound infection, anastomotic leakage, anastomotic stenosis, postoperative ileus, pneumonia, pancreatitis, intra-abdominal abscess, and adhesive bowel obstruction wherever available were also compared.

## RESULTS

Table 1 shows the description about the surgical performances of different surgeons and their intraoperative outcomes, suggesting that operative time taken in robotic surgery is definitely more than that taken in laparoscopic surgeries, and few studies which also included open surgery in their report did suggest the same that time taken in robotic surgery is significantly higher than that taken in an open laparoscopic surgeries.

While it was not same in respect to total blood loss which is definitely less in robotic group than in open or laparoscopic groups, even number of lymph nodes harvested in robotic group were more in most of the studies although not significantly but were never less than that harvested in laparoscopic or open groups. Margin status did not show any significant difference, but surgeon's ease in doing the surgery with robotic console was much more even though it required them to learn a newer technique.

Immediate postoperative results are also compared in Table 2<sup>15-19</sup> which included analgesic requirement, first

**Table 2:** Summary of studies comparing the postoperative outcome of robotic and laparoscopic gastrectomy

Postoperative data	Cianchi et al <sup>15</sup>	Parisi et al <sup>16</sup>	Hong et al <sup>17</sup>	Shen et al <sup>18</sup>	Kim et al <sup>19</sup>
Analgesic	R = L	R > L	R = L	NA	NA
First flatus day	R = L	R < L	R = L	NA	NA
First oral intake	R = L	R = L	R = L	NA	NA
Hospital stay	R = L	R < L	R = L	R = L	R = L

R: Robotic; L: Laparoscopic; NA: Not applicable

flatus day, first oral intake, and hospital stay, and none of the following showed significant difference between robotic and laparoscopic groups although laparoscopy has already proven its significance in comparison with the open in all the fields. Similarly, in Table 3, postoperative complications were evaluated and there was no significant difference between the two groups.

## DISCUSSION

The clinical efficacy and advantages of the laparoscopic technique in the treatment of gastric cancer have already been recognized<sup>20</sup> and indeed are associated with improved postoperative outcomes and oncological results.<sup>3,4,21,22</sup> However, LG has several drawbacks, such as limitation in the movement range of forceps coupled with the fulcrum effect, inherent tremor, and two-dimensional surgical view available to operating surgeons, and prolongs the learning curve especially for large-scale procedures, such as gastrectomy. Though recent technological advancements have facilitated this to some degree, still there have been serious shortcomings of the procedure.

Robotic gastrectomy may enable us to overcome these shortcomings. Using the da Vinci<sup>®</sup> Surgical System (Intuitive Surgical, Sunnyvale, California, USA), surgeons were

**Table 3:** Main complications reported using robotic and laparoscopic surgery

Complications	Cianchi et al <sup>15</sup>	Parisi et al <sup>16</sup>	Hong et al <sup>17</sup>	Shen et al <sup>18</sup>	Kim et al <sup>19</sup>
Wound infection	NA	R < L	R > L	R = L	R = L
Anastomotic leak	R < L	R = L	R = L	R = L	R = L
Anastomotic stenosis	NA	R < L	R < L	R = L	R = L
Ileus/obstruction	R > L	R < L	R = L	R = L	R = L
Pneumonia	NA	R > L	R < L	R = L	R = L
Pancreatitis	R < L	NA	NA	R = L	R = L
Abscess	NA	R = L	R = L	R = L	R = L

NA: Not applicable

able to attain a three-dimensional surgical view enabling depth perception, the EndoWrist® technology which allows for seven degrees of freedom, tremor suppression and filtration, and improved ergonomics.<sup>10-13</sup> Additionally, images can be enlarged enabling the performance of delicate steps, such as lymph node dissection along great vessels which are essential in achieving a D2 dissection, suturing, or knotting. These features could enable the performance of relatively complicated procedures, such as function-preserving gastrectomy or extended resections for advanced gastric cancer using a minimally invasive method.<sup>23</sup>

Encouraging results are being published using the robotic technique, but the lack of homogeneous study groups in terms of staging, comorbidities, and adjuvant and neoadjuvant therapies makes it hard to establish a clear indication for RG in gastric cancer. Carefully weighing the treatment options is especially important since there are more and more groups publishing acceptable results with the robotic technique.

Nonetheless, there are a series of shortcomings of the robotic platform explaining this situation. First of all, the lack of robotic staplers and robotic seal and cut devices, such as LigaSure™ is a considerable inconvenience. Second, due to the costs and duration of the procedures, the robotic platform cannot be used to cover the whole spectrum of procedures normally performed by a general surgeon.<sup>21</sup>

## CONCLUSION

Within the limitation of a small-sized, nonrandomized analysis, our study confirms that robot-assisted gastrectomy is a feasible and safe surgical procedure. When compared with conventional laparoscopy, robotic surgery shows evident benefits in performing lymphadenectomy with a higher number of retrieved and examined lymph nodes, and also the use of robotics is a good option for the upcoming surgeons since only less than 10 cases of robotic surgery are needed to become proficient in gastric cancer surgery.

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# Port-site Metastasis after Minimally Invasive Surgery for Urological Malignancy: A Review of Literature

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## ABSTRACT

**Introduction:** Port-site metastasis (PSM) has been a concern with the common use of minimally invasive surgery, especially laparoscopy in urologic oncology. We conducted this study to provide a review of PSMs reported after minimally invasive surgery in managing urologic malignancies, possible contributing factors and preventive measures.

**Materials and methods:** An electronic search of MEDLINE, PubMed, Google Scholar, and HighWire Press with the combined keywords "port-site metastasis" and "urology" was carried out.

**Results:** A total of 40 articles comprising almost 60 cases addressing PSM after minimally invasive surgery for urological malignancy were identified.

**Conclusion:** Port-site metastasis in urological laparoscopic surgery is rare and is preventable. Risk can be minimized by applying open surgery oncological procedural principles.

**Keywords:** Laparoscopy, Port-site metastasis, Robotic, Urological malignancy.

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## INTRODUCTION

In recent years, questions have been raised about the oncologic safety of laparoscopic and robotic approach.<sup>1</sup> Even though a large number of specialized centers around the world perform laparoscopy for urologic cancer,<sup>2,3</sup> local recurrence and PSM still remain a concern.<sup>4</sup>

When PSMs occur, they often do so in the presence of advanced disease, but it is not uncommon for them to occur in isolation.<sup>5,6</sup>

The first known report of a PSM was by Dobronze et al<sup>7</sup> in 1978. The authors reported implantation of

malignant ovarian cystic adenoma in penetration sites of the pneumo-needle and trocar. Some specific procedures and tumors have been associated with a higher incidence of PSM or tumor seeding; however, the precise incidence of PSM and its etiology and pathogenesis have not been well defined in urologic laparoscopy.<sup>8</sup>

Since the first successful laparoscopic nephrectomy in 1991,<sup>1</sup> minimally invasive approaches have been increasingly used in tumor resection and lymph node dissection for urologic cancers. This approach has multiple advantages, including decreased length of hospitalization, decreased pain, faster recovery, and improved cosmesis.<sup>2</sup> Laparoscopic surgery has equivalent oncologic outcomes to open procedures; however, PSM is rare, troubling, and often an unexplained occurrence. The first known occurrence of PSM after a urologic procedure was in 1994, when Stolla et al<sup>9</sup> reported a case of subcutaneous metastasis of bladder transitional cell carcinoma (TCC) after laparoscopic pelvic lymph node dissection. Since then, about 50 PSMs have been reported in the setting of urologic surgery.<sup>10</sup>

Port-site metastasis is a multifactorial phenomenon with an as-yet undetermined incidence. Etiological factors include natural malignant disease behavior, host immune status, local wound factors, laparoscopy-related factors, such as aerosolization of tumor cells (the use of gas, type of gas, insufflation and desufflation, and pneumoperitoneum) and sufficient technical experience of the surgeons and operating team (adequate laparoscopic equipment, skill, minimal handling of the tumor), surgical manipulation, wound contamination during instrument change, organ morcellation, and specimen removal.<sup>9</sup>

## MATERIALS AND METHODS

An electronic search of MEDLINE, PubMed, Google Scholar, and HighWire Press of the published literature up to 2017 was carried out using the combined key words "port-site metastasis" and "Urology."

Duplicate references, as well as repeated references to the same data sets, were removed. The articles and case reports directly addressing PSM after minimally invasive surgery for urological malignancy were reviewed.

## RESULTS

Table 1<sup>11-16</sup> shows the case reports found on MEDLINE, PubMed, Google Scholar, and HighWire Press; search of

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**Table 1:** Search results on MEDLINE, PubMed, HighWire Press, Google Scholar, and SciELO compiled according to the date of publication

Author	Procedure	Tumor type, stage, and grade	Number of cases
Shimokihara et al <sup>35</sup>	Laparoscopic radical nephrectomy	Clear cell RCC—metastatic RCC on histopathological examination	1
Johnson <sup>5</sup>	Robotic radical cystectomy	TCC	1
De Bruyne et al <sup>11</sup>	Prostatic adenocarcinoma	Prostatic adenocarcinoma T3b, Gleason 7	1
Shiozaki et al <sup>12</sup>	Laparoscopic nephroureterectomy	Rt upper ureter carcinoma T2N0M0 grade III	1
Song et al <sup>13</sup>	Robot-assisted partial nephrectomy	RCC	1
Javali et al <sup>14</sup>	Laparoscopic radical nephrectomy	Chromophobe RCC T2N0M0	1
Kumar et al <sup>6</sup>	Laparoscopic radical nephrectomy	1. T2N0M0 RCC 2. T1N0M0 RCC	2
Huang et al <sup>36</sup>	Laparoscopic radical cystectomy and pelvic lymph node dissection	NA	1
Wen and Yin <sup>3</sup>	Hand-assisted retroperitoneoscopic nephroureterectomy and bladder cuff excision	Left renal urothelial carcinoma	1
Yasuda et al <sup>15</sup>	Laparoscopic nephroureterectomy	Upper urinary tract carcinoma. T2N0M0 grade II>3	1
Greco et al <sup>16</sup>	Laparoscopic partial nephrectomy	Renal clear cell papillary carcinoma pT1a, high grade	1
Spermon and Witjes <sup>37</sup>	Laparoscopic retroperitoneal lymph node dissection	Stage IIb nonseminomatous germ cell tumor (histology-yolk sac and teratoma elements)	1
Masterson and Russo <sup>38</sup>	Laparoscopic partial nephrectomy	T1bNxM0 RCC	1
Segawa et al <sup>39</sup>	Laparoscopic nephroureterectomy and cystectomy	Invasive bladder cancer with bone metastasis. Grade NA	1
Cresswell et al <sup>40</sup>	Laparoscopic retroperitoneal lymph node dissection	Stage 1 nonseminomatous germ cell tumor. Grade NA	1
Castillo and Vitagliano <sup>41</sup>	Laparoscopic retroperitoneal lymph node dissection	Mixed germ cell tumor T3N0M0	1
Muntener et al <sup>42</sup>	(A) Laparoscopic radical nephroureterectomy (B) Laparoscopic partial nephrectomy	Upper tract TCC. Stage T1, high grade RCC T1N0M0G3	1 1
Manabe et al <sup>43</sup>	Laparoscopic nephroureterectomy	Upper tract TCC without distant metastases	1
Dhobada et al <sup>44</sup>	Laparoscopic nephrectomy	RCC T2N0M0G3	1
Kobori et al <sup>45</sup>	Laparoscopic nephrectomy	Papillary adenocarcinoma of pelvis. Stage and grade unavailable	1
El-Tabey and Shoma <sup>46</sup>	Laparoscopic cystectomy (robot assisted)	Bladder TCC T3bN0M0G3	1
Porpiglea et al <sup>47</sup>	Laparoscopic adrenalectomy	Adrenal metastasis from nonsmall-cell lung carcinoma	1
Chueh et al <sup>48</sup>	Laparoscopic bilateral nephroureterectomy	Grade II renal TCC with pelvic muscular invasion and bladder metastasis	1
Naderi et al <sup>49</sup>	Laparoscopic nephroureterectomy	Kidney TCC cT1N0M0	1
Micali et al <sup>8</sup>	(A) Laparoscopic retroperitoneal lymph node dissection (B) Laparoscopic simple nephrectomy (C) Laparoscopic nephroureterectomy (D) Laparoscopic adrenalectomy (E) Laparoscopic pelvic lymph node dissection	Nonseminomatous germ cell tumor Incidental TCC in each instance—pT1/G2; pT1/G3; pT2/G3; NA pT3/G3 Penile cancer	1 4 3 4 1
Iwamura et al <sup>50</sup>	(A) Laparoscopic retroperitoneal nephrectomy (B) Laparoscopic Adrenalectomy (C) Laparoscopic pelvic lymph node dissection	RCC T1bN0M0 Lung metastases pT4/G3 (3); Adrenocortical Ca-grade and stage NA (1) Squamous penile Ca	1 4 1
Matsui et al <sup>51</sup>	Laparoscopic retroperitoneal nephroureterectomy	SCC pT3N0M0	1
Saraiva et al <sup>52</sup>	Laparoscopic adrenalectomy	Metastatic melanoma of adrenal gland. Grade unavailable	1
Rassweiler et al <sup>10</sup>	(A) Laparoscopic adrenalectomy (B) Laparoscopic retroperitoneal lymph node dissection	Small-cell lung carcinoma adrenal metastasis NA	1
Chen et al <sup>53</sup>	Laparoscopic nephrectomy (hand-assisted)	RCC T2N0M0	1
Wang et al <sup>54</sup>	Laparoscopic cystectomy	Incidental finding of SCC in ovarian dermoid cyst	1
Castilho et al <sup>55</sup>	Laparoscopic nephrectomy	RCC T1N0G2	1

(Cont'd...)

(Cont'd...)

Author	Procedure	Tumor type, stage, and grade	Number of cases
Landman and Clayman <sup>56</sup>	Laparoscopic nephrectomy	RCC T1N0G2	1
Fentie et al <sup>57</sup>	Laparoscopic nephrectomy	RCC T3N0G4	1
Otani et al <sup>58</sup>	Laparoscopic nephrectomy	Incidental finding of TCC, G3 within tuberculous atrophic kidney	1
Ahmed et al <sup>59</sup>	Laparoscopic nephrectomy	Kidney TCC T3G3-G4	1
Altieri et al <sup>60</sup>	Laparoscopic pelvic lymph node dissection	Bladder TCC T3G2	1
Bangma et al <sup>61</sup>	Laparoscopic pelvic lymph node dissection	PCa T3N1	1
Andersen et al <sup>62</sup>	Transperitoneal laparoscopic bladder biopsy	Bladder TCC T1G2	1
Stolla et al <sup>17</sup>	Laparoscopic pelvic lymph node dissection	Bladder TCC pT3G2	1

the published literature up to 2017 recovered 40 articles comprising almost 60 cases for the words “port-site metastasis” and “urology.”

Etiological factors have been categorized into three main categories: Tumor-related, wound-related, and surgical technique-related factors. Surgical technique-related factors have been categorized into two main categories: Manipulation is the principal factor acting in tumor dissemination. Extraction of the surgical specimen is determined by the surgeon. The possible preventive measure has been categorized into two main categories: Active measures and measures for reducing the risk of laparoscopic PSM in urological surgery.

## DISCUSSION

In urothelial cancers, port-site recurrence has been reported in a total of 13 cases, as reviewed by Micali et al<sup>8</sup> in an international survey of 19 urologic laparoscopic centers performing a total of 18,750 laparoscopic procedures for urologic malignancies. The incidence was 0.12% (13 of 10,912). Majority of port-site recurrences reported in this survey represented TCC. Of these 13 cases, there were 4 metastatic adrenal carcinomas, 4 urothelial carcinomas, 3 nephroureterectomy cases of upper urothelial carcinoma, 1 case of retroperitoneal lymph node resection for testicular cancer, and 1 case of lymph node resection for penile cancer. Port-site metastasis after laparoscopic extirpative surgery for renal-cell carcinoma (RCC) is extremely rare. Micali et al<sup>8</sup> identified no instances of port-site recurrence in 2,604 cases of laparoscopic radical nephrectomy for RCC.

Port-site metastasis is a rare complication of laparoscopic intervention in urologic malignancies. Of the more than 50 reported cases of PSM in the urologic oncology literature, only 10 have occurred after surgery for RCC.<sup>13</sup> First case of camera PSM after robot-assisted partial nephrectomy was reported by Song et al.<sup>12</sup> The estimated incidence of PSM for robotic cystectomy is <0.5%. This is higher than the overall PSM rate for urologic cancers (0.09%).<sup>5</sup> The incidence of tumor seeding in general laparoscopic surgery ranges from 0.8 to 21%.<sup>8,9</sup>

Tsivian and Sidi<sup>9</sup> alone reported nine cases of PSMs after urologic laparoscopy, and Rassweiler et al<sup>10</sup> published eight local recurrences observed in 1,098 laparoscopic procedures for urologic malignancies. Single case of PSM after prostatic adenocarcinoma has been reported by De Bruyne et al<sup>11</sup> and usually associated with poor prognosis.

For port-site tumor recurrence to occur, several conditions must be present. There must be release of viable cancer cells from the tumor. There must be a mechanism by which these tumor cells are transported to the port site. Lastly, implantation of the tumor cells at the port site and subsequent growth must occur. It has been hypothesized that several factors may aid in this process, namely (1) the biologic aggressiveness of the tumor, (2) local wound factors, (3) host immune responses, and (4) laparoscopic surgical techniques.<sup>13</sup>

Biological aggressiveness of the tumor, represented by grade and stage, plays a decisive role in possible tumor seeding determination, explaining why grades II and III TCCs represent the majority of PSMs in urological procedures.<sup>13</sup>

Local wound factors help in the implantation and proliferation of tumor cells at the port site.<sup>13</sup> Cancer cells have high proliferation potential within healing skin incisions or intestinal anastomosis.<sup>17</sup> Tumor cells implant more easily and successfully during early wound healing, adhering to fibrin deposited at the site of surgical wound as a part of normal healing.<sup>18</sup> The presence of growth factors at the wound site promotes the survival and propagation of these cancer cells. As suggested by few animal studies, the port-site incision is more conducive than the laparotomy incision for tumor seeding.<sup>19</sup> Aoki et al<sup>20</sup> suggest that repair of the peritoneum at the trocar entry site may reduce the risk of tumor implantation and subsequent recurrence.

Immune depression of the peritoneum occurs during laparoscopic insufflation as demonstrated by macrophage function alteration, resulting in tumor recurrence and metastasis.<sup>21-25</sup> Overall, immune function is diminished

in the perioperative period because of factors like anesthetic agents, opioids, surgical trauma, blood transfusions, temperature changes, pain, and psychological stress.<sup>23</sup> Some studies showed a better preservation of cell-mediated immunity after laparoscopic surgery.<sup>34</sup> However, these benefits are not applied to the peritoneal level, possibly related to the hypoxic environment due to pneumoperitoneum pressure and secondary effect of the carbon dioxide in the peritoneal macrophage response.<sup>34</sup>

Factors related to laparoscopic surgical technique contribute to port-site recurrence.<sup>26</sup> These include the use of pneumoperitoneum, trocar site contamination, organ and tumor morcellation, and the method of specimen retrieval. The direct dissemination of tumor cells from contaminated material or from extraction with an open bag has been reported.<sup>5,6,23</sup> Several studies have suggested that CO<sub>2</sub> insufflation has an impact on the movement of tumor cells within the peritoneal cavity and subsequent implantation at port sites.<sup>12,27</sup> Wittich et al<sup>26</sup> found that aerosolization of tumor cells occurs during CO<sub>2</sub> laparoscopy. According to the chimney effect hypothesis,<sup>28</sup> the continued leakage of gas around and through the trocar results in a cumulative buildup of tumor cells at the port site, thus promoting PSM. Tseng et al<sup>28</sup> demonstrated that tissue trauma at trocar sites, combined with leakage of CO<sub>2</sub>, leads to enhanced tumor growth at these sites. In addition to the potential effects of pneumoperitoneum on the transfer of tumor cells, it has also been proposed that malignant cells may be transferred from the tumor to the port site by the aggressive manipulation of the tumor with laparoscopic instruments and the subsequent withdrawal and reinsertion of these contaminated instruments. Hewett et al<sup>27</sup> were the first to demonstrate this concept in a pig model. The importance of minimizing tumor manipulation is first detailed by Greco et al.<sup>16</sup> Irrigating port sites with povidone iodine may lower the risk of port-site recurrence.<sup>29</sup> Local application of cytotoxic agents, such as methotrexate and cyclophosphamide, is also found to be effective.<sup>30</sup> Javali<sup>14</sup> suggested that positron emission tomography and computed tomography could be a useful adjunct in diagnosing port-site recurrence especially in cases presenting within a short span of time following laparoscopic surgery for urological malignancy, wherein induration due to surgical factors at scar site may be confused with port-site recurrence.

### Measures suggested in the Literature to prevent Urologic Port-site Metastasis<sup>31</sup>

- Avoidance of laparoscopic surgery if ascites is present<sup>9,31</sup>
- Avoidance of gas leakage along the trocar<sup>31</sup>
- Avoidance of tumor-boundary violation

- Use of an impermeable bag if morcellation is done<sup>15</sup>
- Use of a bag for intact specimen removal
- Placement of drain if needed before abdominal deflation<sup>32</sup>
- Povidone-iodine irrigation of the laparoscopic instruments, trocar, and port-site wounds.<sup>29</sup> Local application of cytotoxic agents, such as methotrexate and cyclophosphamide, is also found to be effective<sup>30</sup>
- Suturing all port sites  $\geq 10$  mm<sup>9,31</sup>

Burns et al<sup>33</sup> demonstrated on an animal model that port-site tumor implantation was significantly increased when only skin was closed compared with closure of all three layers. The authors proved that closure technique may influence the rate of port-site tumor implantation.

### CONCLUSION

Port-site metastasis in urological laparoscopic surgery is rare and is preventable. Risk can be minimized by applying open surgery oncological procedural principles.<sup>31,34-62</sup>

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# Hypocalcemia and Vitamin D Deficiency in Patients Post-bariatric Surgery: A Systematic Review

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## ABSTRACT

**Introduction:** Bariatric surgery is viewed as the best tool for the control and treatment of severe obesity; however, postsurgery, they have a greater risk of developing nutritional deficiencies as this procedure hinders the absorption of most of the nutrients.

**Objective:** To evaluate the effect of vitamin D insufficiency and that of calcium in bone in patients after Roux-en-Y gastric bypass (RYGB), and the mode of administration of calcium, its dosage, and efficacy.

**Materials and methods:** A precise survey was performed with articles identified that are associated with the subject of interest. Articles from 10 years back were looked up in PubMed, the US National Library of Medicine, the National Institutes of Health, Medline, Lilacs, Scielo, and Cochrane utilizing the headings “bariatric surgery,” “bone,” “obesity,” “vitamin D,” “calcium,” and “absorption.”

**Results:** Five articles were incorporated into this survey that have analyzed the facts that bariatric surgery can cause wholesome inadequacies of nutrition and poor assimilation of fats and fat-dissolvable vitamins and micronutrients, e.g., calcium.

**Conclusion:** Patients submitted to RYGB should make use of multivitamins and minerals, especially vitamin D and calcium to prevent bone fractures. Monitoring, treatment, and control of risk factors are essential to prevent complications after this operation.

**Keywords:** Bariatric surgery, Calcium deficiency, Vitamin D deficiency.

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## INTRODUCTION

Since the advent of bariatric surgery, numerous surgical techniques for the treatment of obesity have been proposed and further improvised over the decades. The RYGB is an operation, i.e., viewed as a gold standard of treatment for extreme obesity in light of the fact that it results in fewer serious side effects and complications than conventional malabsorption techniques, e.g., jejunioleal bypass.<sup>1-3</sup> The malabsorption methodologies have been perceived as a risk factor for diseases of bone<sup>4-8</sup> because of the resulting alteration of calcium metabolism and decreased absorption.<sup>9-15</sup> Some studies explored these deranged levels of calcium tentatively in patients with jejunioleal bypass, and demonstrated that assimilation diminishes by half after surgery.<sup>10,11,14</sup> Insufficient calcium intake is common after gastric bypass,<sup>16,17</sup> further increasing the bone loss. Comprehending the postoperative RYGB, diminishing of calcium absorption and supplements, and exploring the dosages, modes of administration, and the duration of medication treatment and its impacts on bone were the sole objectives of this review.

## MATERIALS AND METHODS

The population, intervention, comparison, and outcome (PICO) strategy was adopted to expound the response to the question, “How is bone lost in patients who experience bariatric surgery and what supplements help to diminish this loss?” Obese patients who had bone loss and additionally BMI from 35 to 39.9 kg/m<sup>2</sup> with comorbidities and  $\geq 40$  kg/m<sup>2</sup> (population); patients submitted to RYGB by laparoscopy or laparotomy (intervention); eutrophic patients with BMI of 18.5 to 24.9 kg/m<sup>2</sup> (comparison); patients with insufficiency of vitamin D and calcium and conceivable nearness of fractures (outcome) were selected.

## Qualification Criteria for Study Consideration

### Inclusion Criteria

All studies; patients of age 15 to 70 years; BMI from 35 to 39.9 kg/m<sup>2</sup> with comorbidities and  $\geq 40$  kg/m<sup>2</sup>;  $\geq 3$  months postsurgery; and laparoscopic or laparotomic RYGB.

### Exclusion Criteria

Pregnant women or, women in lactation; smoking or previous smoker; people treated with bisphosphonates; and animals.

## Types of Outcome

Essential outcome was engaged in vitamin D and calcium inadequacy; nonetheless, conceivable bone fractures were investigated after bariatric surgery. As auxiliary outcomes, connection between the kind of supplement administration and the body's capability in engrossing the administered medication was looked at; and the dosages and their consequences for the maintenance or recuperation of bone resorption after bariatric surgery were observed.

## Search Strategy

PubMed/Medline, Lilacs, Scielo, and Cochrane were utilized with the headings "bariatric surgery," "bone," "stoutness," "vitamin D," "calcium," "AND" "assimilation." Following the collection of data, examination of the title, perusing of the theoretical abstracts, the complete perusing of the articles was made.

## RESULTS

Table 1 shows the methodological characteristics of the selected studies. Of the five articles, three corresponded to prospective cohort studies;<sup>18-22</sup> two used the laparoscopic approach and one enrolled only women; there was one case report and one case series. All assessed the nutritional status and bone fractures, routes of administration, as well as the respective dosage of vitamin D and calcium; one article evaluated the parathyroid hormone and its influence on bone reabsorption in RYGB.

## DISCUSSION

The results of this systematic review are based on five publications. The research did not identify bone fractures in patients undergoing bariatric surgery; nonetheless, there appeared high inadequacies in vitamin D and calcium in the bones. The studies demonstrated the diverse ways of administration and the results, noting the different answers regarding insufficiencies that emerge in the bone tissue because of dose and adequacy, as indicated by the route of administration. After bariatric surgery, all investigations pronounced outcomes with deficiency in the bones of patients, paying little heed to the kind of bariatric surgery. All studies specified administration of vitamin D and calcium by means of tablets or infusions in various doses.

None of them exhibited complete loss of bone calcium, yet demonstrated a critical distinction in bone resorption, fundamentally by parathyroid hormone. Parathyroid hormone increases the movement of osteoclasts, prompting the devastation of the cortical bone, indicating a likewise marked inadequacy of vitamin D,<sup>15,19</sup>

finally debilitating the bones and then leading to the likelihood of fractures in the postoperative period. Avgerinos et al<sup>21</sup> in their essential prospective cohort in people of the two sexual orientations for a period of 2 years have demonstrated the significance of vitamin D supplementation to prevent the decline of calcium in the bones.

Research investigated women in pre- and postmenopausal stages demonstrating that there was no critical difference between them in calcium absorption inadequacy and even the differences in relationship to the sort of surgery were not present.<sup>17,18,23</sup>

As per this review, the sort of administration and dosage had no relationship or significance over time on drug treatment. Nonetheless, no direct connection to the postoperative bone loss was demonstrated. Vasconcelos et al<sup>18</sup> considered the calcium intake in the eating routine of 600 mg and supplemented with 200 mg as tablet form during the 22 months in the operated group. Although the intake was fundamentally higher than in the nonoperated group, it was still lower than the prescribed levels for these patients, which ought to be between 1,000 and 1,800 mg/day.<sup>24-26</sup>

Intake of vitamin D (500 IU) was likewise beneath the prescribed levels. It can be deduced from the postoperative vitamin supplementation that it ought not just comprise multivitamins, since most do not contain the calcium and vitamin D required and prescribed to be taken each day. The above changes may increase the postoperative and preoperative screening; care ought to be taken to prevent the changes in bone metabolism. Reasonable supplementation of vitamins and minerals is basic to avoid or limit bone metabolic intricacies that can happen after RYGB.<sup>27</sup>

Another important factor apart from vitamin D supplementation and calcium that may influence bone change in these patients is age, other than the differences in between women in premenopausal and postmenopausal women that need particular approach. There are different elements that can impact straightforwardly and add to bone resorption, which include lack of vitamin D, deficient calcium intake, and secondary hyperparathyroidism, present sometimes in the obese. The parathyroid hormone additionally increases the activity of osteoclasts, prompting bone cortical destruction to make up for the abatement of serum calcium.<sup>10</sup>

In connection with bone density and fracture prevalence, no significant differences in the studies were found. It is conceivable that the generally short follow-up contributed to the lack of identification of bone fracture. Future research is needed to better elucidate the bone complications in these patients.

Table 1: Articles reviewed

Reference (year)	Type of study	Study location	Period of follow-up	n	Type of surgery	Age (years)	Sex	Type of medication	Type of administration	Individual	Doses	Time of medical therapy	Conclusion
Vasconcelos et al <sup>18</sup>	Case series	Brazil	From 7 to 22 months	n=29	RYGB	>18	F	Calcium and vitamin D	Tablets and diet	People	600 mg diet +200 mg tablet of Ca and 500 IU vitamin D (per day)	From 7 to 22 months	There were no significant differences between the average bone mass density and prevalence of vertebral fractures in both groups
Flores et al <sup>19</sup>	Prospective cohort study	Spain	1 year	n=222	RYGBL	18-65	F and M	Calcium and vitamin D	Tablets	People	1,200 mg Ca and 800 IU vitamin D (per day)	4,8, and 12 months	The parathyroid hormone leads cortical bone destruction and improving serum Ca. 80% of patients have vitamin D deficiency but not bone fractures
Williams et al <sup>20</sup>	Case study	United States	2 years	n=1	RYGB	56	F	Calcium and vitamin D	Tablets	Person	500 mg Ca and 400 IU (per day)	2 years	After 2 years the patient showed no fracture or risk to bone fracture level
Avgerinos et al <sup>21</sup>	Prospective cohort study	United States	2 years	n=444 (M=91 F=353)	RYGB	21-64	M and F	Calcium and vitamin D	Tablets	People	1,200 mg Ca and 800 IU vitamin D	1.8 years	Total calcium decreases in body-related mobilization of bone. Supplementation with vitamin D prevents the decrease in bone calcium
Riedt et al <sup>22</sup>	Prospective cohort study	United States	6 months	n=21	RYGB and RYGBL (5: open field and 16 laparoscopy)	29-62	F	Calcium and vitamin D	Tablets, diet, and injections	People	Diet, 1,000 mg of Ca, and 400 IU vitamin D	6 months	Low Ca absorption after surgery is considered a marker of bone resorption (60 to 200%). There was a higher bone resorption than bone formation

RYGBL: Roux-en-Y gastric bypass laparoscopy

## CONCLUSION

Patients undergoing RYGB should make use of multivitamins and minerals, especially calcium and vitamin D to prevent bone fractures. Monitoring, treatment, and control of risk factors are essential to prevent these complications after the surgery.

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# Achalasia Cardia: Revisited

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## ABSTRACT

**Introduction:** Achalasia cardia is a very common esophageal motility disorder affecting a large population worldwide including the Indian subcontinent. The diagnosis of the condition is equally important as the treatment ranges from medicines to botulinum injection, to pneumatic dilatation and surgery. This study gives an overview of achalasia cardia and the modalities to diagnose and treat the condition.

**Keywords:** Achalasia cardia, Cardiospasm, Esophageal achalasia, Esophageal peristalsis.

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## INTRODUCTION

Achalasia cardia is an esophageal motility disorder in which the smooth muscle layer of the esophagus loses normal peristalsis and the lower esophageal sphincter (LES) fails to relax properly in response to swallowing (Fig. 1).<sup>1-3</sup>

## SYMPTOMS

The main symptoms of achalasia are dysphagia (difficulty in swallowing) and regurgitation of undigested food.<sup>4</sup> Dysphagia tends to become progressively worse over time to involve both fluids and solids. Some achalasia patients also experience weight loss, coughing when lying in a horizontal position, and chest pain which may be perceived as heart burn. The chest pain experienced, also known as cardiospasm and noncardiac chest pain (NCCP), can often be mistaken for a heart attack.<sup>5</sup> It can be very painful in some sufferers. The food and liquid, including saliva, are retained in the esophagus and may cause aspiration.<sup>6</sup>

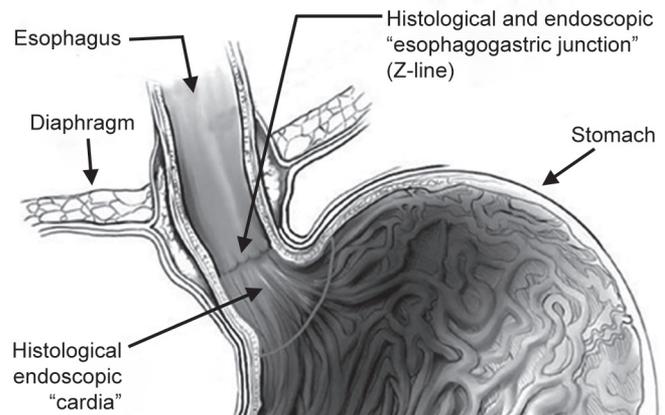


Fig. 1: Lower esophageal sphincter

## DIFFERENTIAL DIAGNOSIS

A few other conditions may mimic the symptoms of achalasia cardia,<sup>7</sup> such as

- Gastroesophageal reflux disease (GERD),
- Hiatus hernia, and
- Psychosomatic disorders.

## INVESTIGATIONS

Specific tests for achalasia are barium swallow and esophageal manometry. In addition, endoscopy, with or without endoscopic ultrasound, may be done to rule out the possibility of cancer.<sup>4</sup>

### Barium Swallow

The classical "Bird's beak" or "Rat's tail" appearance may be seen. An air-fluid margin is often seen over the barium column due to the lack of peristalsis.<sup>8</sup>

A 5-minute timed barium swallow can provide a useful benchmark to measure the effectiveness of treatment.<sup>9</sup> It also shows aperistaltic contractions, increased intraesophageal pressure, and failure of relaxation of the LES (Fig. 2).<sup>10</sup>

### Esophageal Manometry

Because of its sensitivity, manometry is considered the key test for establishing the diagnosis.<sup>11</sup> Manometry reveals failure of the LES to relax with swallowing and lack of functional peristalsis in the smooth muscle of esophagus (Graph 1).<sup>12</sup>

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Fig. 2: Bird's beak appearance

## Endoscopy

The internal tissue of the esophagus in achalasia cardia, generally, appears normal in endoscopy, although a “pop” may be observed as the scope is passed through the non-relaxing LES with some difficulty, and food debris may be found above the LES.

## Biopsy

Biopsy from the esophagus shows hypertrophied musculature and absence of certain nerve cells of the myenteric plexus, a network of nerve fibers that controls esophageal peristalsis.

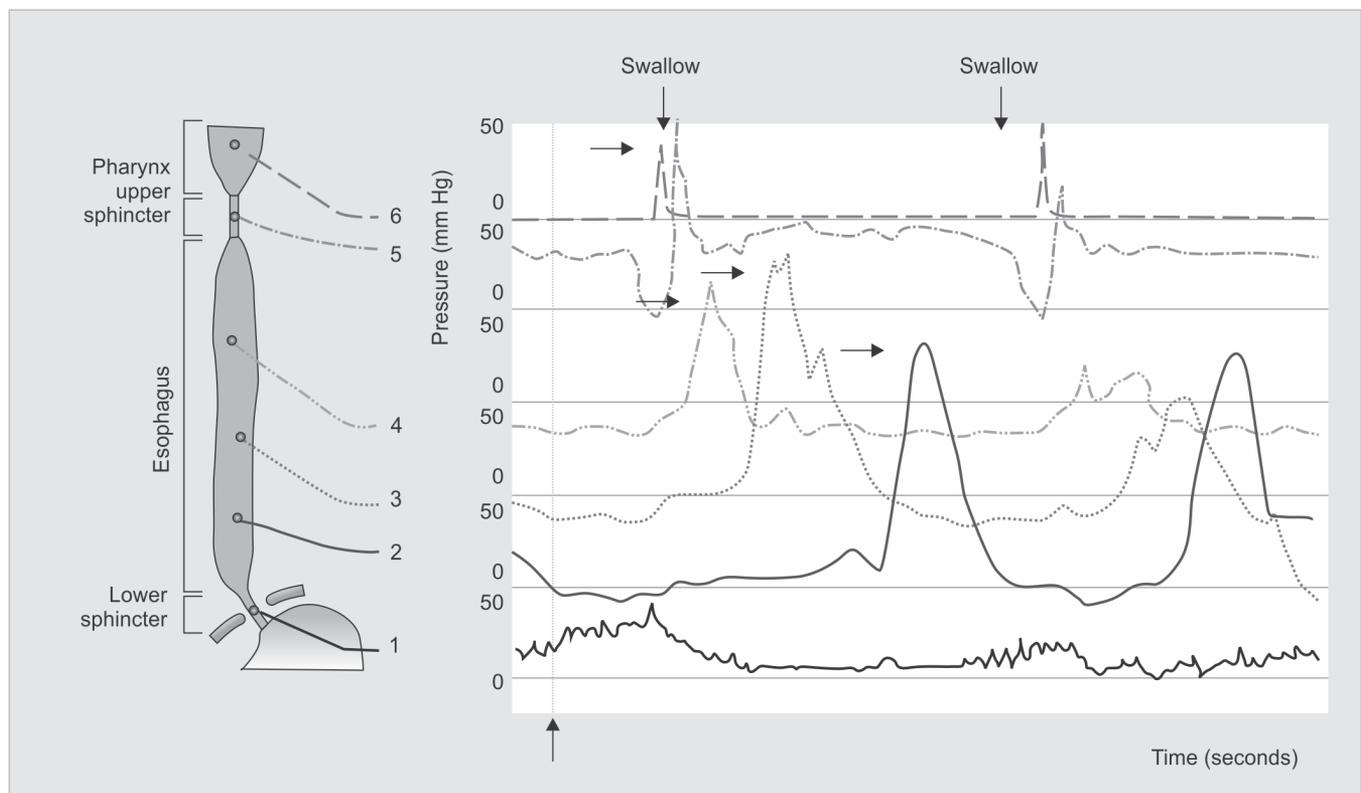
## MANAGEMENT

### Medications

- Drugs that reduce LES pressure are useful at early stages. These include calcium channel blockers, such as nifedipine and nitrates, such as isosorbide dinitrate and nitroglycerin.<sup>13</sup> Sublingual nifedipine significantly improves outcomes in 75% of people with mild or moderate disease.<sup>14</sup> However, many patients experience unpleasant side effects, such as headache and swollen feet, and these drugs often stop helping after several months.<sup>4</sup>
- Botulinum toxin (Botox) may be injected into the LES to paralyze the muscles holding it shut. The effect is only temporary and lasts about 6 months. Botox injections cause scarring in the sphincter which may increase the difficulty of later Heller myotomy.<sup>15</sup> This therapy is only recommended for patients who cannot risk surgery, such as elderly persons in poor health.<sup>16</sup>

### Pneumatic Dilatation

- Pneumatic dilatation is most effective in the long term, in patients over the age of 40; the benefits tend to be shorter lived in younger patients.<sup>17</sup> It may need to be repeated with larger balloons for maximum effectiveness.<sup>18</sup> Also in balloon pneumatic dilatation, a small risk of a perforation requires immediate surgical repair. Pneumatic dilatation causes some scarring



Graph 1: Manometry reading

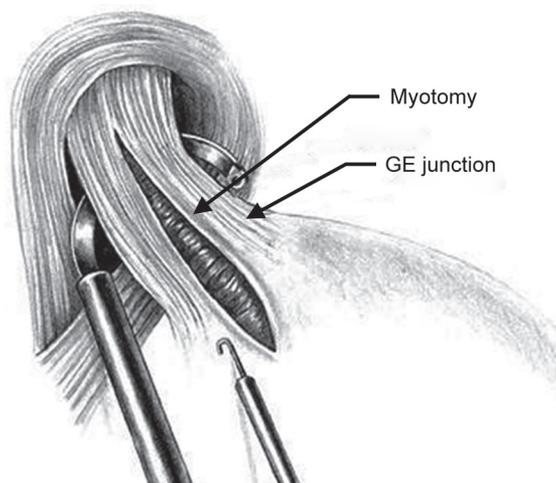


Fig. 3: Laparoscopic cardiomyotomy<sup>25</sup>

which may increase the difficulty of Heller myotomy if the surgery is needed later.<sup>15</sup> There have been reports of GERD after pneumatic dilatation in some patients.<sup>19</sup>

## SURGERY

Surgical myotomy (Heller's myotomy) provides greater benefit than either botulinum toxin or dilatation in those who fail medical management.<sup>20,21</sup> Heller's myotomy helps 90% of achalasia patients.<sup>22</sup> The myotomy is a lengthwise cut along the esophagus, starting above the LES and extending down onto the stomach a little way leaving the inner mucosal layer intact. Laparoscopic management of achalasia leads to short-term results comparable to those of the well-established conventional open technique. Heller's myotomy for achalasia performed laparoscopically offers patients significant benefits compared with open surgery. In view of the less severe surgical trauma and lower hospital cost, the laparoscopic approach is preferable.<sup>23</sup> A partial fundoplication or "wrap" is generally added in order to prevent excessive reflux (Fig. 3).<sup>24,25</sup>

## LAPAROSCOPIC CARDIOMYOTOMY

### Surgical Issues

In view of the concern of postoperative reflux as well as the relative ease of performing an antireflux procedure, a fundoplication procedure is added to most laparoscopic Heller's myotomies.<sup>24</sup> However, the issue of what type of fundoplication should be performed is controversial.<sup>26</sup> Anterior fundoplication and the Toupet posterior fundoplication are the two commonly employed antireflux procedures used in conjunction with a laparoscopic esophagomyotomy.

Proponents of the Toupet procedure argue that it prevents reapproximation of the myotomy and may be better than an anterior fundoplication in preventing postoperative GERD, whereas the advocates of the anterior fundoplication

procedure argue that it is easy to perform and can be used to protect the esophagus following myotomy.<sup>27</sup>

Additionally, it has been suggested that the retro-esophageal dissection required for a Toupet procedure may increase the incidence of postoperative dysphagia. Despite the controversy, laparoscopic Heller's myotomy is most often accompanied by an anterior fundoplication.

Laparoscopic Heller's myotomy with anterior fundoplication significantly relieves the symptoms of achalasia without causing the symptoms of GERD and results in excellent overall patient satisfaction.<sup>28,29</sup>

Laparoscopic Heller-Dor operation has the advantages of reduced compromise of the cardiopulmonary function, with less disruption of the supporting structures (phreno-esophageal membrane) of the antireflux mechanism, requiring simpler general anesthesia and providing excellent exposure permitting an easy fundoplication, less pain and reduced morbidity, shorter hospitalization, and faster convalescence.<sup>23,28</sup>

## Robotics in Achalasia

Robot-assisted laparoscopic Heller's myotomy was demonstrated to be safe and effective in reducing basal LES pressure and dysphagia. Several studies support the feasibility of the use of this system in performing a delicate laparoscopic surgical procedure. The use of a robotic system was experienced as being highly supportive in manipulation and visualization by the surgical team involved.<sup>30</sup>

## Per-oral Endoscopic Myotomy

Per-oral endoscopic myotomy is a new technique of performing esophageal myotomy at the LES.<sup>31</sup> In this technique, an endoscope is passed into the esophagus and an opening is made in the esophageal mucosa a few centimeters above the LES to create a tunnel within the wall of the esophagus (between the inner lining of the esophagus and the outer muscle layer of the esophagus). The endoscope is then advanced into the tunnel, and the circular muscle of the esophagus is cut using an electrocautery device that is passed through the endoscope. Per-oral endoscopic myotomy is considered an effective approach for the treatment of achalasia, which improves esophageal emptying and lowers LES pressure, and thereby relieves the symptoms of achalasia. However, only limited centers and expert endoscopists are performing the procedure right now and further trials and long-term follow-up is required.

## FOLLOW-UP

Even after successful treatment of achalasia, swallowing may still deteriorate over time.<sup>32</sup> Therefore, the esophagus

should be checked every year or two with a timed barium swallow because some may need pneumatic dilatations, a repeat myotomy, or even esophagectomy after many years. In addition, some physicians recommend pH testing and endoscopy to check for reflux damage, which may lead to Barrett's esophagus or a stricture if untreated.<sup>1</sup>

## LIFESTYLE CHANGES

The treatment of achalasia cardia demands a host of lifestyle changes that improve the outcome as well as quality of life if followed as routine habit. Achalasia patients may require to eat meals slowly, chew the food very well, drink adequate water with meals, and avoid eating dinner immediately before going to bed. Emptying of the esophagus by gravity is promoted by raising the head end of the bed or sleeping with a wedge pillow. After surgery or pneumatic dilatation, proton pump inhibitors can help prevent reflux damage by inhibiting gastric acid secretion; and foods that can aggravate reflux, including ketchup, citrus, chocolate, mint, alcohol, and caffeine, are better avoided.<sup>33</sup>

## CONCLUSION

The understanding of the pathophysiology of achalasia cardia is important to initiate treatment, and the failure of the medical treatment calls for a definitive surgical treatment for the same. The success of the treatment also depends on patient compliance and lifestyle changes with appropriate follow-up.

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# Systematic Review of Laparoscopic Surgery and Simulation-based Training

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## ABSTRACT

**Introduction:** We performed a systematic review to analyze the effect and to describe all available simulation-based training as well as the securing of laparoscopic surgery aptitudes during residency programs.

**Materials and methods:** This systematic review aimed to examine the effectiveness of simulation-based training to develop laparoscopic surgery skills using the published randomized controlled trials (RCTs) Searching in PubMed from 2014 till now. This review of the literature tends to the subject of whether laparoscopic recreation deciphers the gain of surgical abilities to the operation room (OR).

**Results:** According to this review, we found that specific learned skills could be reproduced in the OR. Reenactment-based preparing and laparoscopic surgery found that particular abilities could be translatable to the OR. Twenty one investigations revealed learning results measured in five behavioral classifications: Economy of development (8 ponders); suturing (3 examines); execution time (13 considers); mistake rates (7 thinks about); and worldwide rating (7 contemplates).

**Conclusion:** Simulation-based training can help to obtain obvious advantages of surgical aptitudes in the OR. This review proposes that simulation-based training is a successful approach to instruct laparoscopic surgery abilities, increasing reproduction of laparoscopic surgery aptitudes to the OR, and increment safety for patients. Nevertheless, more research ought to be directed to decide whether and how this training can become a part of surgical curriculum.

**Keywords:** Laparoscopic training, Simulation, Surgical skills.

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## INTRODUCTION

Laparoscopic approach has turned into a “gold standard” for a lot of common surgical procedures, e.g., cholecystectomies and appendectomies,<sup>1</sup> and is associated

with less surgical trauma, faster postoperative recovery, shorter hospital stays, and better cosmetic results.<sup>2</sup> There is a common agreement that simulation-based training enhances information and formation<sup>3</sup> and that preparation outside the working room (OR) diminishes the danger of unfavorable surgical events.<sup>4</sup>

As the surgeon community establishes and keeps up new instructing strategies to prepare capable specialists, learning ways that exist outside the OR are turning into a prescribed strategy for creating laparoscopic surgery abilities.<sup>5,6</sup> Preparing outside the OR lessens the danger of unfavorable surgical events.<sup>4,5,7</sup> Simulation-based surgical aptitudes and methods enable unpracticed specialists to secure abilities through repetitive practice in a safe, nonthreatening condition, preceding experiencing the hazard and time pressures intrinsic in the OR.<sup>8</sup> Those in charge of planning training centers work with restricted proof to determine complex inquiries identifying with training, interpretation of abilities learned, and safety concerns about learning laparoscopic surgery.

Supervision by an expert during laparoscopic colorectal surgery aims at similar results among learners, according to a systematic review in 2006.<sup>9</sup> In an alternate review, investigators revealed that simulation training may not be a superior strategy than patients, corpses, and creatures for instructing surgical abilities,<sup>9</sup> yet the aptitudes learned by simulation-based preparation gave off an impression of being transferable to the OR. This review was restricted to 11 distributed investigations and was led in 2008.<sup>10</sup>

One study found that virtual reality training can supplement laparoscopic surgery training,<sup>11</sup> yet fluctuation crosswise over research outlines and clashing discoveries in the published results kept the affirmation of clear best procedures. Cook et al<sup>12</sup> considered technology-enhanced simulation training and reasoned that simulation training is related with vast impacts on clinician practices and mild consequences for patient care.

This systematic review aims to analyze the topic of whether laparoscopic simulation deciphers the gain of surgical aptitudes to the OR. The scope of this document is centered around the significance and pertinence identified with the gaining of surgical aptitudes, the interpretation of surgical abilities obtained outside of the OR, and enhancements concentrated on well-being for patients. A

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review of available articles was completed to depict the effect of simulation-based training in light of the securing of laparoscopic surgery aptitudes and the reproducibility of these abilities to the OR. Training skills were surveyed for execution time; worldwide rating; suturing, cutting, and searing abilities; mistakes; and ergonomics.

## MATERIALS AND METHODS

This systematic review aims to analyze the topic of whether laparoscopic simulation depicts the gain of surgical aptitudes to the OR. The studies were recognized via seeking PubMed from the initiation of the database to December 2016 and Specific search: Simulation in Health Care, *Annals of Surgery*, *Journal American Surgery*, *International Journal of Surgery*, *Surgery*, *Archives of Surgery*, and *The British Journal of Surgery* from 2000 to December 2016. Different mixes of a few pertinent watchwords were utilized to recognize articles for audit (haptic or simulation or simulation education or simulation medicine or laparoscopic simulation or simulation training or translation and laparoscopic surgery).

Inclusion criteria required for inclusion in the review are of as follows:

- Utilization of a randomized controlled plan that incorporates at least one intervention group and one control group that either got no training or traditional training in the OR;
- Single-bunch pretest–posttest;
- Two group nonrandomized;
- Parallel group;
- Crossover designs;
- Utilize simulation-based training as the instructive intercession for showing laparoscopic surgery abilities;
- Interpretation of aptitudes was measured in the OR setting.

Simulation-based training was characterized extensively to incorporate gear that imitated the required conditions with adequate authenticity to fill in as training instrument. Cases of the test systems incorporated into this study were box trainers, PC programming, virtual reality systems, undertaking mentors, and high loyalty and static mannequins.

The exclusion criteria were:

- Articles that did not utilize simulation as the instructive mediation for learning laparoscopic surgery abilities.
- Interpretation of aptitudes was not measured in the OR setting.

A scope based on PRISMA<sup>13</sup> and Cochrane handbook<sup>14</sup> was utilized to survey the writing. The primary writer autonomously coded each of the articles found

through the research. While checking on the results, a few abstracts gave enough detail and data identified with the strategies to decide whether the incorporation criteria were met; if not, the full composition was perused to decide whether the techniques met the consideration criteria. The original copies were dispensed with in light of the fact that the strategies did not meet the consideration criteria.

## RESULTS

The outcomes detailed in this segment depend on the 20 articles that we decided met our inclusion criteria. A total of 21 studies were examined. All posttraining evaluations were translational to either a Porcine model or the OR, 9 (43%) led the posttest in a Porcine model, 12 (57%) led the posttest in the OR with patients.

In Table 1, we describe the types of simulators implemented in the 21 studies, manufacturers for the simulators, descriptions for the simulators, and performance skills the simulators provide. A total of 21 studies were assessed/reviewed; the specific simulators, members, assessments, and details of the 21 studies are provided in Tables 2 and 3.

### Performance Time (n = 13 studies)

Performance time<sup>1,5,7,8,15-22</sup> was accounted for as the measure of time taken to play out the laparoscopic procedure at the posttest assessment. Of the 21 studies that surveyed whether the training intercession brought about the change of execution time, 13 (62%) investigations announced factually statistically significant improvement. For instance, in one study scientists announced that the control group took 58% longer to play out the surgery<sup>23</sup> and in another study specialists detailed that the control group, all things considered, played out the surgery twice the length of the intervention group (24 minutes when contrasted with 12 minutes,  $p < 0.001$ ).<sup>24</sup> In yet another investigation the intervention group was 29% quicker in dismembering the gallbladder during a cholecystectomy than the control one.<sup>24</sup> Then again, two investigations<sup>1,15</sup> detailed no noteworthy changes in time between the intervention and control groups when execution time was measured.

### Global Ratings (n = 7 studies)

Global appraisals were led utilizing the Objective Structured Assessment of Technical Skill (OSATS) rating scale.<sup>6,7,17,25-29</sup> The OSATS assessment tool assesses members on regard for tissue dissection, time and movement, instrument ergonomics, information of instruments, stream of operation, utilization of collaborator, and learning of methodology. GOALS rating scale<sup>30</sup>

**Table 1:** Laparoscopic training tools, definitions, and manufacturers

Type of simulation	Definition	Manufacturer
Box trainer Task trainer	A box that incorporates conventional laparoscopic equipment to perform basic skills, is versatile, and enables training on animal parts as well as synthetic inanimate models. A partial component of a simulator or simulation modality, for example, an arm, leg, or torso	Simulab Corporation Limbs and Things
MIST-VR	A virtual reality simulator with six different tasks to simulate maneuvers performed during laparoscopic cholecystectomy in a computerized environment	Mentice AB
LapMentor/LapMentor II	A virtual reality simulator consisting of a camera and two calibrated working instruments for which the motion of the instruments is translated to a two-dimensional computer screen for student practices	Simbionix Ltd.
LapSim	A computer-based simulator creating a virtual laparoscopic setting through a computer operating system, a video monitor, a laparoscopic interface containing two pistol-grip instruments, and a diathermy pedal without haptic feedback	Surgical Science
EndoTower	EndoTower software consists of an angled telescope simulator composed of rotating camera and telescopic components	Verefi Technologies, Inc.
MISTELS/FLS trainer	McGill Inanimate System for Training and Evaluation of Laparoscopic Skills—this inexpensive, portable, and flexible system allows students to practice in a virtual Endotrainer box	SAGES
SIMENDO VR	Computer software used to train eye–hand coordination skills by camera navigation and basic drills	Delta Tech
URO Mentor	A hybrid simulator consisting of a personal computer-based system linked to a mannequin with real endoscopes. Cytoscopic and ureteroscopic procedures are performed using either flexible or semirigid endoscopes	Simbionix Ltd.
Da Vinci Skills Simulator	A portable simulator containing a variety of exercises and scenarios specifically designed to give users the opportunity to improve their proficiency with surgical controls	Intuitive Surgical

measures execution in five spaces: Three of the areas are particular to laparoscopic surgery (e.g., depth perception, bimanual skill, and tissue dissection) and two of the spaces are bland (e.g., efficiency and autonomy). The standard Fundamentals of Laparoscopic Surgery (FLS) measurements<sup>16</sup> are the essential psychomotor abilities fundamental before figuring out how to perform and build up a laparoscopic surgical case. An alternate report revealed that global evaluation scores expanded and their standard deviation diminished in the intervention group when contrasted with the nonprepared group ( $p = 0.004$ ).<sup>25</sup> Also, in the same article, 100% of intervention members achieved the passing score level whereas it was just 37.5% of the control group. Researchers did not locate any statistical significance between the two groups; nonetheless, the members with low benchmark execution expanded their scores altogether after simulation training.<sup>31</sup>

### Suturing, Cutting, and Cautery Skills (n = 3 studies)

Three (14%) of the 21 examines detailed huge change on suturing, cutting, and cauterizing abilities<sup>8,23,24</sup> in the training group when contrasted with the control group. Researchers assessed that the trained members beat the control members in the execution of safe electrocautery ( $p < 0.01$ ).<sup>8</sup>

### Mistakes (n = 7 studies)

Seven (33%) of the investigations evaluate whether simulation-based training brought about a lessening in errors.<sup>5,6,18,19,21,22,32</sup> These were accounted for as clipping errors, dissection errors, tissue damage, incorrect plane for dissection, lack of progress, and instrument out of view. Each one of the seven investigations looked into articles for detailed statistical discoveries that the intervention diminished and the number of errors that happened. For instance, the intervention group made altogether less mistakes identified with tissue division ( $p = 0.008$ ) and dissection ( $p = 0.03$ ) with the control group creating three-fold the number of blunders.<sup>23</sup>

### Ergonomics (n = 8 studies)

Eight of the examinations surveyed found that simulation-based training brought about an expansion in the ergonomics.<sup>1,7,8,15,23,25,28,33</sup> It was accounted for as camera navigation, efficiency of instrument, total path length, number of movements, navigation, and bimanual dexterity. The eight investigations (38%) revealed statistical significances that the intervention expanded the ergonomics. In particular, training was essentially identified with path length ( $p < 0.001$ ) and aggregate number of developments ( $p = 0.009$ ).<sup>7</sup> Interestingly, agents found no distinction in ergonomics between the control and intervention groups ( $p = 0.40$ ).<sup>1</sup> In two distinct studies, specialists found that

**Table 2:** Study participants, prestudy data, simulation, features of training procedures, and assessment

Citation	Participants	Prestudy data collected	Simulation intervention	Additional training	Time between initial assessment and final assessment	Training time	Training tasks
Aggarwal et al <sup>7</sup>	19 novice surgeons	None	LapSim VR	None	Not specified	Not specified	7 basic tasks; 3 levels of difficulty Skills for: Instrument navigation—Grasping Tissues—Clip
Ahlberg et al <sup>5</sup>	29 fourth-year medical students	None	MIST-VR	None	Not specified	3 hours	Six tasks simulate the maneuvers performed during a laparoscopic cholecystectomy
Andreatta et al <sup>8</sup>	19 surgical interns: (1) 10 in the training group, (2) 9 in the control group	Computer game experience	Simbionix LapMentor	None	Four weeks duration is not specified	At least 10 repetitions were performed in order to reach proficiency by trainees	30° camera navigation; eye-hand coordination; clipping and grasping; cutting; electrocautery; translocation of objects
Ahlberg et al <sup>23</sup>	13 surgical residents	Mental rotation, cognitive tests, verbal working memory, attitude toward simulator	LapSim	None	The first surgery performed within 2 weeks of baseline measurement. The last surgery performed within 6 months of the start	Maximum of 40 hours in 1 week	Grasping, lift grasp, cutting right, cutting left, clip application
Banks et al <sup>35</sup>	20 postgraduate year (PGY)1 residents	Laparoscopic experience	Task Trainer Laparoscopic BTL	None	4 months	Not specified, estimated to be approximately 4 hours	1 hour of didactics; 2 hours of hands-on teaching in the skills lab with three stations: (1) Suturing pig's feet; (2) knot tying board; (3) a lap simulator and an operative lap tower
Bennett et al <sup>1</sup>	70 medical students	Laparoscopic experience Interest in surgical specialty Angled laparoscope	Box trainer	None	6 weeks	10 minutes	Tutorial on camera simulator navigation
Gala et al <sup>15</sup>	44 residents (PGY1 and 2); 66 (PGY 3 and 4)	Baseline data laparoscopic Pomeroy Bilateral tubal ligation	Psychomotor board testing with a peg board test	Two times till mastery accomplished on all 5 validated laparoscopic simulators	Not reported	30 minutes with faculty member	Clipping, grasping, lifting, time, peg transfer, pattern cutting
Ganai et al <sup>20</sup>	19 third-year medical students: (1) 9 training group, (2) 10 control group	Laparoscopic cases observed or participated in were measured between baseline and performance	Endo Tower	None	3–4 weeks	1-hour sessions. Limit of 10 sessions per difficulty level (3 levels). Had to train to proficiency	Navigation around a complex geometric structure to achieve specific view of target objects

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Citation	Participants	Prestudy data collected	Simulation intervention	Additional training	Time between initial assessment and final assessment	Training time	Training tasks
Grantcharov et al <sup>17</sup>	16 surgical residents with limited laparoscopic experience	None	MIST-VR	None	14 days	3 hours	Task 1: Virtual sphere to box transfer; Task 2: Hand to hand transfer Task 3: Grasping the segments of virtual pipe Task 4: Grasp virtual sphere, touch tip of other instrument, withdraw and reinsert, and touch sphere again. Task 5: Virtual sphere was grasped, three plates appear on the surface of sphere, these are then touched by the other instruments Task 6: Combines actions of 4 and 5 with diathermy of the plates while holding the sphere
Hogle et al <sup>25</sup>	Study 1: (1) 6 trained; (2) 6 control Study 3: 10 trained; 11 control	Study 1 and 3: None	Study 1 and 3: LapSim	Study 1 and 3: None	Study 1: 1 month Study 3: 5 weeks	Study 1 and 3: None specified	Camera navigation, instrument navigation, coordination, grasping, lifting and grasping, cutting, clip applying
Hung et al <sup>31</sup>	24 robotic surgery trainees	Completed fewer than 10 robotic cases	Vinci Si	None	5 weeks	45 minutes	Run bowl and cut on circumferentially inked line on bowl Cut 2.5 cm inked line on anterior surface of bladder and water tight repair Resect Styrofoam tumor with a clean margin of renal parenchyma Trainees trained on suturing
Korndorffer et al <sup>32</sup>	17 surgical residents PGY1-5	Demographic video game ability	MISTELS	None	8 weeks	8 hours (8 weeks during 1-hour weekly sessions)	Trained on "lifting and grasping" and "cutting" and performed salpingectomy sparing ovary 0 and 30° camera manipulation, hand-eye coordination, clipping, grasping and clipping, two-handed maneuvers, cutting, fulguration, and object translocation
Larsen et al <sup>16</sup>	21 first and second year students specializing in obstetrics/gynecology	None	LapSim Gyn	None	Unclear	7 hours and 15 minutes	Manipulate and diathermy task
Seymour et al <sup>26</sup>	16 PGY1-4 surgical residents Psychomotor ability tests	Visuospatial, perceptual	MIST-VR	Video demonstrating optimal procedure performance	No initial assessment other than ability tests	1 hour	

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Citation	Participants	Prestudy data collected	Simulation intervention	Additional training	Time between initial assessment and final assessment	Training time	Training tasks
Stefanidis et al <sup>21</sup>	32 medical students: (1) 6 control group, (2) 13 trained group, (3) 13 trained group plus environment al and more complex	Demographic data Simulator experience Laparoscopic experience- NASA TLX work load	FLS video trainer model	Assessed on the trainer for retention before being assessed for transfer on Porcine model	Retention and transfer tests conducted on same day Average time between baseline and completion of training was 8.4 days	For group II average training time was 239 minutes For group III average training time was 329 minutes	Group II a. Trained to proficiency in lap suturing on an FLS video trainer model Group III: Trained until proficiency Perform the task in a constrained space Had to listen to OR noise through headphones Had to practice with shorter suture Had to start with a dropped whose tip was facing away from the FLS model These four conditions were introduced gradually Laparoscopic suturing was assessed
Stefanidis et al <sup>22</sup>	15 Novices	Demographics: Experience with surgery and simulators	Simulator	None	Not specified (approximately from 4–5)	Average training was 4.7 hours (1.2 SD) 41 reps (10 SD) Lasted 6 days (4 SD)	Peg transfer Circle cut Placement of a ligating loop Simple suture tied with extra and intracorporeal techniques
Stroka et al <sup>27</sup>	16 Surgical residents (PGY1–3) with no prior fundamentals of laparoscopic surgery training: (1) 8 trained, (2) 8 control	None	MISTELS -Box Trainer	None	Mean time between pre and posttraining evaluations was 145 days	Average time training on the simulator was 450 minutes.	Suturing on the VR trainer and box trainer -Knot tying on the box trainer
Van Sickle et al <sup>24</sup>	22 senior surgical residents (PGY3–6): (1) 11 control group, (2) 11 trained group (simulation and box trainer)	Demographic: Perceptual ability Previous laparoscopic surgery experience	MIST-VR -Box trainer	None	Not specified	Not specified	Double surgical knot tying
Verdaasdonk et al <sup>6</sup>	19 surgical trainees (1st and 2nd year): (1) 10 control group, (2) 9 training group	None	SIMENDO VR simulator	None	1 week	Not specified	Trainees reduced the hernia sacs of right-sided indirect and femoral hernias and to position and tack a piece of 3.5 inches x 5 inches polypropylene mesh over the myopectineal orifice covering all potential right-sided hernia defects
Zendejas et al <sup>28</sup>	50 PGY1–5: (1) 26 trained group, (2) 24 control group	Demographics: Video game ability	Guildford MATTU TEP task trainer	None	Approximately 10 days	Unclear	

SD: Standard deviation

**Table 3:** Published reference, context of final assessment, source of assessment, skills assessed posttraining, and results from studies

Citation	Contextual setting for final assessment	Source of final assessment ratings	Skills assessed posttraining	Results from research studies
Agganwal et al <sup>7</sup>	Porcine model (pre on box trainer)	Two observers (OSATS global rating and a motion tracking device)	Change in operative performance: (1) Time taken; (2) total path length; (3) total number of movements The OSATS global rating scale	Trained group performed significantly better on time ( $p = 0.038$ ), total path length ( $p = 0.001$ ), total number of movements ( $p = 0.009$ ), and overall rating scores ( $p = 0.001$ ) Trained group demonstrated dexterity scores equivalent to expert levels The performance with MIST-VR correlated with surgery skills. MIST-VR did not improve surgical skills. MIST-VR did predict surgical outcomes
Ahliberg et al <sup>5</sup>	Porcine model			
Ahliberg et al <sup>23</sup>	Patients in OR (pre on a simulator)	Two observers (reliability greater 0.98)	Exposure errors, clipping and tissue division errors, and dissection errors Performance was broken up into phases: (1) Exposure of the cystic duct and artery; (2) clip placement followed by division of the cystic duct and artery; (3) gallbladder excision: Total time, path length, angular path, tissue damage, and max damage	Intervention group made significantly fewer errors The trained group made significantly fewer objectively assessed, intraoperative errors during the exposure portion of the procedure ( $p < 0.04$ ), clipping and tissue division ( $p < 0.008$ ), and dissection ( $p < 0.03$ ). The control group made three times as many errors and used 58% longer surgical time
Andreatta et al <sup>8</sup>	Porcine model	Two surgeons (0.99 reliability)	30° Camera navigation: (1) Time, (2) Accuracy, (3) Efficiency of motion, (4) Instrumentation use eye-hand coordination: Two handed transfer of ski needle: (1) Time, (2) Efficiency of motion, (3) Instrument handling Eye-hand coordination: 0° camera navigation and one handed object transfer: (1) Time, (2) Accuracy, (3) 0° camera navigation skills, (4) Perceptual ability safe, placement of clips, and application of electrocautery (1) Clipping, (2) Electrocautery performance	Intervention group outperformed the control group in: Camera navigation skills ( $p < 0.05$ ), efficiency of motion ( $p < 0.001$ ), optimal instrument handling ( $p < 0.001$ ), perceptual ability ( $p < 0.001$ ), and performance of safe electrocautery ( $p < 0.01$ ) Time and accuracy ratings on 30° navigation ( $p < 0.05$ ), and eye-hand coordination two-handed transfer of ski needle ( $p < 0.001$ ) was better in the trained group. Prior training with LapMentor leads to improved resident performance of basic skills in the animate OR
Banks et al <sup>35</sup>	Patients in OR (post only. Preassessment was done on simulator and then the training group performed on the simulator again before being evaluated in the OR)	Observers	Task-specific checklist: assessed 4 categories of skills: (1) Preoperative skills, (2) surgical technique, (3) laparoscopic technique, (4) laparoscopic BTL-specific skills Global rating scale: (1) Respires for tissue, (2) time and motion, (3) instrumental handling, (4) knowledge of instruments, (5) flow of operation, (6) use of assistants, (7) knowledge of the specific procedure – Pass/fail	Intervention group performed significantly better than control group on all three surgical assessment tools ( $p = 0.002$ , checklist; $p = 0.003$ , global score; $p = 0.003$ , pass rate; $p = 0.003$ , posttest) and scored significantly better on the knowledge posttest ( $p = 0.009$ )
Bennett et al <sup>1</sup>	Patients in OR (post only)	Observers	Identification of all four target numbers and the ability to maintain correct orientation of the camera at each target and to properly position the post at each target for a maximum total score of 12 points Max time was 120 seconds	No difference in learning between groups ( $p = 0.40$ )
Gala et al <sup>15</sup>	Patients in OR	Observers	Time Competence levels of participants pre and post intervention Technical skills for both groups	Time the intervention group improved significantly higher ( $p < 0.01$ ) Intervention group was significantly higher with competence levels ( $p < 0.01$ ) The intervention group also had higher technical skills in the operating room ( $p < 0.03$ )

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Citation	Contextual setting for final assessment	Source of final assessment ratings	Skills assessed posttraining	Results from research studies
Ganai et al <sup>20</sup>	Porcine model (pre and post)	3 External observers (90%) and from Endo Tower simulator	12 structured scope navigation tasks in three phases: (1) Navigation within the peritoneal cavity, (2) Navigation around the retracted gallbladder, (3) Navigation around a suspended small intestinal loop	Intervention group was significantly better in object visualization (p<0.05), scope orientation (p<0.05), and horizon errors (p<0.05)
Grantcharov et al <sup>17</sup>	Patients in OR	2 Senior surgeons rated 1 surgery (Cohen's kappa 0.71)	Economy of movement: (1) Unnecessary movements, (2) Confidence of movements Errors: (1) Respect for tissue, (2) Precision of operative technique	Intervention group showed greater improvement in error (p = 0.003) and economy of movement (p = 0.003) Intervention group was significantly faster than the control group when performing cholecystectomy (p = 0.021)
Hogle et al <sup>25</sup>	Study 1: OR patients Study 3: Porcine model (pre and post)	Study 1: Attending surgeon Study 3: Observer	Study 1 and 3: GOALS rating: (1) Depth perception, (2) Bimanual dexterity, (3) Efficiency, (4) Tissue handling and autonomy	Study 1 and 3: No significant differences were found between groups
Hung et al <sup>31</sup>	Porcine model	Three expert robotic surgeons blinded	GOALS: (1) Depth perception, (2) Bimanual dexterity, (3) Efficiency, (4) Tissue handling, (5) Participant autonomy to accomplish task	Groups I and II were comparable in prestudy surgical experience and had similar baseline scores on simulator and tissue exercises (p>0.05) Overall baseline simulator performance significantly correlated with baseline and final tissue performance (p<0.0001) Simulator training significantly improved tissue performance on key metrics for group I subjects with lower baseline tissue scores than their group II counterparts (p<0.05) Group I tended to outperform group II on final tissue performance, although the difference was not significant
Komdorffer et al <sup>32</sup>	Porcine model (pre and post)	Observers	Time, accuracy errors, knot security	The training group and the control group demonstrated significant improvement in completion time, and overall score. The training group also demonstrated significant improvement in accuracy errors. The trained group performed significantly better in completion time and overall score when comparing posttest scores to the control group. Intervention group performed significantly better than control group
Larsen et al <sup>16</sup>	Patients in OR (post only, pre was on a VR simulator)	Observers	Primary outcome measure: (1) technical performance using the objective structured assessment of laparoscopic salpingectomy; (2) 5-item general rating scale and five-item task-specific rating scale. Time	Intervention group gained experience equivalent to 20–50 procedures The median score on general and task-specific scale reached 33 points for the trained group and 23 in the control group (p<0.001) The median score for time was 12 minutes for the trained group and 24 minutes for the control group (p<0.001)
Seymour et al <sup>26</sup>	Patients in OR (post only, pre was only ability tests)	Observers	Operative errors: (1) Lack of progress, (2) gallbladder injury, (3) liver injury, (4) incorrect plan of dissection, (5) burn nontarget tissue, (6) tearing tissue, (7) instrument out of view, (8) attending takeover	Intervention group was faster for gallbladder dissection (29% faster), and control group was more likely to fail to make progress (Z = 2.677, p < 0.008) and more likely to injure the gallbladder or burn nontarget tissue (5 times more likely, chi-square = 4.27, p < 0.039) The mean number of scored errors per procedure was significantly greater in the control group than the trained group (p = -2.76, p < 0.006)
Stefanidis et al <sup>21</sup>	Porcine model (pre and post)	Objective scores based on time and errors using a published formula	Time errors	Intervention group performed substantially better than control group (p < 0.001) Proficiency-based simulator training results in improved operative performance

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Citation	Contextual setting for final assessment	Source of final assessment ratings	Skills assessed posttraining	Results from research studies
Stefaniadis et al <sup>22</sup>	Porcine model (pre and post). A posttest was taken right after training was done, and then a retention test was taken after 5 months	Observers	Errors time	Intervention group outperformed control group ( $p < 0.001$ ) Proficiency-based simulator training results in durable improvement in operative skill of trainees even in the absence of practice for 5 months
Stroka et al <sup>27</sup>	MISTELS and Box Trainer on patients in the OR	Attending surgeon or external evaluator	FLS ratings and GOALS ratings: (1) Depth perception, (2) Bimanual dexterity, (3) Tissue handling, (4) Efficiency, (5) Autonomy	FLS scores: Scores increased and SD decreased in the trained group as compared with the nontrained group ( $p = 0.004$ ). At baseline no participant had reached the required FLS scores. Posttraining 100% of the trained group reached required scores and 37.5% of the nontrained reached required passing scores GOALS scores: The trained group improved significantly and clinically by a mean of $6.1 \pm 1.3$ ( $p = 0.0005$ vs control, and $p < 0.0001$ vs baseline). Gender was examined as a covariate and results remained the same; trained group scores were significantly better than the control group ( $p = 0.001$ ). Of the five individual domains evaluated by the GOALS rating structure, greater improvements were shown in the specific domains than the generic domains for the trained group (bimanual dexterity, $p = 0.04$ ; depth perception, $p = 0.08$ ; tissue handling, $p = 0.04$ ) Intervention group performed significantly faster ( $p < 0.003$ ), made fewer errors ( $p < 0.01$ ), and fewer excess needle manipulation ( $p < 0.05$ )
Van Sickle et al <sup>24</sup>	Patients in OR (post only)	2 surgeons (agreement > 0.80)	Suturing operative errors	
Verdaasdonk et al <sup>6</sup>	Porcine model (post only)	Two expert laparoscopic surgeons	Observer rated error assessments of knot tying economy of movements Error assessments	Intervention group tied knots faster (30%, $p = 0.034$ ) and made fewer errors (33%) as compared with control group. Experimental group dropped the needle fewer times and made less frequent unnecessary contact with the tip of the needle against the tissue than the control group ( $p < 0.05$ ). No significant differences in the scores assigned to the groups by the two experts (economy of movement $p = 0.114$ ; error assessment $p = 0.148$ )
Zendejas et al <sup>28</sup>	OR (pre and post)	Observers and medical records	Operative performance by using a global rating using: (1) GOALS, (2) operating time, (3) proportion of procedure performed by the trainee, (4) need for overnight stay, (5) recurrence of inguinal hernia and chronic groin pain and complications	The trained group were on average 6.5 minutes faster than the control group ( $p < 0.0001$ ) Resident participation was also different between the groups with the trained group performing more of the procedure than the control group (88 vs 73%) After correcting time to account for varying participation rates, the trained group performed the procedure 13.1 minutes faster The trained group had higher performance scores than the trained group ( $p = 0.001$ ) Intraoperative and postoperative complications and overnight stay were less likely in the trained group than the control group $p < 0.05$ When follow-ups with patients were conducted the number of patients who experienced a hernia recurrence or were evaluated for groin pain at least 3 months post repair there was no difference between the groups

the control bunches did not demonstrate significant differences contrasted with the intervention group as identified with ergonomics.<sup>1</sup>

## DISCUSSION

This review of available laparoscopic publications and interpretation of aptitudes outlines the proof for the simulation-based training studies and learning surgical skills in a safe way for residents to be reproducible on patients in the OR. Those in charge of instructing and surveying surgical execution ought to consider ramifications of these discoveries in three noteworthy areas: (1) Training for capability or enhanced aptitudes honed in a controlled setting, (2) interpretation of new information into execution outside the reenacted setting, and (3) well-being and safety for patients. Laparoscopic surgery educational module might be altered or supplemented with the usage simulation-based training. Recreation can prompt enhanced evaluation, enhanced preparing, blunder diminishment, and the improvement of specialized abilities in laparoscopic surgery important to work on genuine patients.<sup>24</sup> Participants in the intervention group made less mistakes and were less inclined to harm the gallbladder or to burn nontarget tissue on genuine patients.<sup>24</sup> Simulation-based training allows for repeated practice of standardized tasks under reproducible conditions and enables the use of objective measures for assessment purposes<sup>27</sup> and students' feedback. Simulation-based training modules can possibly abbreviate the learning time for laparoscopic strategies contrasted with customary showing techniques in laparoscopic surgery.<sup>26</sup> Surgeons in training who got simulation-based educational modules essentially beat surgeons who got the standard educational programs on knot tying.<sup>28</sup> Moreover, surgical residents who had simulation-based training played out the suturing errand quicker, made less mistakes, and were more productive in handling the suture.<sup>28</sup> In general, surgeons who got simulation-based aptitudes exhibited speedier accomplishment of those abilities than their associates from the control group in a high-stakes condition.<sup>17</sup> Training educational programs identified with laparoscopic surgery aptitudes consider all the more learning open doors for junior specialists to hone with simulation-based training before entering OR condition; along these lines, taking into account the capability of abilities converting into the OR.

At long last, the studies in this review demonstrate that simulation-based training ought to be fused into surgical educational program particularly focusing on novel surgeons. By and large, simulation-based training programs are offered as a supplement to conventional surgical preparing and are voluntary.<sup>34</sup> At present, there is no standard or all-inclusive particular surgical educational

program setup in surgical instructive projects; be that as it may, there has been a current change. The Fundamentals of Endoscopic Surgery was endorsed in March 2014 as an extra necessity for residents graduating in 2018 and after this is a simulation-based training program.

Additionally, inquiries about this are expected to decide the best longitudinal educational programs for fundamental and propelled abilities' procurement and exchange to the OR condition. Simulation-based training takes into account the beginner to take in the psychomotor aptitudes and spatial judgments essential for laparoscopic surgical abilities, enabling them to concentrate more on learning agent methodologies and taking care of intraoperative inconveniences while in the OR.<sup>33</sup> Preparing in capability-based abilities ought to be joined into an extensive surgical preparing and appraisal educational program for residents preceding working on genuine patients.<sup>35</sup> The strain to make surgical preparing more productive and more secure for patients is generous, and simulation-based training can possibly enhance surgical educational module.<sup>18</sup>

Translational effect was accomplished in the OR with live patients when simulation-based training was utilized for the instructive intercession. Researchers found that preparation in a reenacted domain prompted enhanced surgical execution on either animals or people.<sup>5,6,18,23,24,26,28,35,36</sup> Simulation-based training impacts the interpretation of laparoscopic surgery abilities to the OR. Because of these discoveries, simulation-based training can possibly give the foundational abilities important to future specialists to learn in a controlled domain and make an interpretation of those obtained aptitudes to the OR. With increments in innovation and the requirement for a standard surgical educational program, there is potential with recreation as an instructive apparatus to facilitate the interpretation of laparoscopic surgical aptitudes into the OR. All the more particularly, run-of-the-mill aptitudes that convert into the OR are suturing, camera navigation, and the control and manipulation of equipment.

## Simulation-based Training

Simulation-based training can possibly prompt an expansion in tolerant security. Trainers who prepared with reproduction had less mistakes than control group<sup>19,24</sup> while in the OR. Members in the intervention group had less occurrences of the administering specialist assuming control over the procedure. These sorts of occasions can essentially influence clinical results, since they speak of potential mistakes in procedure, trading off patient security.<sup>23</sup> Utilizing simulation for training surgical abilities can profit the bigger objective of enhanced patient well-being in a few ways. With reproduction, students

can rehash a system or even a particular component of a methodology until the point that competency is illustrated. Beginner specialists enter the OR more adept to create ideal patient results and are better arranged to take part in surgical cases with live patients in the OR in the event that they already prepared on a test system. Reproduction can likewise give more chances to healing preparing to lessen ability rot.<sup>27</sup> Laparoscopic surgical test systems give chances to prepare different ideas integral to tolerant security. For instance, collaboration abilities can be prepared through specialists interfacing with camera pilots or medical caretakers in a recreated OR. Mimicking laparoscopic surgical hardware and interfaces can even be utilized to present, test, and prepare new gear or conventions before they are executed in the OR, prompting recognizable proof of potential idle dangers to security and evasion of restorative mistakes because of poor human frameworks incorporations.

As with any writing review, our audit and results are constrained by the information given in the first examinations. Our discoveries are restricted by the absence of depictions of the information gathering procedure and intercessions of the included investigations. Specifically, it was hard to perceive a significant number of potential covariates that were utilized as a part of the information examinations and additionally the planning among pre-and posttests once the intercessions were actualized. Also, a larger part of the examinations that detailed factual outcomes revealed the outcomes utilizing p-values. The absence of impact estimate revealing adds to the trouble in really understanding the size of the impact of these mediations on the obtaining of surgical abilities. Another restriction to this investigation is that just a single database was utilized to recognize all writing, information, or concentrates identified with a particular point. Therefore, excluding conference presentations, gathering introductions, other online web indexes, and reaching associates inside the field to recognize any potential missing examinations that might not have been included. Moreover, not every surgical diary was hand looked, recently those distinguished by one creator as to be key surgery diaries inside the field. The extent of our review is both a quality and restriction. Confining our extension to just RCTs expanded the solidness of the discoveries announced in the first examinations. Nonetheless, it is impractical to make firm determinations about the viability of the distinctive sort of reenactment in light of our discoveries. The same number of RCTs did not lead similar investigations between changing sorts of reproductions. In any case, we contend that our audit provides helpful understanding into the writing that inspects the adequacy of *simulation-based* laparoscopic training mediations. The requirement for more powerful examinations of

these training mediations should have been ready to give an unequivocal conclusion to the effect on surgical skills.

Simulation-based training can prompt evident advantages of surgical abilities in the OR. These advantages incorporate diminished procedural mistakes and in addition different impacts on general patient security. This review proposes that simulation-based training is a successful approach to educate laparoscopic surgery aptitudes, increment interpretation of laparoscopic surgical abilities to the OR, and increment safety. Notwithstanding, more research ought to be led to decide whether and how simulation can turn out to be separated from the surgical educational modules.

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# Laparoscopic Sleeve Gastrectomy vs Laparoscopic Roux-en-Y Gastric Bypass Surgery in Obese and Morbidly Obese Patients

Shalmali Alva

## ABSTRACT

The review article deals with the comparison between the procedures of laparoscopic sleeve gastrectomy (LSG) vs laparoscopic Roux-en-Y gastric bypass (LRYGB) in the morbidly obese/obese patient subset. Given that the bariatric surgery deals not only with the weight loss of the patient, but also the accompanying myriad systemic and metabolic manifestations, this comparison was made to look into any prominent differences in the outcome of patients including postoperative sequelae. The studies were taken from reputed institutes across the world that were sourced from Medline and Cochrane Central and PubMed, which compared these two procedures on their patient groups and also followed up to a maximum period of 5 years for improvement on overall health parameters. The two procedures have shown fairly comparable results with regard to improvement in metabolic and hormonal parameters and LRYGB as better than LSG in long-term excessive weight loss in the follow-up phase of up to 5 years.

**Keywords:** Excessive weight loss, Laparoscopic Roux-en-Y gastric bypass, Laparoscopic sleeve gastrectomy, Morbid obesity.

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## INTRODUCTION

Over the last three decades, the prevalence of obesity and morbid obesity has steadily increased in populations across the world, affecting all age groups from pediatric to geriatric. The widespread prevalence of obesity has its implications as it gives rise to several comorbidities in the patient, affecting all the organ systems. The conditions more commonly encountered in this patient category range from Type II diabetes mellitus, hypertension, asthma, obstructive sleep apnea, to degenerative bone diseases and Infertility issues. The wide ramifications on the overall quality-of-life of the patient irrespective of gender and age make morbid obesity and obesity a challenge to be

dealt with on a mammoth footing. In the current scenario, bariatric surgery is the only effective means of long-term weight loss in the morbidly obese and also to reduce and/or remove the concomitant comorbidities arising as a result of the grossly elevated body mass index (BMI).

Given that the patient's BMI is > 40 or BMI is >35, but with comorbidities, and patient is found to be compliant with nutritional advice and is psychologically competent to withstand and understand this process of weight loss, various surgical options are presented to give the best possible outcome to the patient.

In this article, we will review LSG vs LRYGB as a surgical procedure offered to patients, their outcomes in the various studies, and also their effect on the comorbidities of the patients. Laparoscopic sleeve gastrectomy is a restrictive component surgery, whereas LRYGB entails both a restrictive and malabsorptive component. The following studies have been conducted in reputed hospitals and medical universities across the world.

## AIM

The aim of this article is to compare LSG vs LRYGB surgery and evaluate if there is any difference in the patient weight loss and/or reduction in comorbidities or if there is prevalence of any increased postoperative sequelae following any one of the procedures.

## MATERIALS AND METHODS

The studies included in the review article include ten randomized controlled trials and nonrandomized prospective and retrospective studies and meta-analysis taken from reputed institutes across the world, published during the period from 2010 to 2017. Research material for the review article was sourced from Medline, PubMed, and Cochrane central.

## OBSERVATION

The observations are presented in Table 1.<sup>1-40</sup>

## DISCUSSION

This review article covered the above 10 articles (prospective, retrospective randomized controlled trials, and meta-analysis) after short listing them from extensive

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Table 1: Comparative studies

Name of principal author and institute	Year of publishing	Year study was conducted	Study group	Operative outcome	Follow-up	Conclusion
Pablo Vidal et al (Hospital del Mar Institut d'Investigacions Mèdiques, Barcelona, Spain)	November 2012	January 2004–October 2011	249 patients between 18 and 60 years. Of these 135 patients underwent LRYGB and 114 patients underwent LSG	Operative time higher for LRYGB. Long-term weight at end of 4 years better for LRYGB	Median follow-up period of 24 months. Weight loss at end of 12 months similar	Both LRYGB and LSG have good outcomes in weight loss and resolution of comorbidity. Better long-term weight loss for LRYGB
Yong Zhang et al, Center of Minimally Invasive Surgery, Nankai, Hospital of Tianjin Medical University, China	May 2014	January 2007–July 2008	64 patients randomly assigned to either LRYGB or LSG	Weight loss better in LRYGB except in first postoperative year	Followed up for period of 5 years postoperative till 2013	Weight loss maintenance in LRYGB better. Resolution of comorbidities same in both
Chengda Zhang et al Peking Union Medical College, Chinese Academy of Medical Sciences, Beijing, People's Republic of China	June 2014	Database collected from inception to September 2013 from CNKI, Embase, and PubMed	Among all 16 included studies, 1 was randomized controlled trial and 15 were nonrandomized (11 parallel controlled trials, 4 retrospective observational studies)	LRYGB had longer operative time and technically more complicated but reversible. LSG not reversible	Follow-up of 2 years in postoperative period	Weight loss better with LRYGB at 2 year follow-up, but resolution of type II DM similar in both LSG and LRYGB
Rodrigo Koproovski Menguer et al Diabetes and Obesity Education and Research Center and Obesity Treatment Center of Hospital Santa Casa de Misericórdia de Porto Alegre, Brazil	February 2017	Between 2010 and 2013	102 patients diagnosed with metabolic syndrome (63 undergoing LRYGB and 39 undergoing LSG)	Postoperative hospital stay longer in LRYGB group	Excessive weight loss (EWL) better in LRYGB at end of 1 year compared with LSG	Both LRYGB and LSG promote significant remission rate in metabolic syndrome over 12 months. EWL better in LRYGB
Maher El Chaar Division of Bariatric and Minimally Invasive Surgery, St Luke's University Hospital and Health Network(USA)	August 2014	Retrospective analysis of data conducted between January 2009 and December 2012	Total of 885 patients. 547 patients underwent LRYGB (61.8%) and 338 underwent LSG (38.2 %)	Postoperative readmission rates for LRYGB higher for complaints of dehydration and pain control	Follow-up at 6, 12, and 24 months. At 24 months, the %EWL lesser in patients of LSG vs patients of LRYGB	In the short term, LSG has better safety profile than LRYGB but at 2-year follow-up and more, LRYGB has better excess weight loss than LSG
Rinki Murphy Michael W C. Booth et al Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand	August 2017	October 2011–October 2015 RCT	114 patients were randomized at time of surgery, 56 to SR-LRYGB and 58 to LSG	Postoperative complications marginally greater in LRYGB group	One-year follow-up and smaller sample size limiting factors to detect modest differences. 5-year follow-up planned	Significantly greater weight loss and greater improvements in lipids after SR-LRYGB at 1-year follow-up. LRYGB and LSG are similarly effective in achieving diabetes remission

(Cont'd...)

(Cont'd...)	Name of principal author and institute	Year of publishing	Year study was conducted	Study group	Operative outcome	Follow-up	Conclusion
	Leyba et al <sup>4</sup> Torre Médica Terras Plaza, Caracas, Venezuela	July 2014	January 2008–December 2008	117 patients of whom 75 were assigned to LRYGB and 42 to LSG	Operative time marginally higher for LRYGB group	One-year follow-up and 5 year-follow-up done	Excess weight loss better with LRYGB and comorbidity resolution similar efficacy at end of 1 year. But at 5 years, similar excess weight loss in both groups. More complications in LSG group at 5 years
	Albeladi B et al <sup>17</sup> Department of Digestive and Bariatric Surgery, TOURS University Hospital (Hôpital Trousseau), Tour, France	September 2013	January 2008–June 2011	36 LRYGB and 34 LSG	Operative time longer in LRYGB	Follow-up at 6, 12, and 18 months done. Weight loss better in LRYGB at 18 months	Both LRYGB and LSG safe procedures for weight loss and resolution of comorbidities at 18 months
	Lim et al Department of General Surgery, Naval Medical Center San Diego, San Diego, California	March 2014	Retrospective review from 2005 to 2011	226 patients assigned to LRYGB and 208 to LSG	Operative time longer for LRYGB than LSG	Yearly follow-up for up to 5-year period	Similar long-term weight loss between LRYGB and LSG. No difference in two procedures in EWL after 2 years postsurgery
	Jeremei Thereaux et al Ambroise Pare University Hospital, France	December 2014	January 2004–January 2013	74 patients underwent LSG and 285 patients underwent LRYGB	No adverse postoperative outcome in either group	Follow-up period of 1 year	LRYGB provides better weight loss and resolution to diabetes than LSG

online literature search from Medline, PubMed, and Cochrane central. The article was to see if the popular procedure of LRYGB was better than or comparable to LSG. Laparoscopic Roux-en-Y gastric bypass is a more complex operative procedure, which entails longer operative time compared with LSG and, in some studies, comparatively longer hospital stay. The incidence of postoperative complications has not been much in both study groups since surgeons who have achieved a good learning curve in bariatric surgery have done the above studies. The studies detailed above show that with LRYGB, there is a sustained excessive weight loss even on prolonged follow-up compared with LSG. On a limited follow-up, both LSG and LRYGB show similar excessive weight loss and resolution of comorbidities. The need of long-term follow-up is emphasized and also to ensure that patients are not lost to follow-up to ensure data collection.

## CONCLUSION

The LRYGB shows better excessive weight loss on long-term follow-up compared with LSG. Resolution of comorbidities in both procedures has similar efficacy. More studies which have 5-year and longer follow-up will be useful in this regard.

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# Management of Ovarian Dermoid Cyst and Highlight on Chemical Peritonitis

Priyanka Shekarappa

## ABSTRACT

Mature cystic teratomas or dermoid cysts, most common among germ cell tumors of ovary, contribute to 70% of benign neoplasms affecting women of age group less than 30 years. Mature cystic teratomas or dermoid cysts are most commonly mistaken for malignancy in ultrasound.

**Keywords:** Chemical peritonitis, Dermoid cysts, Laparoscopy, Tissue retrieval techniques.

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## AIMS AND OBJECTIVES

- Diagnosis of dermoid cyst
- Choices in surgical treatment—laparoscopy or laparotomy
- Oophorectomy or ovarian cystectomy
- Tissue retrieval techniques
- Prevention of spillage of cyst contents during cystectomy and management of consequences if rupture occurs

## MATERIALS AND METHODS

Sources from PubMed, Royal College of Obstetricians and Gynecologists (RCOG) guidelines, search on literature from articles published between 1998 and 2016.

## RESULTS

### Diagnosis of Dermoid Cysts

According to RCOG guidelines, a pelvic ultrasound is the single most effective way of evaluating ovarian mass with TVS being preferable.<sup>1</sup>

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### Ultrasound Findings

- Presence of a Rokitansky nodule—densely echogenic tubercle projecting into the cyst lumen
- Fat fluid levels
- Dermoid mesh sign—matrix of echogenic bands made by hair fibers floating within the cyst
- Tip of the iceberg sign—acoustic shadowing the sebum can have on hair-containing lesions<sup>2</sup>

### Choices in Surgical Treatment: Laparoscopy or Laparotomy

Most of the trials reported laparoscopy is superior to laparotomy and considered to be the gold standard in the management of dermoid cysts (RCOG level 1).<sup>1,3-6</sup>

Advantages of laparoscopic removal of dermoid cysts:

- Better magnification, more precise, less injury to ovarian tissue
- Less bleeding
- Less adhesion
- Less postoperative pain
- Shorter hospital stay
- Cosmetically better scar
- Cost-effective due to shorter hospital stay, less postoperative narcotics, and early return to work

Disadvantages:

- Longer duration of surgery
- Requires expertise
- Chances of rupture

### Laparoscopic Oophorectomy or Ovarian Cystectomy

Cystectomy is considered the first procedure of choice as it affects women of reproductive age group. In postmenopausal women, oophorectomy is the procedure of choice.<sup>1,7</sup>

### Tissue Retrieval Techniques

- Minilaparotomy
- Endobag
- Colpotomy

Commercially available endobags are considered to be superior over other two techniques.<sup>4</sup>

## Prevention of Spillage of Cyst Contents during Cystectomy and Management of Consequences if Rupture occurs

During laparoscopic cystectomy, about 40 to 50% of cysts rupture.

To prevent the cyst contents entering into the peritoneal cavity, before starting cystectomy, an endobag is kept open underneath the cyst so that if it ruptures contents will spill into the endobag and not into the peritoneal cavity.

The endobag should be of good quality so that it does not tear while retrieving the cyst as the cyst might contain sharper contents like tooth.

If there is spillage of cyst contents in spite of all precautions, the abdominal cavity should be irrigated with warmed fluid (NS/RL) with skimming of floating debris with suction tube until clear. Cold fluid may solidify the fat-rich contents and make retrieval of spilled contents more difficult and can cause hypothermia.<sup>8-10</sup>

### Consequences of Cyst Rupture

- Adhesions
- Fistulization
- Chemical peritonitis
- Squamous cell carcinoma

### Note on Laparoscopic Cystectomy during Pregnancy

- Protect the uterus while placing trocars
- Low pressure pneumoperitoneum
- Maternal end tidal CO<sub>2</sub> gas level should be maintained
- Mobilization of the patient soon after the surgery

Laparoscopic cystectomy is superior to laparotomy. Although there is high rate of rupture, the incidence of chemical peritonitis is only 0.2% (Table 1). In 2009, a Cochrane review which included 12 randomized control trials concluded laparoscopy was superior to laparotomy. Although there was inadvertent rupture of cysts during laparoscopy, no statistical difference was found between the two treatment arms regarding total number of adverse events of surgery.

### CONCLUSION

Laparoscopic cystectomy of dermoid cysts is considered to be a safe procedure in the hands of experienced surgeons when compared with the morbidity and mortality associated with laparotomy. Incidence of chemical peri-

**Table 1:** Comparison of number of dermoid cysts ruptured and incidence of chemical peritonitis in various studies

Journal	Dermoid cysts removed by laparoscopy	Number of cysts ruptured	Incidence of chemical peritonitis
Laparoscopic management of dermoid cysts, <i>JSLs</i> —10 years	93	39	0.2%
Does prevention of intraperitoneal spillage when removing a dermoid cyst prevent granulomatous peritonitis, <i>BJOJ</i> —20 years	314	26	0.2%
Factors that increase the risk of leakage during surgical removal of benign cystic teratomas—5 years	178	115	Nil

tonitis is very less compared with spillage rates when appropriately managed following spillage.

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# Laparoscopy in Cesarean Scar Pregnancy

R Meenakshi Menon

## ABSTRACT

**Introduction:** With the increase in rates of cesarean deliveries, complications in subsequent pregnancies like placenta accreta/percreta, uterine rupture, and cesarean scar ectopic pregnancy are on the rise. Cesarean scar pregnancy (CSP) accounts for about 2 to 4% of all ectopic pregnancies. Improvement in diagnostic techniques and advancement in transvaginal ultrasound and advent of minimal access surgery has contributed to early detection and timely management of CSP.

**Objective:** This article aims to review different treatment modalities of CSP and hence to compare efficacy of laparoscopy with other management techniques.

**Materials and methods:** Case series, retrospective cohort studies, and articles were reviewed which included studies from PubMed, MEDLINE, Cochrane library, and EMBASE. The main outcome was successful first-line treatment. Complications during treatment were listed as bleeding more than 1 L, blood transfusion, hysterectomy, and laparotomy.

**Results:** Successful treatment and reduced complications were noted with laparoscopy as compared with medical management.

**Conclusion:** Interventional than medical approach is preferred in management of CSP. Laparoscopic surgery helps in removal of ectopic tissue in cesarean scar with simultaneous repair of the defect under adequate visualization.

**Keywords:** Cesarean scar pregnancy, Ectopic pregnancy, Laparoscopy.

**How to cite this article:** Menon RM. Laparoscopy in Cesarean Scar Pregnancy. *World J Lap Surg* 2017;10(3):135-138.

**Source of support:** Nil

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## INTRODUCTION

National Family Health Survey 2014 to 2015 reveals that rate of cesarean surgery has doubled over the last decade from 8.5% in 2005 to 17.2% in 2015. Thus, complications like CSP have also been on the rise. Incidence of CSP has been reported to be 1 in 1,800 to 1 in 2,200 pregnancies. With the advent of transvaginal ultrasonography, early

detection is possible, mean gestational age at diagnosis being  $7.5 \pm 2.5$  weeks with interval between last cesarean section and CSP being 6 months to 12 years.<sup>1</sup>

Cesarean scar pregnancy has been hypothesized to occur from an early invasion of myometrium which occurs through a microscopic tract in the cesarean scar tissue.<sup>2</sup>

Two types of CSP have been explained: Endogenic or type I and exogenic or type II. Endogenic CSP progresses toward cervicoisthmic space, or uterine cavity could progress to viability but with high risk of bleeding from placental site.

Type II progresses toward bladder or abdominal cavity with deep invasion of scar defect. Type II usually complicates with uterine rupture or bleeding early in pregnancy.<sup>3</sup>

Ultrasound plays a pivotal role in diagnosis. Cesarean scar pregnancy (Fig. 1) is characterized by certain ultrasound findings<sup>4</sup>:

- Empty uterus and cervical canal
- Gestational Sac located in anterior uterine wall (part of isthmus) with diminished or absent myometrium between gestational sac and bladder and discontinuity in anterior wall of uterus adjacent to gestational sac
- Circular blood flow surrounding the sac on Doppler.

Aborting gestation and cervical pregnancy are easily mistaken for a CSP.

Early diagnosis with high index of suspicion and timely management depending on the availability, skill of surgeon, and severity of symptoms are of prime importance.

The treatment options available and reviewed are

- Dilation and curettage (D&C) and excision of trophoblastic tissue using laparoscopy or laparotomy
- Local or systemic methotrexate (MTX)

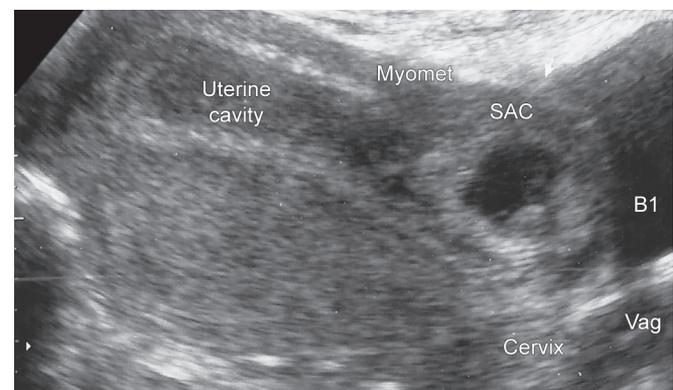


Fig. 1: Ultrasonographic view of a scar ectopic

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- Bilateral internal iliac artery ligation and dilation and extraction under laparoscopic guidance
- Selective uterine artery embolization (UAE) + D&C and MTX
- Transvaginal resection
- Hysteroscopy

A systematic review of the above management options was done by Petersen et al<sup>5</sup> focusing on efficacy and complications related with each method in 2,037 cases, where it was found that laparoscopy had 97.1% success rate with no severe complications. Rest of the management options had a variable success rate. Least success was seen with expectant management of 41.5% with a complication of 53.7%. Maximum success was noted with high-intensity focused ultrasound (HIFU) ablation of 100% with no complications, but only 16 cases were studied as compared with 69 cases who underwent laparoscopy.

Majority of the reviewed articles in this study were case reports, which was a major limitation in providing conclusions. Also, there was no consensus on individualizing treatment strategy based on type of CSP or thickness of intervening myometrium.<sup>5</sup>

Successful laparoscopic resection of CSP was first reported by Lee et al.<sup>6</sup>

### OPERATIVE PROCEDURE

In the review done by Birch Petersen et al,<sup>5</sup> laparoscopy was done under general anesthesia where CSP with

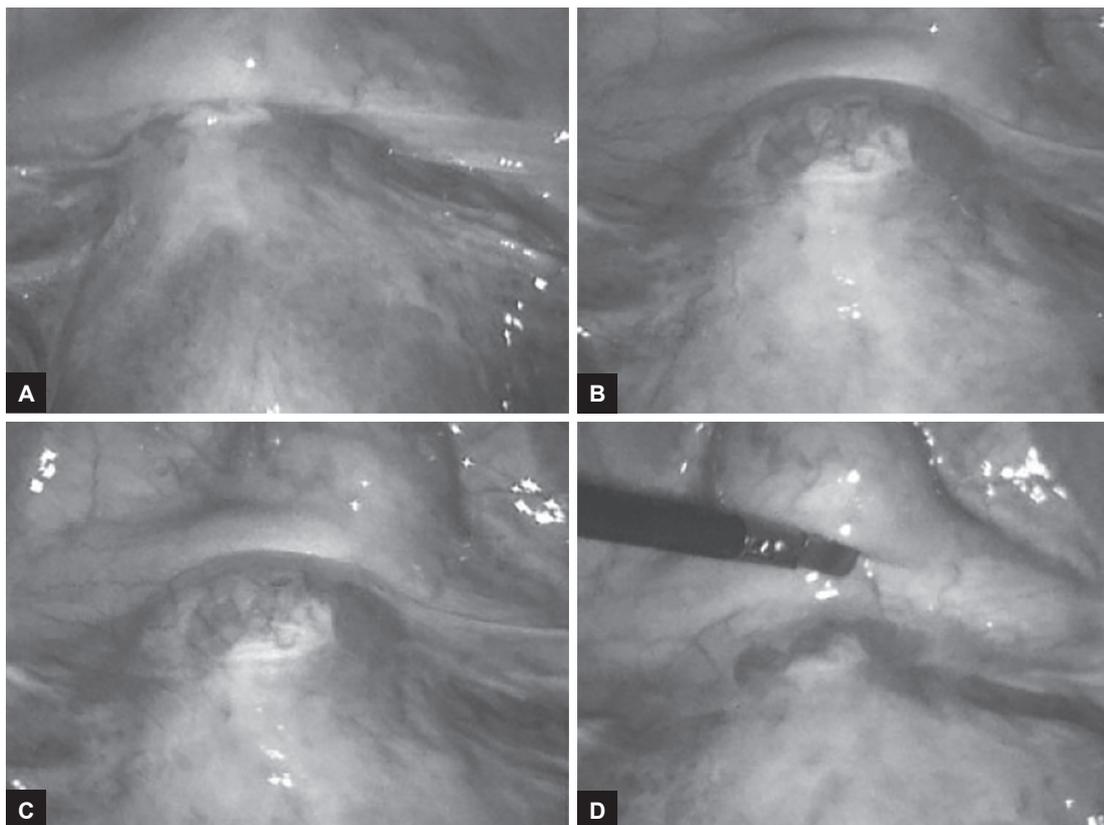
progression toward the bladder is seen. Bladder is dissected down, and excision of uterine scar is done with repair of defect in uterus.

Laparoscopic management is done by local injection of vasopressin followed by an incision over the bulge after reflecting the bladder, thereafter enucleating the sac and retrieval in an endobag. The uterine incision is sutured. Bipolar is used for hemostasis. Some surgeons also make a bilateral uterine artery ligation at the start of surgery to minimize blood loss (Fig. 2).<sup>7</sup>

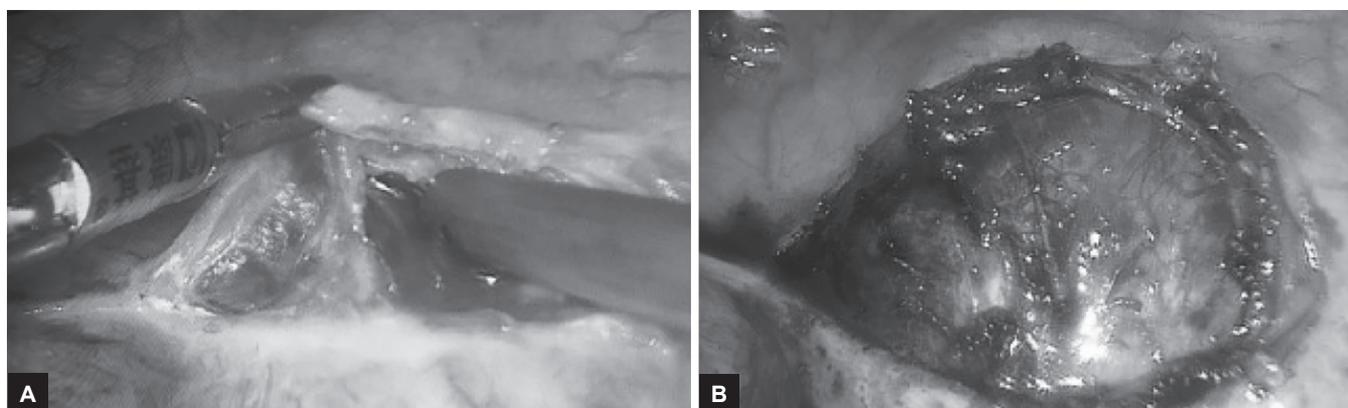
### ALTERNATIVES

Hysteroscopy was also considered an option, but additional treatment was required in 17% of cases. Hysteroscopic management of CSP has benefits over local and systemic MTX with normalization of  $\beta$ -human chorionic gonadotropin level more rapidly and decrease in follow-up time according to a retrospective cohort study conducted by Deans and Abott<sup>8</sup> in Sydney (Fig. 3).

In a study done by Pan and Liu,<sup>9</sup> hysteroscopy under laparoscopic guidance was preferred in cases with myometrial thickness less than 3 mm to avoid the risk of uterine perforation and bladder injury. Also, additional advantage of performing a laparoscopy concomitantly helps in resection and repair in case of perforation of scar site (Table 1 and Fig. 4).<sup>10</sup>



Figs 2A to D: Laparoscopic view of cesarean scar pregnancy



Figs 3A and B: Incision on the bulge

Table 1: Treatment modalities in Cesarean scar pregnancy

Method of treatment	Cases (n)	Success rate (%)	Severe complication rate (%)
Expectant management	41	41.5	53.7
Systemic MTX	339	75.2	13
Needle aspiration + MTX/KCl	148	84.5	13.5
Hysteroscopy	95	83.2	3.2
Selective UAE without MTX	295	93.6	3.4
UAE + D&C + hysteroscopy	85	95.4	1.2
UAE + MTX	427	68.6	2.8
Local + systemic MTX	34	76.5	2.3
Local MTX	74	64.9	4.1
Transvaginal resection	118	99.2	0.9
D&C	243	48.1	21
Laparoscopy	69	97.1	0
Repeated HIFU ablation	16	100	0
HIFU + hysteroscopic suction curettage	53	100	0



Fig. 4: Uterine scar repair by endo-suturing after enucleation of sac

According to a literature review by Fuchs et al,<sup>11</sup> the laparoscopic approach in management of CSP is safe and effective with minimal blood loss. It also gives an excellent visualization of the pathology at hand and permits a good reconstruction of the lower uterine

segment, which is very important for future pregnancy outcomes.

Medical management leaves the scar behind which can predispose to recurrence and also requires strict adherence to monitoring by ultrasound and hormone profile.<sup>12</sup>

Laparoscopy helps to confirm the diagnosis, removal of scar ectopic under better visualization, repair of defect, as well as preservation of reproductive capacity.<sup>13</sup> Use of vasopressin intraoperatively and suturing can minimize chances of hemorrhage and allow safe removal of ectopic with multilayer closure of uterine defect.<sup>14</sup>

Based on a review of literature by Api et al,<sup>15</sup> they concluded that laparoscopy has an edge over hysteroscopy with respect to repair of cesarean scar defect as it increases uterine wall thickness when compared with repair by hysteroscopic approach which does not help in reducing the potential risk of scar dehiscence or rupture in subsequent pregnancies.

In a case report published by Mahgoub et al<sup>16</sup> from a study conducted in Starsbourg, France, enucleation of ectopic mass was done with isthmocoele treatment with no complications, intraoperative blood loss of less than 100 mL, and discharge of patient on day 3.

## DISCUSSION

From the studies reviewed, treatment of CSP should be individualized with choice of management based on preventing severe complications and conservation of fertility. With facilities for laparoscopy readily available, it should be considered as a good option for management of CSP. In centers where facilities and skills are there, HIFU is also an effective alternative but limited by availability.

Limitation in this area is that many of the reviewed articles are case reports. Well-designed multicentric randomized controlled trials are required before any conclusion is made regarding best method of management. Until then, evidence-based treatment is followed with individualization of cases also taking into account surgeon's skills

and severity of patient symptoms. From the literature reviewed, laparoscopy is indeed an effective modality of treatment of CSP as it allows removal of ectopic mass *in toto* under visualization along with adequate repair of the defect which is particularly of importance in preserving subsequent reproductive capacity.

## CONCLUSION

Interventional approach is preferred in the management of CSP. Laparoscopy offers benefits of removal of ectopic tissue with repair of defect as well as need for a shorter hospital stay and follow-up while preserving fertility. However, case selection and surgical skills have an important role in management.

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## CASE REPORT

# Heterotopic Pregnancy: Successful Management by Laparoscopic Salpingectomy in First Trimester and Continuation of Intrauterine Pregnancy until Term

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## ABSTRACT

**Introduction:** We report a case of a heterotopic pregnancy (HP) with resultant normal intrauterine pregnancy after laparoscopic salpingectomy. A heterotrophic pregnancy is defined as the coexistence of intrauterine and extrauterine gestation. Incidence is more common in infertility patients conceived after treatment than natural conception. A 20-year-old primigravida presented with 7 weeks amenorrhea, pain in abdomen, and per vaginal spotting. The ultrasound (USG) report was suggestive of a right-sided adnexal mass indicative of either tubal ectopic along with an intrauterine live gestation of 7 weeks and hemoperitoneum. Emergency laparoscopy was done and right salpingectomy was done in view of right ruptured tubal ectopic pregnancy. The intrauterine pregnancy then continued subsequently to 35 weeks of gestation as on September 18, 2017. Early diagnosis and prompt intervention are essential to save the intrauterine pregnancy and avoid maternal morbidity and mortality related to hemoperitoneum due to ruptured ectopic pregnancy.

**Keywords:** Hemoperitoneum, Heterotopic pregnancy, Laparoscopy, Salpingectomy.

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**Conflict of interest:** None

## INTRODUCTION

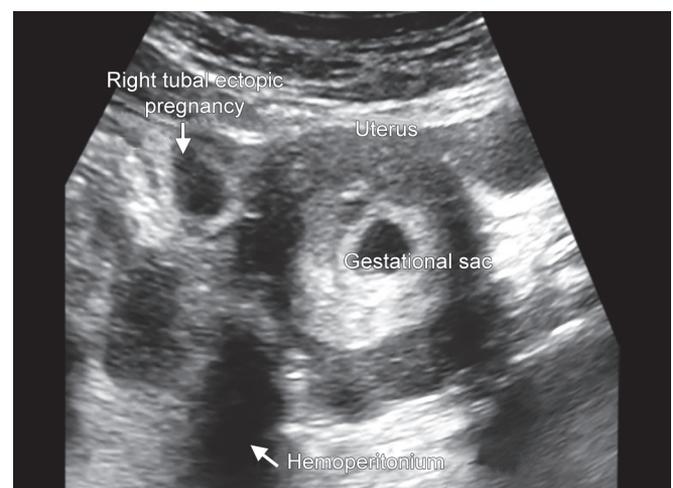
A heterotrophic pregnancy is defined as the presence of an intrauterine and extrauterine pregnancy together.<sup>1,2</sup> It is common with assisted reproductive techniques like ovulation induction and *in vitro* fertilization (1:7,000) and is very rare in natural conception (1:30,000).<sup>3</sup> Diagnosis and management of HP are great challenges for obstetricians. Early diagnosis and prompt intervention are

essential to save the intrauterine pregnancy and avoid maternal morbidity and mortality related to hemoperitoneum due to ruptured ectopic pregnancy.<sup>4</sup> Laparoscopy with minimal or no manipulation of uterus can be used as an effective minimal invasive treatment tool to salvage intrauterine pregnancy and prevent morbidity related to hemoperitoneum and laparotomy. Here, we present a case of a 20-year-old primigravida with HP (7 weeks live intrauterine pregnancy with ruptured right tubal ectopic pregnancy) managed by laparoscopic salpingectomy and with successful continuation of intrauterine pregnancy until term.

## CASE REPORT

A 20-year-old primigravida presented with 7 weeks amenorrhea, pain in abdomen, and per vaginal spotting. The USG report was suggestive of a right-sided adnexal mass indicative of tubal ectopic pregnancy along with an intrauterine single live gestation of 7 weeks and hemoperitoneum (Figs 1 and 2).

It was spontaneous conception. There was no risk factor present, e.g., infertility treatment, pelvic infection, or contraceptive use. A diagnosis of live intrauterine pregnancy with rupture of the extrauterine (tubal) pregnancy was made. Hemodynamically, patient was stable. Routine laboratory tests and serum beta human chorionic gonadotropin (hCG) were ordered. Adequate

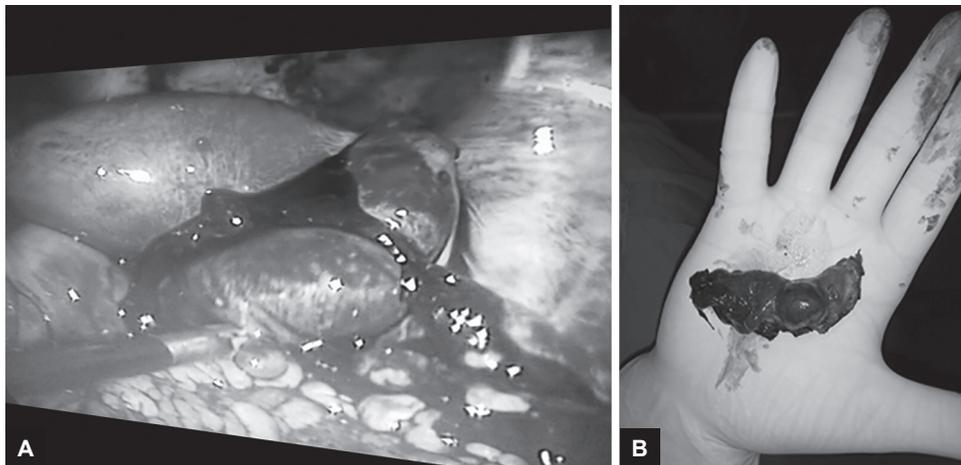


**Fig. 1:** Ultrasound suggestive of intrauterine pregnancy with right tubal ectopic pregnancy with hemoperitoneum

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**Figs 2A and B:** Right ruptured tubal ectopic pregnancy with salpingectomy done

blood and blood components were arranged. Couple was counseled for emergency laparoscopy, complications, and future risk of abortion and the couple gave consent for procedure. Anesthesia team was informed regarding the same so that they should be cautious while using drugs as we were planning to continue intrauterine pregnancy.

Under general anesthesia, laparoscopy was performed with one suparumbilical 10 mm and two 5 mm left lateral ports. A significant amount of hemoperitoneum (400–500 mL) was found. After suctioning the clots from the pelvis, a mass within the right fallopian tube was identified consistent with an ectopic pregnancy. The mass was approximately 4 × 4 cm, with rupture at the isthmoampullary region. A right salpingectomy was then performed with minimal handling of the uterus.

Preoperative serum beta hCG was 1,20,000 mIU/mL. Immediate postoperatively injection hCG 10,000 IU and injection hydroxyprogesterone depot 500 mg intramuscularly were given and continued weekly until 12 weeks. Postoperative USG on day 3 was suggestive of live intrauterine pregnancy. The patient recovered well and was discharged home on postoperative day 7, and the intrauterine gestation was viable. Histopathology examination of the right fallopian tube and its contents revealed chorionic villi, confirming the diagnosis of a tubal pregnancy. Further USG 1 month after the laparoscopy revealed a viable intrauterine singleton fetus with gestational age of 12 weeks with normal nuchal translucency scan. She is receiving routine antenatal care and the pregnancy as of September 18, 2017 was 35 weeks of gestation.

## DISCUSSION

Heterotopic pregnancy is usually considered a rare event. However, the incidence of HPs is increasing, especially with ovulation induction and use of assisted reproductive technology. But, it can also occur in spontaneous conceptions. Diagnosing an HP can be challenging. However,

the diagnosis should be made early so that treatment can be initiated in a timely manner to prevent morbidity and mortality.

Ectopic pregnancy and HPs are usually diagnosed in the early first trimester.<sup>5</sup> Tal et al<sup>6</sup> reported that 70% of the HPs were diagnosed between 5 and 8 weeks of gestation, 20% between 9 and 10 weeks, and only 10% after the 11th week. We should offer an early USG scan in patients who have had a positive pregnancy test, between 6 and 7 weeks of gestation as was done in our patient. The majority were diagnosed late and serum beta hCG and transvaginal USG are not foolproof, resulting in significant morbidity and occasional mortality. In HP, hCG levels are almost the same as of normal intrauterine pregnancy. On USG, as intrauterine gestation is seen, and extrauterine pregnancy can be missed. Heterotopic pregnancies are also confused with hemorrhagic corpus luteal cyst. Methotrexate or KCl can be used for conservative management.<sup>6–8</sup> Surgical treatment remains the most common therapy in most patients. As in our case, laparoscopy can be used when a patient is hemodynamically stable. But in unstable patients, laparotomy should be done.<sup>9</sup>

## CONCLUSION

This report has demonstrated that early first trimester transvaginal USG should be performed for all pregnancies and coexisting adnexal mass with intrauterine gestation should raise an index of suspicion for possible HP. This case demonstrates that early diagnosis is essential to prevent morbidity and mortality.

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