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## Two port laparoscopic ventral hernia mesh repair: An innovative technical advancement

Prateek K. Mehrotra, C.S. Ramachandran\*, Vijay Arora

Department of General &amp; Laparoscopic Surgery, Sir Ganga Ram Hospital, New Delhi, India

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### ABSTRACT

Ventral hernia is a common surgical problem. The traditional open surgical repair has the disadvantage of excessive morbidity, long hospital stay and high recurrence rates. Laparoscopic ventral hernia repair (LVHR) is gaining acceptance but there is no standardized technique for the repair of these hernias. We have introduced an innovative technique of 2-port laparoscopic mesh repair for ventral and incisional hernias.

Between January 2002 and September 2008, 168 patients underwent the 2-port repair of ventral hernias at our institution, with Bard polypropylene mesh in 162 cases and Gore-tex expanded polytetrafluoroethylene mesh in 6 patients. The average size of the defects was 10.2 cm (6.6–24.8 cm). Mean operating time was 61.4 min (48–102 min). The mean post-operative hospital stay was 1.2 days. Prolonged ileus over one day occurred in 22 patients while 6 patients had urinary retention in the post-operative period. There were 6 recurrences (3.94%) in the mean follow up period of 42 months (6–62 months). Seroma formation occurred in 5.3% cases but all of them subsided within 6 weeks without any active intervention.

In conclusion we recommend that the 2-port LVHR is a technically sound procedure which is less invasive and with comparable complication rates to the 3 or 4 port hernia repair.

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### 1. Introduction

Ventral hernias are the most common complication after abdominal surgery and reported rates vary from 3% to 20%.<sup>1</sup> Surgical repair of these hernias have evolved progressively over the last two decades from simple suture repair to the present day laparoscopic techniques of repair.<sup>2</sup> There has been a shift away from conventional open tissue repair, which has reported recurrence rates of 35%, and when repaired for recurrences, rates up to 50% have been reported.<sup>3,4</sup> The addition of prosthetic mesh to conventional repair has lowered recurrence rates to 10%–24%<sup>5</sup> and is now an integral part of all minimally invasive repairs. Multiple studies have shown the advantages of laparoscopic repair like short hospital stay, less pain<sup>6,7</sup> and lower recurrence rates between 9 and 12%.<sup>2</sup>

Laparoscopic ventral hernia repair (LVHR) was first introduced in the early 1990s.<sup>3</sup> Classically the repair is carried out using three to four ports of entry into the abdominal cavity<sup>4,5</sup> and a prosthetic expanded polytetrafluoroethylene (ePTFE) mesh like Gore-tex or a polypropylene mesh like Bard was used to cover the hernial defect. The 2-port procedure for ventral hernia repair has been

previously reported in 3 cases by Abir et al.<sup>6</sup> We have in a previous communication described the 2-port technique of laparoscopic cholecystectomy,<sup>7</sup> with its added advantages of being the least minimally invasive procedure so far described. In this study, we have adapted this 2-port technique to the surgical management of ventral hernia, and this is possibly one of the largest series being reported. We have standardized this 2-port technique for ventral hernia repair at our center.

### 2. Material and method

Between January 2002 and September 2008, a total of 168 patients with an incisional, umbilical or para-umbilical hernia were subjected to the 2-port laparoscopic repair. All patients were offered 2-port LVHR using prosthetic mesh. We used Bard (Bard Ltd. Crawley UK) polypropylene mesh in 162 patients and Gore-tex (Gore Associates, Arizona USA) expanded polytetrafluoroethylene mesh in 6 patients. Patients with obstructed or strangulated hernias, giant hernial defects measuring more than 25 cm with redundant abdominal skin and flabby pendulous abdomen underwent either an open repair or a 3–4 port conventional laparoscopic repair.

#### 2.1. Surgical technique

The procedure is performed in a supine patient under general anesthesia. A 3rd generation cephalosporin is administered at the time of induction. Pneumoperitoneum is created with a Veress needle lateral to the mid-clavicular line on the left side, at the level of the umbilicus. This point avoids the hernial sac area and its contents.

\* Corresponding author. Tel.: +91 9811047375.

E-mail address: [surgicalrama2000@usa.net](mailto:surgicalrama2000@usa.net) (C.S. Ramachandran).

Intra-abdominal pressure is maintained at 12 mm of Hg. A 10-mm trocar is inserted at the site of the Veress needle puncture and using a 10 mm 30° scope, the site of the hernia is examined. A second 10-mm port is made under vision in the left hypo-chondrium lateral to the mid-clavicular line at least 8-cm cranial to the first port (Fig. 1). The position of the two ports outside the mid-clavicular line and the distance between the two can be individualized according to the site of the hernia, whether supra umbilical, infra umbilical or umbilical. We prefer 10 mm ports since they accommodate even large rolled mesh used for repair large hernias. Subsequently the patient is tilted towards the right side so that the contents of the hernia fall away from the dissecting ports for better visualization. The camera is switched to the upper port and the lower port is used as the working channel. Using the hook, dissector forceps or harmonic forceps, as the individual case may require, the contents are dissected free from the anterior abdominal wall. The procedure is facilitated by external pressure exerted by the operating surgeon with his left hand over the hernia. This procedure helps in applying counter pressure. Care must be taken with the use of electro-cautery and harmonic to avoid inadvertent injury to the bowel. Haemostasis is achieved after completing the dissection. The patient is made supine once the dissection has been completed and the defect has been defined. The peritoneal sac is left in situ. We did not use any transfixation sutures to close the defect.

## 2.2. Mesh placement

Ethilon 1-0 mounted on a straight needle is inserted percutaneously into the peritoneal cavity from the center of the hernial bulge. It is held by the grasper within the peritoneum and is brought out from the working port (Fig. 2). The size of the mesh depends on the hernial defect. The defect is measured internally. An appropriate size mesh is chosen allowing at least 4-cm overlap on all sides of the defect. We commonly use a medium (15 × 15 cm) mesh or a small (15 × 7.6 cm) size Bard mesh. In larger defects two medium meshes or one medium and one small mesh sutured together using vicryl 2-0 ( $n = 18$ ) were used. The needle end of the ethilon suture that has been brought out of the port is used to tack the suture to the center of the mesh after which the needle is removed. The mesh is then rolled up and is railroaded into the peritoneal cavity through the working port using a 5-mm grasper (Fig. 3). Gradual traction from the cutaneous end of the suture is applied to smoothly guide the mesh into the peritoneal cavity under vision. Once the mesh has passed the trocar into the peritoneal cavity, it is unrolled using the grasper (Fig. 3). The cutaneous end of the ethilon is pulled up and the mesh opens out and is anchored to the anterior abdominal wall covering the hernial defect. Adequate traction on the Ethilon suture by the assistant is maintained during this maneuver to prevent the mesh from falling down. This obviates the need for a 3rd port. The edges of the mesh are fixed using a Protack 5 mm auto suture spiral tacker (Tyco Health care, Connecticut USA) at 3-cm interval. Extra tacks are placed around the hernial defect. It is not very difficult to place circumferential tacks from one side of the abdomen. By lowering the intra-abdominal pressure and using the left hand of the surgeon to indent the abdominal wall, it is possible to reach all corners of the mesh for tacking. Interchanging the camera and working ports and maintaining adequate traction on the ethilon suture, also helps in adequately tacking all corners of the mesh. At the end of the procedure the omentum was pulled down to the pelvis and spread out evenly to intervene between the underlying bowel and the overlying prosthetic mesh. This step is important to prevent bowel adhesions. No drains were placed. Once the patient is extubated, the abdominal wall is strapped with adhesive tape for 1 week to obliterate all potential dead spaces. This step is essential to prevent post-

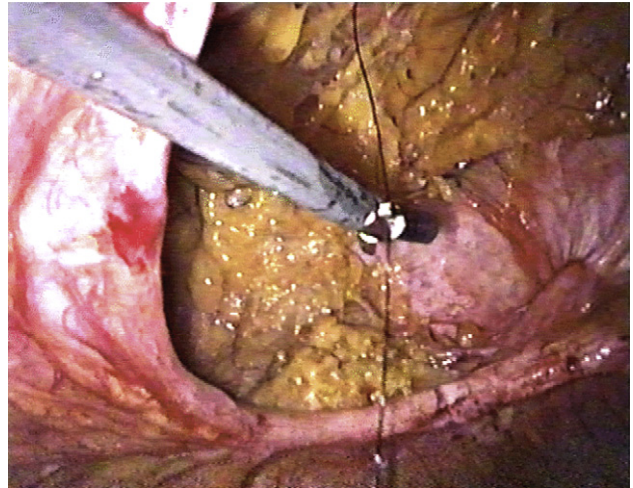


Fig. 2. Straight needle with suture being passed through the center of the hernial defect, which subsequently will be brought out of the working port.

operative seroma formation. Postoperatively the patient is administered a single dose of non-narcotic analgesics and ambulation begins on recovery as early as possible. Oral feeding is started within 12 h of the surgery and the patient is discharged on the next day. The patients were called on the 7th and 15th post-operative day. Port site skin clips were removed on the 7th day. The third visit was at 6 weeks and then on a 6 monthly basis.

## 3. Results

A total of 168 patients underwent the procedure in the duration of 6 years. Females ( $n = 124$ ) outnumbered the males ( $n = 44$ ). The females presented at a younger age (mean 32.8 yr) compared to the male patients (mean 51.8 yr). The average age of the patients at the time of surgery was comparable to their age at first presentation (Table 1). Approximately 30% of the males presented with irreducible hernias. 21% of females also had irreducible hernias. None of the patients had any features of obstruction or strangulation. Among the males, half the patients presented with incisional hernias following some abdominal surgery. Rest had either an umbilical or a para-umbilical hernia (Table 2). Most of the females ( $n = 76$ ) presented with incisional hernias. Hysterectomy and caesarian section operations were the commonest surgeries



Fig. 1. A large incisional hernia operated by the 2-port technique.

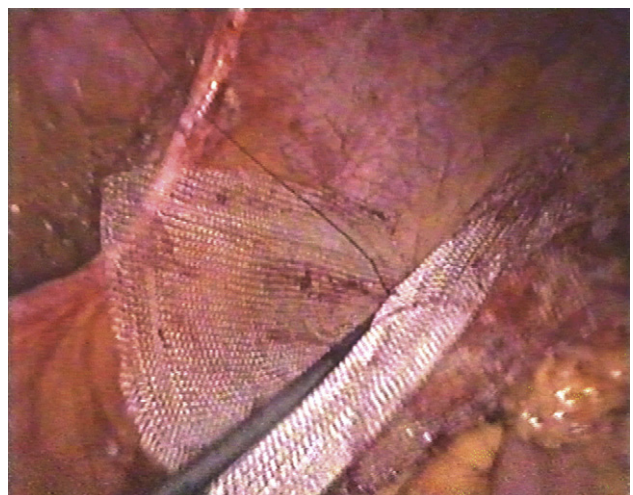


Fig. 3. Mesh with the suture fixed to the center of it, in the peritoneal cavity being manipulated to cover the hernial defect.

**Table 1**  
Demographic profile of the patients.

	Males	Females
Total patients	44	124
Age at 1st presentation (yrs.)	51.8 (32–76)	32.8 (22–61)
Irreducible hernia	13 (29.5%)	26 (21%)
Average age at Surgery (yrs.)	52.2	33.8
Multiple hernial defects	10 (22.7%)	36 (29%)

leading to incisional hernias. All patients underwent the 2-port procedure successfully. There were no conversions to the open or the 3-port procedure in any of the cases.

The average operating time was 61.4 min (48–102 min). 10 males (23%) and 36 females (29%) had multiple hernial defects. The average size of the defects was 10.2 cm (6.6–24.8 cms). In larger defects, two medium meshes or one medium and one small mesh sutured together using vicryl 2-0 ( $n = 18$ ) were used. We used Septocoll along with the mesh in our last 16 cases of the series.

85% of the patients ( $n = 143$ ) were discharged within 24 h of the surgery. The rest of the patients had a longer hospital stay. The prolonged hospital stay was either due to the tedious dissection process and bleeding during the surgery or due to the slow return of bowel functions in the post-operative period. Prolonged ileus over one day was encountered in 22 patients. Antibiotics were continued for 24 h after surgery. Analgesics were continued for 24 h in majority of the patients. 6 patients required catheterization in the post-operative period (Table 3). Follow up of 152 patients was available. The patients underwent a detailed clinical examination at the time of the follow up. The duration of follow up was 6–62 (mean 42) months. There were 6 recurrences (3.94%) seen during the follow up period. Though 8 patients in our series had seroma formation (Table 3), they subsided with conservative management within 6 weeks and none of them required aspiration.

#### 4. Discussion

Laparoscopic surgery of the abdominal wall is increasingly gaining popularity due to its good results, better quality of repair, low morbidity and recurrence rates.<sup>8</sup> There are very few comparative and randomized trials, but the general trend in favour of the laparoscopic approach is obvious.<sup>15–17</sup> Recently some reports of successful ventral hernia repair by a 2-port technique have shown

**Table 2**  
Surgeries performed that led to incisional hernias.

	No. of patients
Males ( $n = 44$ )	
Incisional Hernia	21
Midline laparotomy	6
Recurrent Incisional Hernia	8
Coronary artery bypass graft	3
Hydatid Cyst excision	2
Open Cholecystectomy	2
Umbilical Hernia	11
Para-umbilical Hernia	12
Females ( $n = 124$ )	
Incisional Hernia	76
Hysterectomy (Vertical)	24
LSCS (Vertical)	20
Recurrent Incisional hernia	10
Exploratory laparotomy	8
Ruptured Ectopic	4
Upper Abdominal scar	4
Open Cholecystectomy	4
Coronary artery bypass graft	2
Umbilical Hernia	26
Para-umbilical Hernia	22

**Table 3**  
Complications occurring in the patients.

Complications	No. of Patients
During hospital stay ( $n = 168$ )	
Prolonged ileus (>1day)	22 (13.1%)
Urinary Retention/Catheterization	6 (3.6%)
Pyrexia (Unknown cause)	1 (0.6%)
Intestinal Injury	Nil
During follow up ( $n = 152$ )	
Recurrences	6 (3.9%)
Seroma (<6 weeks)	8 (5.3%)
Seroma (>6 weeks requiring aspiration)	Nil
Port Site pain (>6 weeks)	4 (2.6%)
Mesh Infection	Nil

promising results.<sup>9,10</sup> The present study is probably the largest reported series of 2-port laparoscopic ventral hernia repair involving 168 patients. Females in our series had a higher tendency to incisional and ventral hernia formation. The females had an early presentation while males presented in their early 50's. The age of the females coincided with the peak of their reproductive period, which could be one of the predisposing factors. Caesarian sections were one of the commonest surgeries predisposing to incisional hernias.

1/4th of the patients in our series had multiple defects. In these cases, special precaution was taken to define all the defects. The suture in the case of multiple defects was passed through the centrally lying defect. The size of the mesh was such that all the defects could be adequately covered. Irreducibility was not a contraindication for undergoing the 2-port LVHR procedure. Though technically more time consuming and the dissection process being more tedious, it was possible to complete the procedure with two ports. All the patients with irreducibility had omentum and dense adhesions were encountered between the omentum and the sac. Similarly recurrent incisional hernias were successfully treated using this technique. 13 patients with recurrent incisional hernias had undergone open repair without any mesh. Five cases had undergone onlay mesh repair. In these cases a larger mesh was used compared to the defect, so as to cover the defect on all sides.

By depressing the abdominal wall with the left hand and judiciously tilting the patient to the opposite side, the operator can easily take down all the adhesions safely including those sacs containing bowel loops. This procedure helps in applying counter pressure. The absence of a third port will obviously contribute to lesser pain. Abir et al. has noted similar findings while using the 2 port procedure of ventral hernia repairs.<sup>6</sup> The availability of the harmonic scalpel is especially useful in our 2-port technique especially in cases where we encountered dense adhesions. We did not encounter any case with iatrogenic bowel injury. It is very important to cover the polypropylene mesh with the omentum at the end of the procedure as described by us, as this procedure is crucial in preventing bowel adhesions as shown by Karabulut et al.<sup>11,12</sup> Omentum helps in increasing the inflammation and the peri-inflammatory connective tissue formation causing the omentum to adhere to the polypropylene mesh as a protective barrier.<sup>13</sup> ePTFE is the material preferred by surgeons' worldwide which we used in 6 cases only. The operating time was comparable to the cases in which we used polypropylene mesh.

We preferred polypropylene mesh because it is less expensive and easily available in our country. Its intra-operative handling is more convenient as it is stiff and our experience with covering the bowel with omentum has shown that intestinal obstruction does not occur, as the omentum gets adhered to the peritoneal surface of the mesh and forms a protective barrier between the mesh and the bowel.<sup>12</sup> The bilayer mesh, was seldom available to us during the study period. The use of polypropylene mesh is widely reported and its safety has been well documented in literature.<sup>12,14,15</sup>



Septocoll is a resorbable collagen fleece, which has a local hemostatic effect. It is impregnated with gentamycin sulfate and gentamycin crobefate. The fleece is associated with better wound healing<sup>16</sup> and significant reduction in the concentration of pathogenic bacteria at the wound site.<sup>17</sup> The use of Septocoll provides a sustained release of antibiotic for a prolonged duration at the site of the mesh, thus reducing the chances of mesh infection.<sup>16–18</sup> None of our patients had any mesh infection in the post-operative period.

Immediate post-operative complications viz., prolonged ileus was managed conservatively. Postoperative urinary retention occurred in 3.6% cases and it required catheterization. Incidence of seroma formation has been reported to be 2–13% after LVHR.<sup>5,19</sup> By strapping the abdomen after surgery an attempt is made to eliminate dead spaces and prevent seroma formation. We had short-term seromas in our patients. All the collections resolved without any intervention within a period of 6 weeks, documented by ultrasonography. Prolonged pain in the port sites was seen in 2.6% cases, which is comparable to rates reported in literature.<sup>5</sup> In our series, no intervention was required for the prolonged pain. It subsided with oral non-opioid analgesics. Recurrences were detected by a detailed clinical examination in the follow up period and confirmed by ultrasound if required. The recurrence rate in our series was 3.9% after a mean follow up time of 32 months, which is similar to other published series.<sup>3,5,20</sup> Recurrence rates to the tune of 9% have also been reported.<sup>3</sup> The procedure was well received, especially by the female patients, who constituted the majority of cases in our series. Even though in the early learning curve phase the operating time was longer than the 3 or 4 port procedure. It was reduced to comparable levels in the later part of our series. The surgeon along with a single assistant holding the camera can easily perform the procedure. A laparoscopic procedure was undertaken as the patients demanded the procedure and were not willing to undergo an open repair of the hernia. Subsequent to the study period our present policy is to operate such cases as a day care procedure in majority of cases. Only selected cases with very large hernias or co-morbidities are kept overnight after surgery.

In this paper we present a technically different approach in the mesh repair of ventral hernias. The short and long-term results are comparable to the 3 port technique and have been well accepted by the patients. In conclusion we recommend that the 2-port LVHR is a technically sound procedure which is less invasive and with comparable complication rates to the 3 or 4 port hernia repair.

#### Conflicts of interest

None.

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None.

#### Ethical approval

Ethical approval was cleared by the Ethical Committee of Sir Ganga Ram Hospital, New Delhi, India.

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