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Multidisciplinary Academic Journal Publisher

Laparoscopic Ventral Hernia Repair with Polypropylene Mesh and Visceral Omentopexy Running Head: Ventral Hernia Repair

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Abstract: **Background:** There is no conformity among surgeons on whether the laparoscopic surgery must be used in tiny or huge ventral hernias (VH) or as a first technique for repair. An ethylene poly tetra fluroethylene (ePTFE) patch usage was permitted a protected intraperitoneal position of the mesh in connect with the visceral content. By the passing of years, the laparoscopic method for VH repair was established its likelihood and consistency with a small rate of diversion to open surgery and the capability to heal even the largest defects in abdominal wall. The aim is to study the efficiency and safety of laparoscopic polyprolene mesh repair for primary VH more than 3 cm in diameter and omental patch as coverage of the mesh to avoid adhesions among mesh and intestine. **Methodology:** A cohort prospective study including 10 patients with incisional or primary VH with a defect size more than 3 cm. in diameter. Fayoum Ethical committee approval was taken .These patients were operated upon laproscopically at Fayoum University Hospital from April 2014 to April 2016 using polypropyelene mesh and omental patch as coverage of the mesh to protect adhesions between mesh and intestine. Following surgery, patients will be followed up one week following discharge from the hospital, then at intervals of 4 weeks, and at 6 weeks for late morbidity, then at 9 and 12 month, and later at the end of second postoperative year for recurrence**. Results:** Our results showed decrease morbidity, earlier recovery and shorter hospital stay with low reappearance rate and no complications as intestinal obstruction or enterocutaneous fistula. **Conclusion:** To conclude, this study proved to be congruent with other studies concerning the obtained data of laparoscopic VH repair through composite mesh. Laparoscopic VH repair using polypropylene mesh and omental coverage is safe, effective, and technically feasible.

[El Esawy, A., Shaaban, N., Thabet, A. and Ragab, A. **Laparoscopic Ventral Hernia Repair with Polypropyl ene Mesh and Visceral Omentopexy Running Head: Ventral Hernia Repair.** *Nat Sci* 2021,19(12):13-19]. IS SN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 3. doi:10.7537/marsnsj191221.03.

Key words: Laparoscopic Repair, Omentopexy, Ventral hernia, Mesh

1. Introduction

Previous study revealed that laparoscopic VH repair has increased bigger attractiveness among surgeons, in addition to patients over the ordinary surgical restore without or with mesh. The profit of the laparoscopic method relative to the open surgical method with mesh application are the less overall complication rate, postoperative pain, and staying in hospital [1]. Mesh usage in open repair became common where the benefits of the abdominal wall prosthetic reinforcement was revealed. On the other hand, this implies the use of long incisions, prolonged drainage and big subcutaneous flaps. Although the benefits of laparoscopy over the open repair are still vague, the recurrence hazard is equally at a rate of 9% or less in comparison to large group of open repair with mesh. Laparoscopic approach can decrease the difficulties of open hernioplasty without disturbing the capability to carry out tension- free mesh repair [2,3]. On the other hand, till now worldwide there is no agreement on whether the laparoscopic therapy should be used as a main technique for repair in very large or very small VH. The usage of an ePTFE patch has permitted an assured intraperitoneal emplacement of the mesh contacting with the visceral content [4].

Through the years, the laparoscopic method for VH repair has confirmed its viability and consistency with small rates of transformation opening and its treating ability of even the biggest abdominal wall defects. Intraperitoneal mesh emplacement has been completed probable with the aid of ePTFE whilst avoiding the hazard of bowel fistula and with a decrease in adhesion formation [5,6].

In developing countries as Egypt, the main limiting factor of laparoscopic procedure is the raised cost as a result of usage of the disposable tacker and expensive composite mesh. The current work is intended to evaluate the feasibility and safety of using low cost polypropylene mesh in managing of laparoscopic VH.

2. Patient and Methods

A cohort prospective study included 10 patients with incisional or primary VH with defect size more than 3 cms. Fayoum Ethical committee approval

was taken before starting the study. These patients were operated upon laproscopically at Fayoum University Hospital from April 2014 to April 2016 using polypropyelene mesh and omental patch as coverage of the mesh to avoid adhesions between mesh and intestine.Inclusion criteria will be patients having an abdominal wall hernia >3 cm diameter of the defect on medical evaluation (incisional or primary), who are suitable for a surgical technique with remedial intent. The exclusion criteria including who were complicated and recurrent hernias, hernias less than 3 cm in diameter, an American Society of Anesthesiologists' score >2 and contraindications to laparoscopic surgery, and BMI more than 45 kg/m^2.

All patients were submitted to the following :Full clinical assessment in the form of full physical and history examination .(including clinical assessment of the size of the defect)Routine preoperative laboratory examinations including renal function parameters, hepatic function parameters, ECG, and complete blood count. Radiological investigations; chest x ray was done for patients more than 50 years with respiratory problem. Ultrasound was done for sizing of defect.

Following surgery, patients will be followed up one week following discharge from the hospital, then at 4 weeks, then at 6 weeks for late morbidity, then at 9 and 12 month, and later at the end of second postoperative year.

All patients were registered in the hospital before surgery with one day, they were fasting 8 hours before surgery, on clear fluids 24 hours before surgery, charcoal tablets were given to reduce gastric distension .All patients were given thromboprophylaxis in the form of 40microgram clexan 12 hours before surgery and mechanical prophylaxis during surgery to decrease the incidence of deep venous thrombosis .Informed consent was taken from all patients.Antibiotic prophylaxis was taken with induction of anesthesia as a single intravenous dose in the form of 3rd generation cephalosporin. Anesthesia was in the form of general anesthesia, Nasogatric tube and foly's catheter were inserted after intubation and were detached at the end of the process.

The patients were assessed for the following: time of the procedure, duration of hospital stay, postoperative pain score, resumption of oral diet and return to normal activity. Early and late complications in the form of :bleeding, wound infection, infected mesh and bowel injury, post-operative ileus, early and late recurrences. From the 10 patients seven females and three males. Their age were ranged from 27 to 43 years. The following pain score was used to evaluate post-operative pain in both groups. Rating description ,0 No pain,,1 Tolerable (and does not inhibit any activities), 2 Tolerable (but does inhibit some activities), 3 Intolerable (but can read, watch TV or use telephone), 4 Intolerable (but cannot read, watch TV or use telephone), 5 Intolerable (and not capable to communicate verbally due to pain). Scoring: The patient's personalized rating of pain and the objective specification of the pain's intervention with activities will yield a corresponding score on a scale of 0-5. A lesser score equals less severe pain and less intervention with activities, if any. Perfectly, all patients should have a 0 to 2 level, if possible 0 to 1. It should be clear to the respondent that restrictions in activities only apply if restrictions are attributed to the evaluated pain.

Technique of Laparoscopic Ventral Hernia Repair (LVHR)

On the surgical table the patient is positioned in the supine position with the operating side near the edge of the table, the arms extended and adducted, the legs extended and adducted, The abdomen was prepared routinely, gastric decompression and bladder was employed in all cases.

Laparoscopic repairs were done under general anaesthesia using two 10 mm camera port and 5 mm working ports in additional to a 30 degree scope.

The surgeon stands on the left side of the patient for right side and midline defects; and on the opposite position for left side defects surgeon. In front of the surgeon located the video monitor.

Preoperatively, an effort should be done to palpate the edges of the defect and trace it on the abdominal wall using a marking pen.

A veress needle inserted below the left costal margin is used for initiating pneumoperitoneum the first trocar was inserted using 10 mm port, being located far from the defect as possible. Direct view laparoscopic (30°) is inserted to facilitate the incision of the other two 5mm trocars.

Primary port placement (initial abdominal access) for LVHR location should be out of the away from the hernia impairment and former laparotomy incisions as able to be done. The perfect site of this port could be the right or left upper quadrant, but the site must be convenient to the patient's anatomy and surgical history. An optical trocar entry or verses needle could all be in safety to be usage for fundamental port position during LVHR. The right method selected should mostly be dependent on the experience of the surgeon and the technique results with considering the patient's anatomy and surgical history.

Secondary port placement must be done under direct vision and placed as laterally as able to be done to the hernia impairment to permit a suitable ergonomical working position for the surgeon in the process of placement/fixation and adhesiolysis of the prosthetic.

Adhesiolysis must be executed cautiously with blunt and/or sharp dissection with the frugal energy usage for hemostasis to get out of inadvertently postponed enterotomy. Usage of sutures and

hemostatic agents and is desirable for energy application to reach hemostasis close the bowel.

The adhesiolysis must including the entire old incision. Depending upon the falciform, the hernia site, and umbilical ligaments must be dissected and taken down to recognize occult hernia impairment and permit appropriate exposure of the abdominal wall for placement of an appropriately sized mesh. 3 cm minimum around the border of the defect was cleared of adhesions.

The surgeon must examine the bowel after adhesions are taken down at the conclusion of the entire adhesiolysis and/or at adhesiolysis progresses to exclude any unintentional enterotomies.

Closure of hernia defect or its narrowing, because narrowing or closing the impairment during LVHR before mesh insertion embrace the opportunity of reduced recurrence and seroma rate, as well as improved abdominal wall contour postoperatively and abdominal functions.

The appropriate size of the mesh is determined once the hernia impairment has been decided. This is done via placing needles over the abdominal wall and confirming the location of the hernia impairment or via approaching an intra- abdominal instrument against a palpating finger on the abdomen and working out the hernia. The defect was narrowed or closed via polypropylene number1 intracorporal suturing. The polypropylene mesh usage during LVHR must be considered to bridge an impairment in the abdominal wall and sized with suitable overlap the defect's location and size.

The first step is to reduce any hernial content, both blunt and sharp dissection is necessary. It is often very useful the counter pressure on the outside of the abdominal wall. Once this is done, the second step is to assess the borders of the hernia, which may on occasion be difficult.

If this was not possible, then after the viscera are reduced, a needle is passed *via* the abdominal wall from the outside to recognize the border of the impairment. This is done for 360 degrees to allow the defect to be traced on the outside of the abdominal wall. An attempt to close or narrow the defect using polypropelene 1 intracorprial suturing used, near to the impairment decrease the occurrence of seroma formation. The mesh then is introduced through 10 mm port, The mesh size depending on the defect size, its size should wrap the defect with 3 to 5 cm overlapping the defect.

We did fix the mesh via 5mm tacks, two cm apart. Identification of the defect and the four corners of the mesh was facilitated via needle inserted via the abdominal wall .

Omentum then covers the mesh and fixed over it to the anterior abdominal wall using 5 mm tacks, then transfascial polypropelene 1 sutures using gore needle was used to stick the omentum to the abdominal wall at corners of the mesh .

We didn't use drains in any case of laparoscopic patients, near to the fascial defect at the 10 mm port site was done via vicryl 0 and skin incision via 4/0 vicryl subcuticular closure.

Both nasogastric tube and Folys catheter were removed before extubation. Patients started oral feeding after compete recovery from anathesia. We managed paralytic ilieus by withholding the oral feeding for 24 hours, IV fliuds, with close follow up. Oral feeding was resumed after these patients passed flatus . US abdomen were done for those patients who developed postoperative seroma, aspiration under ultrasound control, plus I.V antibiotics.

Statistical calculations

Collected results were coded to facilitate data handling, analysis was conducted using SPSS software version 25. Descriptive in the form of frequency and percent was used for qualitative data, while mean ± SD used for quantitative data. Paired t-test used in comparing two dependent quantitative results. The $p \leq 0.05$ was settled as significance level.

3. Results

This prospective research incorporated 10 patients aged 27 to 43 years with a mean age (36.1 ± 5.2 years). Three patients were males (30%) and seven females (70%). Two patients (20%) were hypertensive; one patient (10%) was diabetic Table 1.

Table (1) Demographic information (n=10)

Variables	Frequency/Percent	
Age (years)		
Mean /SD	36.1	5.2
Sex		
Male	3	30%
Female	7	70%

Types of Hernia included 9 primary VH rnias (8 paraumbilical and 2 epigastric), one incisional hernias (post midline incision). Contents of the hernial sac included 8 patients with omentum and 2 patients omentum with bowel Table 2.

Table (2) Types of Hernia (n=10)

Variables	Frequency	Percent (%)
Type of hernia		
Primary	9	90%
Incisional	1	10%
Site of hernia		
Para-umbilical	8	80%
Middle line	2	20%
Content of hernia		
Omentum	8	80%
Omentum and bowel	2	20%

The size of the defect in the study between 3 to 8 cm (with mean value of 4.6 ±1.4). The mean size of the mesh was 15*15 cm and the operative time ranges from 90 to 200 min with a mean (141 ±33.8 min) Table 3.

Table (3) Defect size, mesh size, and operation time

Variables	Minimum	Maximum	Mean	SD
Size of defect (cm)	3	8	4.6	1.4
Size of mesh (cm)	15	15	15	0
Operation time (min)	90	200	141	33.8

The mean time for resumption of oral diet was (22.2 ±21.1) hours ranging between (10 and 72 hours), while the mean days of staying in hospital was (3±1.1) days ranging between (two and five days).

Regarding the postoperative pain score, after 6 hours was (2.8 ±1.1) ranged between (1 and 4 hours), then decrease to (1.2±1) ranged between (0 and 3 hours) after 24 hours from the operation. There is statistical significance decrease with p-value less than 0.05 in pain score from 2.8 after 6 hours to 1.2 after 24 hours of operation Table 4.

Table (4) Postoperative pain score

Variables	Painscore		*P*-value	Sig.
	Mean	SD		
After 6 hours	2.8	1.1	**<0.001**	**HS**
After 24 hours	1.2	1		

Two patients (20 %) were complicated with seroma which was repeatedly aspirated , under cover of antibiotics and tight compression with abdominal binder till complete resolution. One patient (10%) was complicated with prolonged ileus for 48 hours which necessitated Ryle insertion and potassium chloride (KCL) injections until motility regained completely. No early or late recurrence of hernia was recorded during the period of study.

4. Discussion

Ventral hernias are one of the popular operations done by surgeons. The success rate of surgical repair of VH have been always accredited to quite many factors such as the defect size, strain on the edges of the wound or infections [7]. Open suture repairs were used as treatment but with an unfavorable rate of more than 50 % recurrence [8]. Rate of recurrence has been decreased with the start of mesh prosthesis repair, although most surgeons had to face wound related complications, the morbidity of the operation raising. A considerable enrichment in results has been related to the usage of mesh, thus decreased the recurrence rate to 2-11%. An additional stage in the battle against VH was done through initiation of the laparoscopic surgery [9]. Laparoscopic incisional hernia repair has been gradually established by surgeons as it reduces the complication of open prosthetic repair as reduces the danger of recurrence, 16.5% open mesh repair versus 4% for laparoscopic incisional hernia repair [10].

The laparoscopic approach in reality conceded a huge number of hypothetical compensations: smaller fascial dissection, lesser abdominal wall traumatisms, fewer visceral injuries and no require for drainage, lesser wound and prosthetic contamination. These benefits have been proved in many reports [10]. In developing countries as Egypt, price is the major limiting operator of the laparoscopic procedure, which is mainly due to the use of costly disposable tackers and composite mesh.

In this work we evaluated the feasibility and safety of using low price polypropylene mesh with omental coverage in the managing of laparoscopic VH. This study including 10 patients, who underwent laparoscopic repair of VH using polypropylene mesh with omental coverage. Most of them 7(70%) were females & 3 (30%), the ratio of male to female was 1:3.

Regarding the time of operative in the available literature, it revealed that operative takes lengthier period to complete laparoscopic repair of incisional hernias [11,12]. In this study the mean time for operative was long (90:200 min), as transfascial suturing to fix the omentum increases technical difficulty of the operation and longer time. The duration of laparoscopic repair decreases with enhancement in the learning curve, however as in open repair remains related to the defect complexity and the adhesions severity. In no patients conversion to open repair was needed. The laparoscopic technique actually facilitates the adhesiolysis by a backward view, avoiding bowel injuries. The laparoscopic exploration of the abdominal cavity is more comprehensive. There is less risk of iatrogenic injury of the intestinal loops that are imprisoned or closely adherent to the scarring site. The CO_2 itself contributes to separate the adhesions through the chance of creating a surgical emphysematous plane

that can delineate adherent tissue and bowel borders for more safe sharp dissection.

In this study we did not come across any case of intraoperative bowel injury during adhesiolysis because we had specific precautions which were; pre-operative; bowel preparation done for all patients in the form of; clear fluids for 24hours before surgery, and charcoal and gas absorbing tablets were given. In the meanwhile intraoperative adhesions encountered in the way of dissection field were lysed, other membranous or fibrous adhesions were left. Lysis of adhesions is possibly the most challenging part of LVHR. Enterotomy has been well described in both the LVHR as well as in the open repair reports. Gagnerhas reported a 10% occurrence of enterotomy in laparoscopic surgery for abdominal hernia [13]. Even though certain series reported 0% enterotomies, they often have patients with mysterious sepsis or with "major systemic complications"[7,8]. These may actually represent occult enterotomies that self-seal. In our study, we did not have patients with such complications suggesting any occult enterotomies. Various studies reported that there is no risk of mesh infection accompanied by laparoscopic repair of minor bowel perforation and synchronized LVHR [9,13]. A safe choice if laparotomy has been undertaken as the bowel injury, is to simply perform a suture-repair of the hernia and accept the greater possibility of hernia recurrence [9]. Owing to the few number of tissue dissection required in LVHR, no long incision, no wide fascial dissection or flap formation, no opening of the sac and no drains wound related infectious complications are few [10].

Majority of the wound associated infectious complications are due to local wound antibiotics and toilet. Managment of mesh infection could be difficult although it has been documented that polypropylene mesh infection could be managed without mesh removal where as in the case of ePTFE removal of mesh is commonly required [11]. There were no infectious complications of wound in the group. Seroma formation, one of the complications of LVHR and happen in laparoscopic repair and open repair and ranges from 1 to 4% [14,15]. There were 2 (20%) seroma formation in our study which was controlled by percutaneous aspiration and prophylactic antibiotics [12].

De-Maria and Moss [6] and Raftopoul et al. [16] in their studies noticed that patients had fewer pain after laparoscopic repair. Postoperative pain score, after 6 hours was (2.8 ± 1.1) ranged between (1 and 4), then decrease to was (1.2 ± 1) ranged between (0 and 3) after 24 hours from operation. Majority of our patients were personally more comfortable during the postoperative period and on 1st postoperative day were ambulant. The mean hospital stay was significantly short, mean hospital stay was (3 ± 1.1) ranged between (2 and 5 days) [12,14,16]. One patient (10%) developed post-operative ileus. We managed this case with stopping the oral feeding for 24 hours, We kept him on intravenous (iv)fluids, with close follow up, Oral feeding was returned after this patient passed flatus. In retrospective studies, the recurrence rate with laparoscopic mesh repair was similar to, or less than, that of open mesh repair.

The reported rates of recurrence for open mesh repair have been constantly lower (0-10%). Laparoscopic mesh repair brings about comparably low recurrence rate (0-9%)[13-15]. At a mean follow up of 24 months not any recurrence was found in the laparoscopic repair; which may be explained by the total adhesionolysis which was done to expose all "Swiss Cheese hernias" in all cases and in no situation mesh overlap was less than 3 cm. Additionally, in cases mesh was fixed with tacks 2 cm apart. The recurrence rate in our study 0% [11,12,17]. The lower recurrence rates in LVHR can be because by insertion the prosthesis under the fascial margins, intrabdominal pressures are essentially enrichment the repair attachments if it is placed anteriorly. The other is that it can obviously identify the defect margin, so that the extent of the defect can be precisely delineated laparoscopically.

We can clearly establish the amount of overlap required, in practice it is to overlap 3-5 cm all margins, and full thickness transbdominal suture should be used in fixation of the omentum over the mesh to the abdominal wall [11,12,18]. Cost factor should be approached with respect to laparoscopic incisional hernia repair. The priciple contributor to the cost of laparoscopic repair are the disposable tacker used to fix to mesh in place and the mesh (composite mesh). The usage of tacker could be lost by using transfascial suturing to fix the mesh but this clearly increases operative time and technical difficulty of the procedure. Furthermore the results of our study do not discard one in bearing in mind to use polypropylene mesh for laparoscopic incisional hernia repair. In our study in LVHR, during follow up for 24 months, we didn't find any complications like adhesive intestinsl obstruction and/or gut erosion, There was no readmission for any symptom caused by intraperitoneal use of polypropylene mesh and omental cover as a barrier [11,12,17].

However, there is no general conformity for intraperitonial placement of polypropylene mesh. Virijland et al. [18] fulfilled that there is low risk of intestinal complications for intraperitoneal use of polypropylene mesh. Enterocutaneous fistula formation seems to be very rare after incisional hernia repair with polypropylene mesh, inspite of intraperitoneal placement, omental coverage or closing of the peritoneum [19-22]. To conclude, the outcome of this study proved to be matching with other studies concerning the results of LVHR using composite mesh. Our results suggest that LVHR using polypropylene mesh and omental coverage is effective ,safe, and technically feasible operation

with decrease morbidity, shorter hospital stay, and earlier recovery with low recurrence rate and without complications as intestinal obstruction (IO) or enterocutaneous fistula. Longer follow-up is needed to confirm the safety and efficacy, and more prospective randomized trials are required [22-27].

List of abbreviations
(ePTFE) ethylene poly tetra fluroethylene
(LVHR) Laparoscopic Ventral Hernia Repair
(IV) Intravenous
(IO) Intestinal obstruction

Declarations
Compliance with Ethical Standards:
Statement of ethics approval:
Approval was taken from Professor Doctor Ashraf Hussein, the head of the ethical committee, Faculty of Medicine, Fayoum University, on March 2014 with Reference. No. 53.
-Informed consent and permissions of the human participants was obtained from all patients
-Informed consent from the participant was obtained to report individual patient data

Funding: This study was not funded

Conflict of Interest& Approval of Publication:
Authors declares that they have no conflict of interest, and approve for publication

Authors' contributions:
All Authors contributed in data collection, surgical procedure and writing

Acknowledgements: No Acknowledgements.

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10/16/2021