Interposition of the omentum and/or the peritoneum in the emergency repair of large ventral hernias with polypropylene mesh

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**ABSTRACT**

**Background:** Ventral and incisional hernias are common surgical problems and their repairs are among the common surgeries done by a general surgeon. Repair of a large ventral hernia is still associated with high postoperative morbidity and recurrence rates. No single approach to ventral hernia repair will be the best choice for all patients. Large ventral hernias are often better approached with open surgery but may still be problematic when the defect is too wide for primary fascial closure to be achieved, as this leaves mesh exposed, bridging the gap. Techniques for incisional hernia repair have evolved over many years, and the use of mesh has reduced recurrence rates dramatically. The use of polypropylene mesh is reported to be associated with long-term complications such as severe adhesions and enterocutaneous fistula, which occur more commonly if the mesh is applied intraperitoneally with direct contact of the serosal surface of the intestine. Composite meshes containing expanded polytetrafluoroethylene (ePTFE) have been used recently; their major drawbacks lie in their high cost, inferior handling characteristics, and poor incorporation into the tissues. Although several studies have clearly demonstrated the safety and efficacy of prosthetic mesh repair in the emergency management of the incarcerated and/or strangulated inguinal and ventral hernias, however, surgeons remained reluctant to use prosthetics in such settings.

**Purpose:** The aim of this work was to evaluate the effectiveness and safety of placing the omentum and/or the peritoneum of the hernia sac as a protective layer over the viscera in the emergency repair of large ventral hernias using on-lay polypropylene mesh whenever complete tension-free closure of the abdominal wall was impossible.

**Patients and methods:** This study was carried out on all patients with large ventral hernia presented to the Gastrointestinal Surgery Unit, Main Alexandria University Hospital in an emergency situation during the period from October 2005 till October 2012. All patients were treated by placing the omentum and/or the peritoneum of the hernia sac between the viscera and the mesh whenever complete tension-free closure of the abdominal wall was impossible. Some patients necessitated removal of previous meshes and resection-anastomosis of the non-viable bowel prior to mesh repair. Those who underwent complete closure of the abdominal wall without tension prior to mesh repair were excluded from the study as there was no need for interposition of the omentum and/or peritoneum. All patients’ data, surgical procedures, complications and follow-up were collected, reviewed and analyzed. After approval of local ethics committees of both the General Surgery Department and the Alexandria Faculty of Medicine, all patients included in the study were informed well about the operative procedure and use of prosthetic mesh and an informed written consent was obtained from every patient before carrying the procedure.

**Results:** Between October 2005 and October 2012; 105 patients (13 males and 92 females) with incarcerated and/or strangulated large ventral hernias were operated upon in the Gastrointestinal Surgery Unit, Main Alexandria University Hospital using an onlay polypropylene mesh. Their age ranged from 37 to 83 years with a mean of 59.3 ± 11.7 years. The hernia was para-umbilical in 5 patients (4.8%), incisional in 22 patients (21%) and recurrent in 78 patients (74.3%). The recurrent hernias were recurrent para-umbilical hernias in 56 patients and recurrent incisional hernias in 22 patients. Resection anastomosis of non-viable, devitalized or injured small intestine during removal of adherent previous meshes was performed in 19 patients (18%). Hospital stay ranged from 2 to 13 days with a mean of 3.57 ± 1.6 days. There was one perioperative mortality. Complications were encountered in 28 patients (26.7%) and included wound infection with delayed wound healing in 6 patients, seroma formation in 12 patients,
chest infection in 8 patients and deep vein thrombosis in 2 patients. Follow-up duration ranged from 13 to 80 months with a mean of 46.8 ± 20.3 months.

Conclusion: Placing the omentum and/or the peritoneum of the hernia sac as a protective layer over the viscera in repair of incarceraced and/or strangulated large ventral hernia using on-lay polypropylene mesh is cost-effective and safe even with resection anastomosis of small intestine.

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1. Introduction

Ventral and incisional hernias are common surgical problems and their repairs are among the common surgeries done by a general surgeon. Repair of large ventral hernia is still associated with high postoperative morbidity and recurrence rates. No single approach to ventral hernia repair will be the best choice for all patients. Furthermore, there is no standard nomenclature system to accurately stratify ventral or incisional hernias. This has led to the use of poorly defined, confusing terms such as: “complex ventral hernia repair”, “large defects”, and “loss of abdominal domain”. Large ventral hernias are often better approached with open surgery but may still be problematic when the defect is too wide for primary fascial closure to be achieved, as this leaves mesh exposed, bridging the gap. This risks seroma formation and infection where the mesh lies subcutaneously and bowel adhesion, erosion and fistula formation where it is in contact with intraperitoneal contents [1,2].

Incisional hernias complicate about 2%–11% of laparotomies, and they are a major source of morbidity and recurrence [3–5]. Techniques for incisional hernia repair have evolved over many years, and the use of mesh has reduced recurrence rates dramatically [6,7]. Although incisional hernia can be repaired effectively with several types of synthetic mesh, repair of giant and complex incisional hernias with massive depletion of fascial and muscular tissues is difficult [8–10]. Ultimately, the choice of technique is generally determined by the surgeon’s preference, surgical tradition, or even by the hospital’s economic situation [8].

The use of polypropylene (PP) mesh is reported to be associated with long-term complications such as severe adhesions and enterocutaneous fistula, which occur more commonly if the mesh is applied intraperitoneally with direct contact of the serosal surface of the intestine [10–12]. Hence the newer meshes were introduced with its attendant high cost. Newer meshes like PTFE, composite mesh, PCO (polyester coated with antiadhesive collagen layer), Proceed mesh (polypropylene with oxidized regenerated cellulose).

Composite meshes containing expanded polytetrafluoroethylene (ePTFE) have been used recently, especially in laparoscopic repair of incisional hernias. Despite the low adhesive potential of these meshes, their major drawbacks lie in their high cost, inferior handling characteristics, and poor incorporation into the tissues. Encapsulation occurs slowly, and infection can occur during the encapsulation process. When infected, ePTFE mesh almost always requires removal. Newer meshes are 15–20 times costlier than polypropylene mesh [12–14].

Although several studies have clearly demonstrated the safety and efficacy of prosthetic mesh repair in the emergency management of the incarcerated and/or strangulated inguinal and ventral hernias, however, surgeons remained reluctant to use prosthetics in such settings [15–17].

The aim of this work was to evaluate the effectiveness and safety of placing the omentum and/or the peritoneum of the hernia sac as a protective layer over the viscera in the emergency repair of large ventral hernias using on-lay polypropylene mesh whenever complete tension-free closure of the abdominal wall was impossible.

2. Patients and methods

Between October 2005 and October 2012; 105 patients with incarcerated and/or strangulated large ventral hernias underwent repair of their hernias using onlay polypropylene mesh with interposition of the omentum or the peritoneum of the hernia sac as a protective layer between the viscera and the mesh. Those who underwent complete closure of the abdominal wall without tension prior to mesh repair were excluded from the study as there was no need for interposition of the omentum and/or peritoneum. Patients’ age, sex, body mass index, American Society of Anesthesiologists (ASA) score and associated co-morbidities were recorded.

All patients were operated upon under general or epidural anesthesia. Prophylactic intra-venous antibiotic (a third generation cephalosporin and metronidazole) was given to all patients at the time of induction of anesthesia and was continued postoperatively for at least two days. Prophylactic low molecular weight heparin was given to all obese patients and those at high risk and was continued postoperatively during the period of hospital stay.

Transverse elliptical incision overlying the hernia and including the initial scars in case of incisional/recurrent hernias was used in almost all patients. The hernia ring was cut in opposite extremities to release the tension and make further steps of surgery easier. Following complete adhesiolysis and removal of previous meshes and dealing with the contents, the defect was partially closed without tension at its two ends by simple interrupted sutures (Prolene 1, Ethicon). If there were multiple defects, they were transformed into one large defect. All non-viable and injured small intestines were resected prior to abdominal wall closure. Intestinal anastomosis was performed in a single-layer interrupted extramucosal manner using absorbable sutures (Vicryl 3/0, Ethicon). The remaining defect in the abdominal wall after partial closure was covered by the omentum and/or the peritoneum of the hernia sac as a protective layer between the viscera and the overlying polypropylene mesh. Having dissected the skin and subcutaneous flaps from the abdominal wall, a polypropylene mesh (Prolene, Ethicon) was then fixed to the edges of the defect and the abdominal wall muscles as an onlay patch (i.e. between the abdominal wall muscles and the subcutaneous tissue) using interrupted polypropylene su- tures (Prolene 2/0, Ethicon). The size of the mesh should be large enough to cover the defect and the lacerated abdominal wall as well. A closed-suction drain (Redivac, 18 Fr) was inserted under the subcutaneous tissue and was kept in place as long as its daily output was more than 20 ml per day. The patients were encouraged to mobilize with abdominal bandages in the early postoperative period. Abdominal bandages were kept in place for 3 months postoperatively.

The operative time, postoperative mortality and morbidity and hospital stay were recorded. Follow-up was performed by clinical examination every week for the first month and then every three months for the first year and then every six months thereafter to detect complications and recurrence.

Seroma was defined as an accumulation of fluid in the operative field after drain removal, for which percutaneous drainage or aspiration was required. Wound infection was defined as redness...
over the wound and purulent discharge from the incision. Chronic pain was defined as pain which was described by the patient as discomfort preventing daily activities alone.

Data were presented with numbers, percentage, arithmetic mean (X) and standard deviation (SD) and were analyzed with SPSS (version 15) statistical software.

3. Results

From October 2005 through October 2012, 105 patients (13 males and 92 females) with incarcerated and/or strangulated large ventral hernias were operated upon in the Gastrointestinal Surgery Unit, Main Alexandria University Hospital using an onlay polypropylene mesh. Patients’ age, sex, body mass index, American Society of Anesthesiologists (ASA) grade and associated co-morbidities are shown in Table 1. Some patients have more than one co-morbidity.

To ensure careful postoperative monitoring, 15 patients were admitted to the intensive care unit (ICU) after surgery. They were followed up in ICU over one day. They needed noninvasive respiratory support and physiotherapy but no intubation or ventilator therapy.

Data regarding the type of hernia, size of the defect after partial closure without tension, length of hospital stay and postoperative complications are shown in Table 2 and Figs. 1–13. Seventy-eight patients had recurrent hernia, 22 of whom had undergone five or more previous surgeries for repair of such hernias.

Resection anastomosis of non-viable, devitalized or injured small intestine during removal of adherent previous meshes was performed in 19 patients (18%). Complications were encountered in 28 patients and included wound infection with delayed wound healing, seroma formation, chest infection and deep vein thrombosis. The short-term postoperative disorders; i.e. respiratory insufficiency, bowel ischemia, abdominal compartment syndrome and pulmonary embolism were not encountered in the patients of this study. All wound infections were successfully treated by appropriate antibiotics with removal of few stitches for proper healing, seroma formation, chest infection and deep vein thrombosis. The quality of life after surgery was good for all patients, and they were satisfied with the operation. Throughout the study period, only eight patients were lost to follow-up and two died due to unrelated causes. There was no incidence of chronic pain, intestinal obstruction or enterocutaneous fistula. No recurrence and no long-term complications were encountered during the study period.

Table 2

<table>
<thead>
<tr>
<th>Type of ventral hernia</th>
<th>Number of patients</th>
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<tbody>
<tr>
<td>Para-umbilical hernia</td>
<td>5</td>
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<tr>
<td>Incisional</td>
<td>22</td>
</tr>
<tr>
<td>Post-cholecystectomy</td>
<td>6</td>
</tr>
<tr>
<td>Post-appendectomy</td>
<td>2</td>
</tr>
<tr>
<td>Post-Cesarean section</td>
<td>3</td>
</tr>
<tr>
<td>Lumbar incisional hernia</td>
<td>3</td>
</tr>
<tr>
<td>Post-midline abdominal exploratory incision</td>
<td>8</td>
</tr>
<tr>
<td>Recurrent</td>
<td>78</td>
</tr>
<tr>
<td>Para-umbilical hernia</td>
<td>56</td>
</tr>
<tr>
<td>Incisional hernia</td>
<td>22</td>
</tr>
<tr>
<td>Post-Cesarean section</td>
<td>2</td>
</tr>
<tr>
<td>Lumbar incisional hernia</td>
<td>3</td>
</tr>
<tr>
<td>Post-midline abdominal exploratory incision</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 1

<table>
<thead>
<tr>
<th>Patients’ data</th>
<th>Number of patients</th>
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<tr>
<td>Age (in years)</td>
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<tr>
<td>Range</td>
<td>37–83</td>
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<tr>
<td>Mean ± SD</td>
<td>59.3 ± 11.7</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
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<tr>
<td>Male</td>
<td>13</td>
</tr>
<tr>
<td>Female</td>
<td>92</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
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<tr>
<td>&lt;30</td>
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<td>30–35</td>
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<td>35–40</td>
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<tr>
<td>&gt;40 up to 55</td>
<td>27</td>
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<tr>
<td>ASA grade</td>
<td></td>
</tr>
<tr>
<td>I &amp; II</td>
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</tr>
<tr>
<td>III</td>
<td>17</td>
</tr>
<tr>
<td>Associated co-morbidities</td>
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<td>Diabetes Mellitus</td>
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<td>Hypertension</td>
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<td>Liver cirrhosis</td>
<td>13</td>
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<tr>
<td>Chronic bronchitis</td>
<td>18</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>21</td>
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<tr>
<td>Renal failure on dialysis</td>
<td>2</td>
</tr>
<tr>
<td>History of abdominal surgery</td>
<td>7</td>
</tr>
<tr>
<td>for GIT malignancy</td>
<td>6.7</td>
</tr>
</tbody>
</table>

effluent became less than 20 ml. None of the patients required intra- or postoperative blood transfusion. There was one perioperative mortality, she died suddenly just before her discharge on day 11 postoperatively from DVT and massive pulmonary embolism.

Follow-up duration ranged from 13 to 80 months with a mean of 46.8 ± 20.3 months. The quality of life after surgery was good for all patients, and they were satisfied with the operation. Throughout the study period, only eight patients were lost to follow-up and two died due to unrelated causes. There was no incidence of chronic pain, intestinal obstruction or enterocutaneous fistula. No recurrence and no long-term complications were encountered during the study period.

4. Discussion

Large ventral/incisional hernias typically have massive depletion of muscular and fascial tissues. The muscles of the abdominal wall became atrophic and completely diverted from the midline. The skin that covers the sac became very thin and poorly vascularized with dermatitis and infected ulcers. The peritoneum is usually abundant but may also be missing after multiple previous operations. The volume of the abdominal cavity became chronically contracted and diminished because sometimes the entire bowel has been prolapsed into the hernia sac [18,19]. PP mesh is the most commonly used mesh for hernia repairs [20]. Its advantages include its easy use, elasticity, strength, low rate of rejection, well-formed impervious layer is potentially useful for preventing adhesions,
However, the use of such meshes may be associated with seroma and hematoma formation and lower tissue resistance, leading to recurrence [8].

To repair the large ventral hernias in this study, PP mesh was used via an open approach, because of its cost-effectiveness in addition to the above features. There are several different techniques for open repair of ventral hernia according to the site where the surgeon decides to place the mesh; namely, onlay, sublay (preperitoneal/retromuscular), and intraperitoneal anatomical positions [8,10,20].

In this study, the mesh was placed as an onlay patch for several reasons. The abdominal wall in almost all cases was weak and lacerated in multiple areas from removal of previous meshes and placing the mesh as onlay patch in such circumstances would be easier and faster to cover all the disrupted areas of the abdominal wall and the interposed omentum and/or peritoneum as well.

Although onlay positioning has proven to be quick and efficient, it has been associated with a high incidence of postoperative surgical complications such as wound infection, seroma formation, and recurrence [11,21,22]. The onlay positioning was chosen for this study because of the ease of performing it quickly without a large dissecting area.

The sublay or retromuscular approach has had the advantages of minimal adhesion formation, but it requires longer operation time and has a high incidence of local complications, including seroma and hematoma formation because of the large retrorectus muscle dissection, prolonged drainage, and chronic pain [8,23,24].

Intraperitoneal mesh has been associated with dense adhesions and enterocutaneous fistulization. Re-laparotomy after previous incisional hernia repair with intraperitoneally placed PP meshes was associated with more intraoperative and postoperative complications, there were more adhesions requiring adhesiolysis, necessitating small-bowel resections and wound infections [25]. Although a few studies suggest that the intraperitoneal placement of PP mesh does not carry a risk of fistula [26,27], it is generally
accepted that intraperitoneal placement with direct contact of the intestine may cause enterocutaneous fistulization and severe intraabdominal adhesions making future surgery difficult [8, 12, 25]. It could not be concluded that the intraperitoneal application of PP mesh is safe to avoid enterocutaneous fistulization. On the other hand, interposition, either by the omentum or the peritoneum including the hernia sac, was thought to be an important step for preventing adhesion.
From a technical viewpoint, the absence of omental interposition, the presence of a fascial gap, and the pre- and intraperitoneal placement of mesh are regarded as the accepted risk factors for enterocutaneous fistulization associated with prosthetic mesh abdominal wall reconstruction [28]. The interposition of omentum between the mesh and underlying intestine has been proposed as a protective measure while placing PP mesh intraperitoneally [8,12,23,27,29]. However, this measure is not suitable for every patient in case of a lack of satisfactory omental tissue.

With the advent of laparoscopic incisional hernia repair, the intraperitoneal application of mesh is becoming standard [30]. However, these meshes are usually composite ones containing ePTFE and associated with higher costs. There is also a greater
tendency of the ePTFE mesh for shrinkage \[31,32\]. Proper placement of PP meshes in this study with good interposition techniques produces satisfactory results without incurring high costs. The lack of enterocutaneous fistulization after placement of PP meshes in this study is attributed to using the hernia sac as a protective layer for preventing severe adhesions between the mesh and the intestine, in accordance with other studies on using the hernia sac for this purpose \[20,29,33\].

The method of fixation of the mesh can be the cause of acute and chronic pain and postoperative discomfort \[23,30\]. Trans-fascial sutures were believed to predispose to chronic pain after laparoscopic repair of the incisional hernia, probably as a result of nerve entrapment, and extensive tension over the hernia repair is reported to be an important issue for the development of recurrences. Thus, fibrous shrinkage of the mesh over time should be borne in mind while it is being placed \[20\]. As a principle, it is advisable to leave the mesh slack to prevent future shrinkages causing tense repairs, and to avoid primary closure of a large facial defect if it is going to cause tension with the repair. Good fixation and satisfactory overlapping of the mesh over the anterior fascial tissues help prevent future recurrences.

Several studies report high incidences of several postoperative complications including pneumonia, embolism and higher incidence of recurrences \[9\]. The lack of such complications in this study may be due to early mobilization, effective use of low molecular weight heparins, and good surgical techniques.

Wound infection necessitating graft removal is one of the most common complications of hernia repair surgery. Wound infection was reported to be seen in up to 8.5% of patients \[34\]. The acceptable incidence of wound infection in this series is attributed
to the administration of prophylactic antibiotics to every patient, gentle handling of tissues and good hemostasis.

The findings of this study do not support a relation between bowel resection and wound infection. Four of the six patients who developed wound infection with delayed wound healing did not have bowel resection. Only two of the nineteen patients who underwent bowel resection developed wound infection. All cases of wound infections were successfully managed by standard measures without adverse sequelae. Pans et al. [35] reported no wound infection in nine patients who had bowel resection followed by preperitoneal mesh implantation [35]. A recent meta-analysis on the risk factors for mesh related infections after hernia repair surgery estimated the crude mesh infection rate to be 5% [36]. In the present study, none of the 105 patients even those who underwent resection-anastomosis of small intestine developed mesh infection and none developed hernia recurrence.

Seroma formation occurs after 21% of incisional hernia repairs with mesh, making it one of the most common postoperative complications in spite of postoperative drainage. Cystic seroma formation in the subcutaneous abdominal wall may develop in these patients [11,22]. Measures to prevent the accumulation of chronic fluid collections include avoiding the dissection of unnecessary large skin flap, careful using of electrocautery for hemostasis, using the smallest possible PP mesh in direct contact with subcutaneous tissue but it should cover the defect and the adjacent torn anterior abdominal wall, and use of surgical drainage. Therefore, good surgical technique with closed suction drains for a longer period may help prevent seroma formation. In the present study, no cases of cystic seroma formation were reported. The incidence of seroma formation (12/105, 11.4%) reported in the present study is comparable with that reported for elective prosthetic repairs of para-umbilical hernia which ranged from 2.1 to 6% in some studies [37,38].

A follow-up period of at least 3 years is mandatory to assess the recurrence rate correctly [39,40]. The mean follow-up period of 46.8 ± 20.3 months in this study could be accepted as a reliable time period for detecting recurrences after repair of large ventral hernias. These results may be similar to those of other techniques [9,10,21,24,25]. However, low cost and greater ease in the surgical technique is its main advantages. Moreover, the lack of enterocutaneous fistulization and intestinal obstruction and absence of recurrence after a mean follow-up period of 46.8 months may be the result of the simplified and cheaper technique in which the intestine is protected from the mesh by the omentum or the peritoneal mesh implantation [35]. A recent meta-analysis on the risk factors for mesh related infections after hernia repair surgery estimated the crude mesh infection rate to be 5% [36]. In the present study, none of the 105 patients even those who underwent resection-anastomosis of small intestine developed mesh infection and none developed hernia recurrence.

5. Conclusion

Use of PP mesh in the emergency repair of large ventral hernias is safe and cost-effective and is not associated with either major systemic or mesh-related complications. Necessity to perform intestinal resection is not considered a contraindication for prosthetic mesh repair.

The omentum and/or the peritoneum of the hernia sac can be interposed between the viscera and polypropylene mesh safely without mesh related complications.

Creating tension-free repair and avoiding direct contact with intraabdominal viscera are the most important technical points during repair of large ventral hernias with PP meshes, this makes the technique safe, preventing recurrence and enterocutaneous fistulization.

Conflict of interest

There are no specific conflicts of interest.

Funding

No sources of funding as all cases were done in the Main University Hospital with no added costs.

Ethical approval

Ethical approval was given by Ethical Committee of Alexandria Faculty of Medicine.

References


