The Combined Use of Polypropylene and Polyglactin Meshes for A Two Layered Immediate Repair of Large Abdominal Wall Defects Following Tumor Resection

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ABSTRACT

Resection of abdominal wall tumors results in challenging large abdominal wall defects. For the repair of the myofascial component, different composite meshes have been manufactured aiming to minimize adhesions of the nonabsorbable material of the mesh to the bowel, but they may not be available in all institutions. The combination of an absorbable polyglactin and non absorbable polypropylene meshes for a two layered repair of the myofascial defects have been reported with variable results. The aim of this study is to report on the outcome of the use of this technique in our institution. Over a three year period, 28 patients presenting with abdominal wall tumors underwent resection and immediate reconstruction of the myofascial defect with the combined use of polypropylene[Prolene (Ethicon)] and polyglactin [Vicryl (Ethicon)] meshes in a double layered technique. The Overlying skin defect was either closed by mobilization of abdominoplasty flaps or with a tensor fascia lata myocutaneous (TFL) flap. The follow-up period ranged from 6 to 40 months. In the majority of cases the overlying skin defect was closed with mobilized abdominal skin flaps. The complications included wound infections in two patients, wound dehiscence in four other patients, and seromas in another four patients. Three TFL flaps developed distal skin necrosis. Infections were treated conservatively, and dehisced wounds and sloughed flaps’ skin healed spontaneously. All seromas but one responded well to repeated aspirations. Only one patient developed incisional hernia 12 months after surgery. Double layered closure with polyglactin and polypropylene meshes is a simple, safe, and easy and a less expensive way of achieving sound abdominal wall closure once adequate skin coverage is provided.

Key words; abdominal wall repair - prosthetic materials- abdominal wall tumors

INTRODUCTION

Loss of abdominal wall integrity can occur after trauma, infection, or surgical resection. These losses may include skin, muscle or fascia alone, as well as any combination of these components. Those complex defects usually challenge general, plastic and reconstructive surgeons.

In contrast to tissue loss in trauma or infection where the condition of the patient usually precludes single staged reconstruction, elective tumor resection is usually followed by immediate reconstruction for the involved layers.

The methods used would depend on whether the resulting defect is full thickness involving both the skin and the abdominal wall or only the abdominal wall with adequate skin coverage, and whether the condition of the patient allows a single staged or two staged reconstruction.

Once there is adequate skin coverage, the muscle and fascia reconstruction with synthetic materials has become the most common technique(1-2).

However the use of synthetic meshes is not without complications. The use of non absorbable meshes like polypropylene mesh directly over the bowel is commonly attained with complications such as adhesions, migration of the mesh and fistulas. If properly applied with a barrier between it and the gut such as the omentum, or if applied extraperitoneally, those complications are kept to a minimum(3-8).

If the omentum or peritoneum is deficient, a variety of composite meshes have been
suggested in an attempt to minimize those complications. The aim of these designs has been a product that is expected to show strong ingrowth into the abdominal wall while minimizing intestinal adhesion formation. This would normally comprise a non absorbable material lined by an absorbable adhesion barrier. Manufacturers have used different strategies to achieve this goal. In addition to their relatively higher cost, they have the disadvantage that technical errors may occur leading to the exposure of the non absorbable part of the mesh to the bowel.

The combination of a double layered absorbable {Polyglactin 910 [Vicryl (Ethicon)]} and non absorbable meshes {polypropylene [Prolene (Ethicon)]} as an alternative to the composite meshes have been reported clinically and experimentally with variable results. The polyglactin mesh is interposed between the polypropylene mesh and the bowels.

The aim of this study is to report on the outcome of the use of the double layered mesh technique in reconstructing large full thickness abdominal wall defects following tumor resection in our institution.

**PATIENTS & METHODS**

Over a three year period, from January 2006 till December 2009, 28 patients presenting with abdominal wall tumors underwent resection and immediate reconstruction of the abdominal wall defects, at the National Cancer Institute, Cairo University, and Suez Canal University Hospital. There were 6 male and 22 female patients, the ages ranged from 25 to 73 years with a mean age of 36.8 years. The clinical presentation and site of the tumors are summarized in Table (1).

In the majority of patients 23/28 (82.14%), the diameter of the tumor was greater than 10 cm. In the remaining 5 patients, it was less than 10 cm. All cases presented with abdominal wall mass, and regional pain was the commonest symptom.

All tumors were biopsied prior to surgery. Primary soft tissue tumors of the abdominal wall represented the majority of tumors in this study {19 cases (67.8 %)}. All of them except one were desmoids tumors 18(64.3%) (Fig. 1,2). The remaining tumors were malignant visceral tumors either infiltrating the abdominal wall by primary direct infiltration or as a secondary localized metastatic deposit in the abdominal wall. The summary of tumors’ pathology and patterns of their presentations are shown in table (2).

Postoperative morbidities, signs of infection, the presence of enterocutaneous fistulas, signs of herniation, seromas, and oncological follow up were recorded.

**Surgical technique**

All patients received one dose of intravenous antibiotic and low molecular weight heparin preoperatively. The tumor was resected with at least 2cm surgical margin. The skin and the subcutaneous tissue along the defect were dissected free from the underlying abdominal wall fascia and musculature circumferentially.

Closure of the facial defect was done in two layers (double layered technique).

The posterior deep fascial layer was reconstructed using absorbable Polyglactin (Vicryl) mesh sutured in a tension-free manner to the edges of the fascial defect by running 2-0 Vicryl sutures. It provided a barrier between the intestine and the Polypropylene mesh (Fig 1d, and 2e). The anterior fascial layer was reconstructed by nonabsorbable Polypropylene (Prolene) mesh. The mesh should be overlapping the edges of the fascial defect by 2-3 cm and sutured in a tension-free manner using interrupted 0 Prolene (Ethicon) sutures (Fig. 1e, and.2f). In cases where moderate skin resection was done, wound closure was then performed by mobilization of abdominoplasty like flaps in a plane above the external oblique aponeurosis, either in a vertical or horizontal manner depending on the location of the defect (Fig. 1f, and.2h). In larger umbilical or infraumbilical defects with a width of 15 cm or more, a unilateral pedicled TFL flap (Tensor Fascia lata pedicled myocutaneous flap) was considered (Fig.2g,h,i).

The technique of harvesting of TFL is described elsewhere.

In all cases, the fascial defect was reconstructed with the two layered technique described above. The residual omentum left was sufficient to be additionally interposed between the viscera and the vicryl mesh in 4 cases only. The patients were followed up for three years.
RESULTS

There was no perioperative mortality. The mean hospital stay was 8 days (range 6–31 days). At pathologic examination, one patient whose tumor (bladder carcinoma) reached the pubic bone showed microscopic margin infiltration. In the remaining 27 cases, surgical disease-free margin of at least 1 cm was histologically demonstrated. The size of the defects after tumor excision ranged from 56 to 640 cm² (mean, 132.6 cm²). The overlying skin was closed successfully by adequate mobilization of abdominoplasty flaps in 23 cases (82.2%). 20 cases were closed by vertically oriented flaps and in three patients the wound was closed in a reversed transverse abdominoplasty way (Fig. (f)). The tensor fascia lata myocutaneous pedicled flap was utilized to reconstruct the skin defect in the remaining 5 cases (17.8%) (fig.2g,h,i).

In the early postoperative period, pneumonia developed in two patients with complete recovery after medical treatment. Another two patients developed wound infection, four patients developed wound dehiscence and another four patients developed seroma underlying the abdominal skin flaps. Infections were treated conservatively, and dehisced wounds healed spontaneously with local wound care. Three seromas responded well to repeated aspirations and only one seroma persisted for 5 months despite repeated aspirations and formed a pseudo bursa. The latter was treated surgically by curettage of the bursa followed by complete recovery.

Out of the five TFL flaps used, three developed distal skin necrosis that healed spontaneously with conservative treatment (Table (3)).

The follow-up period ranged from 6 to 40 months. The integrity of the abdominal wall repair remained intact throughout the follow up period. Only one patient who had initially presented with a desmoid tumor developed incisional hernia 12 months after surgery. This patient refused further surgical intervention and preferred to use an abdominal binder.

One patient with recurrent desmoid tumor developed another recurrence 6 months after operation at one lateral edge of the wound. Wide resection of the mass with part of the PP mesh and primary fascial closure utilizing the remaining mesh was done. The overlying skin was also closed primarily. Another patient with colorectal carcinoma developed distant metastases 12 months later for which he received chemotherapy, but unfortunately succumbed to his disease few months later. Six patients lost to follow-up after 12 months of their operation, but in their last visit there were no reported problems and clinical examination was unremarkable. Till the end of the follow up period there were no other reported mesh related complications such as entrocutaneous fistulas, wound infections or intestinal obstruction.

All patients reported a postoperative increase in well-being and quality of life, as various activities of daily living could be performed without restrictions.

<table>
<thead>
<tr>
<th>Table (1): Clinical presentation of 28 with abdominal-wall tumor.</th>
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<tbody>
<tr>
<td><strong>Clinical picture</strong></td>
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<td><strong>Clinical presentation</strong></td>
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<tr>
<td>Abdominal pain</td>
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<tr>
<td>Abdominal mass</td>
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<tr>
<td><strong>Site of the mass</strong></td>
</tr>
<tr>
<td>Upper abdomen</td>
</tr>
<tr>
<td>Paraumbilical</td>
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<td>Lower abdomen</td>
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Table (2): Summary of tumors’ pathology and pattern of presentation

<table>
<thead>
<tr>
<th>Pathology Primary Cases</th>
<th>Recurrent cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary soft tissue tumors of abdominal wall</td>
<td></td>
</tr>
<tr>
<td>1- Fibromatosis (desmoid)</td>
<td>10</td>
</tr>
<tr>
<td>2- Soft tissue sarcoma</td>
<td>1</td>
</tr>
<tr>
<td>Secondary Tumors infiltrating abdominal wall</td>
<td></td>
</tr>
<tr>
<td>- Bladder Ca</td>
<td></td>
</tr>
<tr>
<td>1- Squamous Ca (primary direct invasion)</td>
<td>2</td>
</tr>
<tr>
<td>T CC (*)</td>
<td>0</td>
</tr>
<tr>
<td>2- Ovarian cancer (*)</td>
<td>0</td>
</tr>
<tr>
<td>3- Carcinoma of colon (*)</td>
<td>0</td>
</tr>
<tr>
<td>4- Cancer cervix (*)</td>
<td>0</td>
</tr>
</tbody>
</table>

(*)= Secondary deposits after previous primary resection

Table (3): Postoperative complications observed in our series

<table>
<thead>
<tr>
<th>Complication</th>
<th>No. (%)</th>
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<tr>
<td><strong>Local wound and mesh-related complications</strong></td>
<td></td>
</tr>
<tr>
<td>Wound infection</td>
<td>2 (7.1%)</td>
</tr>
<tr>
<td>Simple seromas</td>
<td>3 (10.7%)</td>
</tr>
<tr>
<td>Seroma leading to pseudobursa formation</td>
<td>1 (3.5%)</td>
</tr>
<tr>
<td>Wound dehiscence</td>
<td>4 (14.28%)</td>
</tr>
<tr>
<td>Hernia</td>
<td>1 (3.5%)</td>
</tr>
<tr>
<td><strong>Non mesh-related complications</strong></td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2 (7.1%)</td>
</tr>
<tr>
<td>Partial necrosis of the TFL flap</td>
<td>3 (10.7%)</td>
</tr>
</tbody>
</table>

Fig. 1(a). preop. view of a patient with a large recurrent desmoid tumor of the supraumbilical region.

Fig 1 (b). Preop CT can view showing the extent of the tumor
Fig. 1(c). The tumor after being excised.

Fig. 1(d). The defect following resection and after being reconstructed with the first layer (the vicryl mesh). Note that residual part of the omentum left behind the mesh. Note also the fixation of the mesh to the costal margin.

Fig. 1(e). The insertion of the second layer (the polypropylene mesh).

Fig. 1(f). Two days postoperative view showing primary wound closure with reversed abdominoplasty technique.

Fig. 1(g). Two months postoperative view of same patient in Fig 1(e) showing the right lateral part of the wound healed spontaneously after wound dehiscence.
Fig. 2(a). Preop. view of a patient presenting with recurrent abdominal wall desmoids tumor.

Fig. 2(b). Preoperative CT can view showing the extent of the tumor.

Fig. 2(c&d). Resection of the tumor with parts of lower ribs and left copula of diaphragm.

Fig. 2(e). The defect after being reconstructed with the first layer (the vicryl mesh). Note that the insufficient omentum left to protect part of the viscera.

Fig. 2(f&g). The insertion of the second layer (the polypropylene mesh) with harvesting TFL flap to cover the lower part of defect.
DISCUSSION

Large defects of abdominal wall may arise following resection of primary soft tissue tumors or secondary tumors directly invading abdominal wall.

In this anatomical region, desmoids are the commonest primary soft tissue tumors (47%), followed by dermatofibrosarcoma protuberanse (24%) and then soft tissue sarcomas. The treatment approach of all these three diseases again remains to be complete resection to achieve adequate local control, and hence immediate reconstruction of the resulting composite defect and protection of the exposed viscera is essential.

Rohrich has classified the abdominal wall defects into either complete defect, involving one component; skin or muscle and fascia.

The general agreement is that for large skin defects greater than 15 cm, the soft tissue reconstruction can be done by a variety of available distant pedicled or free cutaneous or myocutaneous flaps. We believe that other factors such as the thickness and the quality of the adjacent skin and the body habitus of the patient additionally contribute significantly to the surgeon’s decision for the choice of the method of skin closure. In the present study, only five cases presenting with composite infraumbilical defects were reconstructed with TFL. The patient’s body habitus, together with their thin stretched skin, and the width and the location of the defect were the main reasons why the TFL was chosen. The distal necrosis of the TFL flap is not uncommon.

We believe that harvesting of the flap beyond its safe distal limits was miscalculated and was probably the reason for the partial necrosis that has occurred in three flaps in this series. The flap should have been harvested with its most distal edge at least 10 cm from the knee joint.

Nonetheless, wound dehiscence occurred in 4 other patients from the remaining group of patients who had their wounds closed directly by mobilization of the abdominal skin flaps. Closure under tension should be strongly avoided and both patients and surgeons should be prepared for the use of alternative reconstructive methods to achieve comfortable skin closure for those relatively larger defects. Fortunately, all the dehisced wounds and sloughed areas of the TFL flap in the present study healed spontaneously with repeated dressings without further consequences to the underlying double meshes.

The choices for abdominal fascia /muscle reconstruction can be either a prosthesis or an autogenous fascial substitute. The use of autogenous fascial substitutes carries their own donor site morbidities.

In addition, autogenous tissues such as the facial part of the TFL alone may not be strong enough to withstand high intra abdominal pressure and mixed data have been reported on its adequacy as a fascial substitute. Hence, the need to reinforce the flap’s repair with a mesh has been suggested by some.
Polypropylene mesh has been and is still the commonest mesh used in reconstruction of the abdominal wall defects\(^{(22)}\).

As a result of its macroporous structure, the mesh induces intense fibrovascular infiltration and incorporates into the surrounding myofascial tissue to provide a strong repair. However, it is also associated with adhesions to intra-abdominal viscera and enterocutaneous fistula formation if placed directly over the intestine\(^{(3-5,23)}\).

Nonetheless, absorbable meshes cannot be used alone when placed intraperitoneally, as they are fully absorbed after 90 days. They have been used commonly as a temporary method of closure of large abdominal wounds in the unstable patient\(^{(24-25)}\).

With the increasing popularity of laparoscopic ventral hernia repairs, many combination meshes have been designed for intraperitoneal placement. The goal of these designs has been a product that demonstrates strong in-growth into the abdominal wall while minimizing intestinal adhesion formation. Manufacturers have used different strategies to achieve this goal. Some place polypropylene against the abdominal wall for strong in-growth and PTFE (polytetrafluoroethylene) toward the bowel for minimal adhesion formation.

Seprafilm (Genzyme) can be used with polypropylene mesh for strong incorporation to the abdominal wall with coating the viscera with an absorbable adhesion barrier\(^{(6)}\). However, the data are mixed; some studies reported that a higher rate of intestinal complications is associated with polypropylene/PTFE mesh, possibly suggesting that the polypropylene side of the mesh material is exposed to bowel as a result of technical error during placement\(^{(26)}\). An additional disadvantage of combination mesh materials is the extra care required to place the mesh to avoid exposure of the bowel to mesh material that may cause dense adhesions. Other studies reported that Seprafilm/polypropylene mesh was associated with more mechanical failure than other types of mesh\(^{(69)}\).

Further more, the latter mentioned composite meshes are found to be expensive in developing countries.

In the present study, all the defects were full thickness defects reflecting from the delayed presentation of our patients referred from other remote underserved areas. The remaining part of omentum left after adequate excision of the tumors was enough to provide an adequate barrier between a non absorbable prosthesis such as polypropylene and the gut only in four cases, hence the need to interpose an easily available material such as the polyglactin mesh.

The idea of interposing an absorbable vicryl polyglactin 910 (Vicryl, Ethicon) mesh between the prosthetic nonabsorbable mesh and the viscera, when primary peritoneal closure is not possible or omentum is not available is not new. Various clinical and experimental reports have been reported\(^{(7-10,27)}\).

The clinical findings in this study suggested that vicryl mesh caused no or minimal adhesions as evidenced by the absence of enterocutaneous fistulas or adhesive intestinal obstruction in the long term follow up. Our results compare favorably with previous clinical reports\(^{(7-9,28)}\).

Furthermore, other experimental studies confirmed that adhesions between mesh and bowel are minimal and decreases as the Vicryl dissolves\(^{(29-30)}\). The latter studies concluded that Vicryl mesh provided the best long-term protection against adhesions.

Nevertheless, some other experimental and clinical studies were not conclusive with respect to the efficacy of the interposition of the polyglactin mesh in preventing these complications\(^{(10,31-33)}\).

Others have confirmed histologically the evidence of strong fibrosis with extensive scar formation around the mesh and an incomplete mesothelial cell layer by comparing different types of barriers between the prosthesis and the viscera\(^{(34)}\). The latter authors believed that this was an effect of the quantity of polyglactin rather than the material itself, explaining the more favorable results this material in the previously mentioned studies.

In clinical practice and the current study, the evaluation of adhesions relies mainly on our clinical observations. Some authors suggested the use of Ultrasound to detect adhesions, but this technique, although it has high accuracy, needs further evaluation\(^{(35)}\).

Despite the disagreement by others, we believe that combining vicryl with prolene is far less expensive than utilizing the composite meshes available in the market.
With regards to the adequacy of this double layered mesh closure, in the long term follow up there was only one recurrent hernia in this study. This is certainly attributed to the adequacy of the repair with the nonabsorbable prolene mesh. The use of non absorbable mesh in general has been reported to be associated with a recurrence rate of 3 to 17 percent in the repair of “difficult” ventral incisional hernias.

In the absence of contamination, the infection rate related to mesh repair for hernias has been reported to range from 0.8 to 10%.

In the present study the infection rate was acceptable. This is probably related to elective nature of the abdominal wall repair following tumor resection in contrast to an emergency laparotomy. Our result compares favorably with others in this regard.

In conclusion, the abdominal wall defects following tumor resection in which major exposure of the viscera is present, double layered closure with vicryl and prolene meshes is simple, safe, easy and a less expensive way of achieving sound abdominal wall closure with minimal complications once adequate skin coverage is provided. Perhaps, a large prospective randomized trial comparing the clinical outcome of abdominal wall reconstruction with a double layered mesh with another type of the composite meshes available in the market may provide an evidence based support for which technique to use.

REFERENCES


