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ORIGINAL ARTICLE

Posterior components separation during retromuscular hernia repair

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Abstract
Background Retromuscular ventral hernia repair with mesh is a durable technique. In this paper, we describe a novel technique which allows for significant mesh overlap via the retromuscular space in cases of massive ventral hernia.
Methods The retromuscular space is developed laterally, to the edge of the rectus sheath. The posterior rectus sheath is incised, dividing the posterior aponeurosis of the internal oblique. The dissection is carried out laterally between the internal oblique and the transversus abdominis muscle, creating space for a large mesh underlay.
Results We have performed this technique successfully in 20 patients with a mean defect area of 223 cm^2 and a mean mesh area of 698 cm^2. Three patients developed wound complications and none complained of long-term pain or abdominal wall deformity. There has been one recurrence due to technical error after a mean 12-month follow-up.
Conclusion This technique of dissection between the internal oblique and transversus abdominis muscles allows for the closure of large hernia defects. The mechanism is two-fold: (1) mobility for closure of the posterior rectus sheath, dorsal to the prosthetic; and (2) increased mobility of the rectus, internal, and external obliques, allowing reconstruction of the linea alba.

Keywords Hernia · Mesh/prosthetic · Surgery · Retromuscular · Components separation

Introduction

The components separation technique (CST), described by Ramirez et al. [1], requires an extensive subcutaneous flap elevation, incision of the external oblique aponeurosis, and incision of the posterior rectus sheath, thus, allowing the rectus muscles to slide medially for primary closure of large abdominal wall defects. Although effective, the largest series of CST demonstrated a wound infection rate of 26% and a hernia recurrence rate of 22% [2]. The retromuscular hernia repair with mesh, as described by Rives and Stoppa [3, 4], has proven to be a durable technique for ventral hernia defects, and completely avoids subcutaneous flap elevation. Technically, the retromuscular technique requires developing the space dorsal to the rectus abdominis muscles up to the edge of the rectus sheath. In the average patient, this translates into a 6–8-cm lateral space on each side of the midline. The repair of large hernia defects with diameters greater than 15 cm may require larger mesh overlap than can be afforded by dissection limited to the confines of the rectus sheath. By incising the posterior rectus sheath and creating the plane between the internal oblique and transversus abdominis muscles, there is a space virtually unlimited in size in which to place large prostheses for hernia repair. We present our novel posterior components separation technique (PCST) in this paper and

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describe the first experience with its use in 20 patients with large ventral hernias.

Materials and methods

A prospectively maintained hernia database was reviewed to identify patients who had undergone PCST during retromuscular ventral hernia repair. The determination to utilize the technique was made on a per-case basis by the primary author (AMC) if it was felt that a wider area of dissection was required to place a large prosthetic. Typically, this meant if the horizontal diameter of the defect exceeded 10 cm. The operative technique of PCST is described in detail and specific patient outcomes analyzed.

Figure 1 depicts the cross-sectional anatomy of a typical midline hernia defect. A midline laparotomy is performed with the complete lysis of adhesions. The retromuscular space is developed by incising the posterior rectus sheath and dissecting the rectus muscle anteriorly (Fig. 2). Once the lateral-most edge of the rectus sheath is reached, the posterior rectus sheath is incised, dividing the posterior aponeurotic sheath of the internal oblique muscle (Fig. 3). This allows access to the plane between the internal oblique and transversus abdominis muscles. Below the semicircular line of Douglas where the posterior rectus sheath terminates, it is the space ventral to the transversalis fascia which is entered. The dissection is carried out as far lateral, inferior, and superior desired, allowing for a large mesh underlay. Hernia defects in close proximity to the xiphoid process require cephalad dissection into the retroxiphoidal space, as described by Conze et al. [5]. The posterior rectus sheath is then reapproximated in the midline with a running absorbable suture. The mesh is placed in the retromuscular space and secured with full-thickness, transabdominal, permanent sutures using the Reverdin needle. The anterior rectus sheath is then reapproximated in the midline to cover the mesh if it can be brought together without undue tension (Fig. 4).

Results

We have performed PCST successfully in 20 patients (14 females, 6 males). The mean patient age was 51 years (range 35–64 years), with a mean body mass index (BMI) of 31.5 kg/m^2 (range 21.6–39 kg/m^2). The defect area averaged 223 cm^2 (range 48–800 cm^2), with a mean horizontal dimension of 11.9 cm (range 3–25 cm), and a mean vertical dimension of 17.1 cm (range 8–32 cm). The mean mesh area was 698 cm^2 (range 128–1,500 cm^2). Anterior rectus sheath closure was possible in 17/20 (85%) patients. The three patients in whom we were unable to close the anterior rectus sheath were among the first four patients in our experience of performing this procedure. Their defects were of sizes 15 × 15 cm, 22 × 22 cm, and 25 × 32 cm, horizontally by vertically, respectively. Simultaneous panniculectomy was performed in 5/20 (25%) patients. One patient with a 16 × 22-cm hernia defect with loss of abdominal domain underwent 3 weeks of outpatient, progressive preoperative pneumoperitoneum prior to definitive PCST hernia repair. The operative time averaged 248 min (range 190–480 min). The mean length of stay was 6.4 days (range 3–21 days). Postoperative complications occurred in eight patients (40%); wound complication (3), pneumonia (1), bowel obstruction (1), bowel obstruction and pulmonary embolism (1), ventricular tachycardia (1), and myocardial infarction (1). One patient died on the

Fig. 1 Illustration demonstrating a midline hernia with normal abdominal wall musculature

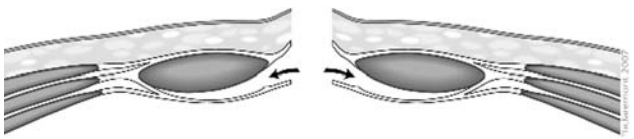

Fig. 2 The retromuscular space is developed by incising the posterior rectus sheath and dissecting the rectus anteriorly

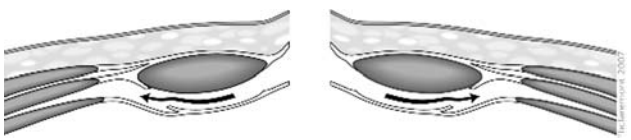

Fig. 3 Once the lateral edge of the rectus sheath is reached, the posterior rectus sheath is incised, dividing the posterior aponeurotic sheath of the internal oblique muscle. This allows access to the plane between the internal oblique and transversus abdominis muscles

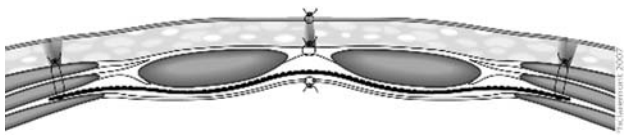

Fig. 4 The posterior rectus sheath is reapproximated in the midline, and the mesh is placed in the retromuscular space. The anterior rectus sheath is then reapproximated in the midline on top of the mesh

third postoperative day of multisystem organ failure from an acute myocardial infarction despite, a normal preoperative cardiac stress test. One patient died of metastatic lung cancer over 1 year after surgery. After a mean follow-up of 10 months (range 1–27 months), none of the patients complained of long-term pain of the abdominal wall or abdominal wall dysfunction. Focused physical examinations did not reveal any abdominal wall paralysis, ptosis, or asymmetry. One patient developed a small recurrence directly below the xiphoid sternum. This recurrence was likely to be technical, from failure to develop the retroxiphoidal space, resulting in an inadequate overlap of mesh behind the sternum.

Discussion

The original description of the retromuscular repair of large ventral hernias describes the dissection of the posterior rectus sheath off of the rectus muscles to create the space for prosthetic implantation [3, 4]. This dissection, however, is limited by the lateral-most extent of the rectus sheath. In hernias with large transverse diameters, this retromuscular space may not be large enough to accommodate a prosthetic which can achieve significant enough mesh-defect overlap. For this reason, an alternate space for the placement of the mesh might be chosen. Both the intraperitoneal position and the preperitoneal space are essentially unlimited in size, can accommodate massive prostheses, and repairs based on these layers have shown durable results [6, 7]. The intraperitoneal onlay repair, however, requires the use of a tissue-separating mesh, since the bowel remains in contact with the prosthetic. The preperitoneal space may be difficult to develop in the multiply-operated abdomen, particularly if a prosthetic has been previously utilized. Additionally, complete closure of the peritoneum in the midline prior to mesh placement can be made difficult by the fragile nature of the tissue itself. PCST allows for wide placement of a prosthetic outside of the rectus sheath, in the interparietal space between the internal oblique and transversus abdominis muscles.

Our PCST during retromuscular hernia serves two purposes. First, medial mobilization of the transversus abdominis muscle with accompanying posterior rectus sheath. This results in less tension and complete closure of a layer of abdominal wall dorsal to the prosthetic mesh. Second, medial mobilization of the internal and external obliques with accompanying anterior rectus sheath and muscles. In most cases, this allows for complete closure of the anterior abdominal wall over the prosthetic, obliterating the hernia defect.

Since the retromuscular repair of incisional hernias is not widely performed in the United States, we have found this space to be relatively undisturbed in most patients with multiply-recurrent hernias. The posterior rectus sheath has inherent strength, which holds sutures well, even under tension, making it an ideal layer to close dorsal to a prosthetic mesh. During retromuscular hernia repairs, as the transverse diameter of hernia defects increases, so does the difficulty in approximating the posterior rectus sheath beneath and the anterior rectus sheath above the prosthetic mesh. Petersen et al. [8] demonstrated the importance of closure of the rectus sheath ventral to a prosthetic during the retromuscular repair of incisional hernias. He found the risk of deep prosthetic infection in patients in which he was unable to close the rectus sheath on top of the mesh to be 13 times higher than patients who received closure over the mesh. In our series, 1 of 17 patients (5.8%) who had closure over the mesh developed wound breakdown and mesh exposure, while 2 of the 3 (66%) without anterior closure over the mesh suffered the same fate. Fortunately, all mesh exposures were managed with local wound care and none required prosthetic excision. By creating significant medial mobilization of the rectus muscles and closure ventral to the prosthetic, our PCST has the potential to decrease the risk of prosthetic exposure, should a wound complication occur. Since the series is small, however, it is difficult to draw any statistical conclusions regarding this.

An additional benefit of our technique is the lack of large subcutaneous flap elevation, which is one of the major criticisms of the CST described by Ramirez et al. [1]. This maneuver predisposes to large seroma formation as a result of the dead space created. Additionally, the sacrifice of the cutaneous perforators of the epigastric arcade to the skin places the medial wound edges at risk of ischemia, which is likely to be why the wound complication rate approaches 30% in most large series of the Ramirez technique [9]. Our PCST obviates the need for subcutaneous flaps since the dissection plane is interparietal, lying just lateral to the retrorectus plane used for the Rives-Stoppa repair. Despite this benefit, 3 of 20 patients (15%) developed postoperative wound complications in our small series. All three patients underwent excision of redundant dermis and hernia sac, and there remained a large dead space with skin thinner than 1 cm adjacent to the midline wound in these patients. These patients were also obese, with a significant tobacco use history, which are well-known risk factors for wound complications.

The anterolateral portion of the abdominal wall and the rectus muscles are supplied by the anterior rami of the 7th–12th thoracic nerves, which course between the internal oblique and transversus muscles before they penetrate the posterior rectus sheath. The first lumbar nerve courses between the internal oblique and transversus muscles for a short distance before passing through the internal oblique muscle to course between the internal and external oblique

muscles. Additional innervation to the lateral muscles comes from individual lateral cutaneous nerve branches, which form off each aforementioned anterior rami. Surgical dictum has taught that sectioning of more than one of these nerves can result in rectus paralysis and abdominal wall weakness. Although every effort is made to preserve these nerves during the traditional retromuscular hernia repair and our PCST, which potentiates the space where these nerves lie, occasional sacrifice of the nerves is required for adequate mesh placement. We believe that abdominal wall paralysis after retromuscular hernia repair is an exceedingly rare complication with no published reports in the medical literature. It seems plausible that a paralysis might be masked by the presence of a prosthetic reinforcing the denervated musculature, which might explain why it has never been reported. On the other hand, flank bulge and abdominal wall paralysis has been well described after flank incisions used for nephrectomy, adrenalectomy, and retroperitoneal aortic surgery [10, 11]. During these procedures, if the incision is extended into the rib interspace, damage to the proximal nerve branches is possible. Since retromuscular hernia repairs occasionally sacrifice the distal-most aspect of these nerves, paralysis is much less likely. In our series of 20 patients, there were no patients who complained of persistent postoperative pain within the abdominal wall. Additionally, none appeared to have abdominal wall asymmetry or bulge, consistent with a denervation injury, on follow-up examination. Although no clinical signs were evident, without performing an electromyelogram study of the abdominal wall musculature in each patient, we cannot definitively say that denervation or paralysis has not occurred in our patients. A future direction of our group includes the objective evaluation and quantification of abdominal wall function before and after surgery in these difficult hernia patients.

A potential criticism of this technique may be the use of the interparietal space between the transversus abdominis and internal oblique which contains the lateral cutaneous nerve branches. Why not access the space between the internal and external oblique muscles, avoiding the concern of nerve transection altogether? We feel that it is more desirable to have the intra-abdominal forces acting on the mesh, as it lies against the thicker backstop of an intact internal and external oblique muscle layer, rather than the single muscle layer of the external oblique, should the mesh be placed more superficially.

Conclusion

Our modified technique of retromuscular ventral hernia repair, dissecting laterally outside of the rectus sheath, and developing the interparietal space between the internal oblique and transversus abdominis muscles accomplishes two objectives. First, it allows for medial mobility in reapproximating the posterior rectus sheath in the midline, for exclusion of the prosthetic from the visceral cavity. Second, it allows for mobility of the internal and external obliques with the anterior rectus sheath and muscles to reapproximate them in the midline, on top of the mesh. This results in a total anatomic repair of the abdominal wall with prosthetic reinforcement. The posterior components separation technique (PCST) appears to be safe and feasible in the hands of surgeons comfortable with the retromuscular repair of Rives-Stoppa, providing an expansive space for the placement of large prostheses, with durable short-term results.

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