Modern Management of Abdominal Wall Hernias

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Although one of the most commonly performed operations in the United States (US), much debate exists regarding the optimal approach for ventral hernia repair (VHR). Over 4 million laparotomies are performed annually, with a resulting incisional hernia rate of 20% or higher.1,2 Nearly 350 000 hernia repairs were performed in 2006, excluding the federal Veterans Affairs system, with a significant annual increase in inpatient cases over the previous 5 years.2 Mesh herniorrhaphy is clearly superior to suture repair alone, the latter resulting in a 63% recurrence rate. Recurrence after mesh repair, however, remains as high as 32% in long-term follow-up,3 in spite of the many advances made in mesh materials, surgical technique, and perioperative care.

Meaningful interpretation of the hernia literature is difficult due to the innumerable combinations of surgical approach, operative technique, mesh selection, mesh fixation method, mesh position, and perioperative management. Heterogeneity of study populations, lack of long-term follow-up, and non-standard language used in reporting techniques and outcomes add to the difficulty. The majority of studies report outcomes over 1-2 years, with relatively few reporting results 5 or 10 years after repair. Wound complications are frequently cited outcomes for VHR, but can encompass a wide range of events, depending on the study. The Centers for Disease Control and Prevention (CDC) has specific definitions for surgical site infections (SSI), including classification into superficial, deep, and organ space infections. Surgical site occurrence (SSO) is a broader term that encompasses all SSIs, as well as other wound events that incur morbidity, but do not meet the criteria for infection, such as seroma, hematoma, skin dehiscence, skin necrosis, cellulitis, and suture granuloma/abscess. Mesh position in the abdominal wall has a significant impact on postoperative complications, including recurrence, but is often inadequately reported in the literature.

This article presents an overview of the current state of abdominal wall hernia repair techniques and prevention, including recent advances and quality initiatives that hold promise to standardize and improve outcomes of this common surgical procedure.

Indication for Surgery
Apart from asymptomatic, small umbilical defects measuring less than 2 cm and containing only fat, most abdominal wall hernias warrant surgical repair, as long as the patient is medically able to tolerate the operation. Watchful waiting is generally safe, and the risk of requiring emergency hernia surgery is approximately 4% over 5 years, though crossover from watchful waiting to elective repair approaches 20%.3 However, the risk for progressively worsening symptoms, acute incarceration, strangulation, and obstruction should be considered since emergent hernia repair confers a significantly higher risk for bowel resection, need for reoperation, hospital readmission, and 30-day mortality.4 Hernias will enlarge over time, becoming increasingly complex and more challenging to repair, which increases the risk for perioperative complications. Surgical repair can be managed in an open fashion, or by a minimally invasive approach with laparoscopy or robotic surgery, depending on patient risk factors, hernia morphology, and surgeon expertise.

Open Surgery
Open surgery remains the most common approach, accounting for approximately 75% of cases.5 This approach involves an incision directly over the hernia defect, reduction of herniated contents into the visceral cavity, and closure of the fascial defect with or without mesh reinforcement. This approach is particularly useful for very small, primary hernia defects, such as umbilical and epigastric hernias, as well as for very large hernias that are not amenable to a minimally invasive approach. However,
there is great heterogeneity in the specific technical aspects of open VHR (OVHR). Suture repair is appropriate for small primary hernias with acceptable recurrence rates of less than 10%. For defects larger than 2-3 cm, and most incisional hernias, mesh reinforcement is necessary. Mesh selection among surgeons varies widely, as does its position against the abdominal wall and technique of mesh fixation, which are discussed further below. Compared to minimally invasive approaches, open hernia repair generally has a higher rate of postoperative SSI and SSO, though this varies according to technique and mesh position.

Various adjuncts to OVHR have also been described to aid in the closure of abdominal wall defects. Often collectively called “component separation,” these include various techniques that separate the musculofascial layers of the abdominal wall to allow sliding of the muscular components back to the midline and decrease tension on the closure. First described by Oscar Ramirez, “component separation” begins with elevation of the skin and subcutaneous tissues off of the anterior abdominal wall fascia, followed stepwise by release of the posterior rectus sheath, then the external oblique aponeurosis to allow reconstruction of the midline fascia. This technique allows for closure of defects up to 20 cm by allowing approximately 8-10 cm medialization of the rectus sheath bilaterally. Though effective for defect closure, the technique carries significant morbidity, with nearly half of patients experiencing wound complications. Several modifications of the originally described technique, such as minimally invasive component separation and endoscopic component separation, have been introduced with improvement in wound morbidity. Release of the rectus sheath was actually described by Jean Rives, though not previously termed “component separation.” This technique involves separation of the posterior rectus sheath from the rectus muscle, continuing laterally up to the linea semilunaris, and extended superiorly and inferiorly to allow mesh overlap of the hernia defect. The posterior sheath is then closed, thus excluding the viscera; mesh is placed behind the muscle (“sublay”), and the anterior midline fascia is closed over the mesh. If additional mobilization is required, a transversus abdominis release (TAR) may be performed, which involves division of the transversus abdominis muscle and fascia with dissection of the plane between the muscle and peritoneum laterally. This minimizes subcutaneous dissection, allows myofascial release to decrease midline tension, and permits wide mesh coverage in a well vascularized compartment separated from the visceral cavity. Many hold this as the gold standard for OVHR, and is the authors’ preferred technique. However, its adoption is relatively low, at an estimated 13%. Table 1 summarizes selected studies of OVHR using the Rives-Stoppa technique.

**Laparoscopic Surgery**

Laparoscopic VHR (LVHR) was first described in 1993 by LeBlanc and Booth, and was adopted fairly widely, peaking at its current rate of approximately 20%-25% of hernia repairs. LVHR is performed through multiple small incisions peripheral to the hernia defect, with mesh placed against the underside of the abdominal wall, in an intraperitoneal position. Intraperitoneal mesh placement mandates some form of mesh fixation, most commonly with transfascial sutures or tacks, and a barrier coating on the mesh to minimize visceral adhesions. This approach significantly reduces the incidence of SSO and SSI related to hernia repair. Hernia recurrence, however, is essentially unchanged from that of OVHR in several more recent studies with longer follow-up. Unlike most minimally invasive procedures, LVHR is not necessarily less painful than OVHR. Patient satisfaction and quality of life can be negatively impacted by bridging larger defects with intraperitoneal mesh, resulting in eventration of the mesh through the previous defect (“pseudorecurrence”). This has been somewhat mitigated by the current trend of transcutaneous closure of the central hernia defect, which also appears to lower the risk of seroma and, possibly, recurrence. Additionally, there is the potential of long-term morbidity with intraperitoneal mesh,

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Study Type</th>
<th>N</th>
<th>Follow-up (months)</th>
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<th>SSI</th>
<th>Recurrence</th>
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<td>McLanahan</td>
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<td>Iqbal</td>
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<td>0.8%</td>
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<td>1.1%</td>
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<tr>
<td>Novitsky</td>
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<td>15.7%</td>
<td>--</td>
</tr>
<tr>
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<td>17</td>
<td>37.7%</td>
<td>19.6%</td>
<td>16.9%</td>
</tr>
</tbody>
</table>

R, Retrospective; P, Prospective
including delayed or secondary mesh infection, enteroprosthetic fistula, and complicated adhesiolysis at the time of future operations. As many as 25% of patients will require a subsequent abdominal operation after hernia repair, and bowel injury or resection at the time of reoperation in the presence of intraperitoneal mesh occurs in up to 20% of cases. Postoperative SSI rate after the subsequent operation is also significantly higher and can result in secondary mesh infection. Tables 2 and 3 summarize selected literature on LVHR and laparoscopic versus open trials, respectively.

Robotic Surgery

More recently, robotic surgery has emerged as an alternative to laparoscopy for minimally invasive hernia repair. The robotic platform affords several benefits, including enhanced 3D visualization, tremor elimination, and articulating instruments. Published experience with robotic VHR to date essentially reproduces LVHR, with intraperitoneal mesh placement. Robotic technology, however, makes hernia defect closure technically easier to perform intracorporeally, and eliminates the need for multiple additional stab incisions necessary for transcutaneous closure. Intraperitoneal mesh securement can also be easily performed with circumferential suturing of the mesh rather than transabdominal wall sutures or tacks, anecdotally decreasing both early and late pain associated with standard laparoscopic repair. Potential future complications associated with intraperitoneal mesh, however, remain a risk with this approach.

The authors have utilized robotic technology to develop a technique that replicates the open retromuscular (RM) repair, including transversus abdominis release, thus facilitating a true abdominal wall reconstruction and placement of mesh in an extraperitoneal position. The initial experience with this approach was compared to a matched cohort of similar open RM hernia repairs. Twenty-one patients in each arm were compared, with a similar incidence of SSI (9.8% vs. 0%; \( P = .48 \)), equivalent recurrence rate, and similar direct hospital cost. The hospital length of stay (LOS), however, was significantly shorter following robotic RM repair (2.3 vs. 4.2 days; \( P = .046 \)). The authors have currently performed over 100 robotic RM hernia repairs, with continued benefit in LOS and SSI.

Prevention

In no area of medicine is the adage that “an ounce of prevention is worth a pound of cure” more applicable than in hernia surgery. For the most common complication following a laparotomy, more effort could be placed on reducing the likelihood that an incisional hernia may result. There are known patient factors that contribute to the formation of incisional hernia. Morbid obesity and chronic cough produce significant mechanical stress on the abdominal wall. Collagen synthesis may be impaired by tobacco abuse, poorly controlled diabetes, chronic steroid therapy, and previous wound infection. These factors can often be mitigated when anticipating elective hernia surgery. Efforts to encourage weight loss and tobacco cessation prior to surgery have been implemented to improve postoperative outcomes. Better control of glucose as measured by the hemoglobin A1C level and treatment of methicillin-resistant Staphylococcus aureus (MRSA) colonization have also been employed to minimize infectious complications.

Unfortunately, it is often very difficult to control these potential patient factors prior to the index surgery that results in hernia formation. Many times, abdominal surgeries cannot be delayed because they are emergent in presentation or the indication for surgery carries some urgency, such as in the case of malignancy. By identifying certain high-risk patients, maneuvers can be utilized at the time of surgery in an effort to minimize the

<table>
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<tr>
<th>Author</th>
<th>Year</th>
<th>Type</th>
<th>N</th>
<th>Follow-up (months)</th>
<th>SSO</th>
<th>SSI</th>
<th>Recurrence</th>
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<tr>
<td>Rosen</td>
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<td>R</td>
<td>100</td>
<td>30</td>
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<td>17.0%</td>
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<td>Heniford</td>
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<td>4.7%</td>
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<td>Bower</td>
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<td>R</td>
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<tr>
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<td>R</td>
<td>277</td>
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<tr>
<td>Banerjee</td>
<td>2012</td>
<td>R</td>
<td>193</td>
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<td>NR</td>
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<tr>
<td>Sasse</td>
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<td>R</td>
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<td>Chelala</td>
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<td>Carter</td>
<td>2014</td>
<td>R</td>
<td>201</td>
<td>39</td>
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<td>12.4%</td>
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risk of hernia. Patient populations that are at high risk for hernia formation have been identified. Those patients undergoing open repair of abdominal aortic aneurysms carry an incisional hernia rate greater than 30%. This is most likely due to a genetic defect in collagen, which is present both in the wall of the aorta that becomes aneurysmal and the abdominal wall. Patients undergoing either creation of an ostomy or reversal of an ostomy pose a difficult challenge to the hernia surgeon. The incidence of parastomal hernia formation (development hernia at the ostomy site) varies widely in the literature from 30% to 60%. The incidence rises in studies where incidence is defined by appearance on computed tomography. Some authors argue that by definition an ostomy is a hernia, given that a segment of intestine is being brought through a fascial defect to reach the skin. The concern for hernia is not over for the patient once the ostomy is reversed, as the rates of hernia formation at the prior ostomy site are as high as 35%.33

Two specific closure techniques have been prospectively shown to reduce the incidence of hernia following laparotomy. First, closure of the midline fascia using a small bite technique and a small gauge (2-0) suture with at least a 4:1 suture-to-wound length ratio has now been evaluated in 2 randomized control trials, reducing the hernia rate from 18.0% to 5.6% in one study,34 and 21% to 13% in the second.35 Second, the placement of prophylactic mesh at the time of laparotomy closure in high-risk patients has been shown to reduce incisional hernia formation.

Following open gastric bypass, the use of a biologic mesh to reinforce the laparotomy closure was shown to reduce the incidence of incisional hernia to 2.7% compared to 17.7% in the traditional closure group without mesh in one study.36 Synthetic mesh has also proven effective in hernia prevention without increased mesh-related complications. A prospective randomized control trial of 107 patients undergoing elective or colorectal surgery demonstrated a reduction in the incidence of hernia from 31.5% to 11.3%, with no difference in SSI.37 Several other studies have also demonstrated the benefits of mesh reinforcement of the midline closure in high-risk patients, with a variety of mesh types and surgical techniques employed.38-40 Further investigation is needed to determine which patients will ultimately benefit from this intervention, as it has the potential for additional cost and morbidity.

Mesh Materials

Hernia surgeons are faced with a veritable cornucopia of mesh options, including absorbable synthetic mesh, permanent synthetic mesh, and biologic mesh (Fig. 1, Page 42). Synthetic mesh can be absorbable, or permanent, with or without an adhesive barrier coating. Absorbable mesh is designed for temporary reinforcement of the abdominal wall, often in the setting of wound contamination, and allows native tissue ingrowth with no remaining permanent material in the operative field. The recently published COBRA study, in which the authors were a participating center, is the only published trial of synthetic absorbable mesh in contaminated and clean-contaminated VHR. Incidence of SSO was 28%, with 18% SSIs, and recurrence at 2 years of just 17%.41 This compares very favorably against the similarly designed RICH trial, in which porcine biologic mesh was used for VHR, which reported a 66% SSO rate, and recurrence rate at 2 years of 28%.42

Permanent mesh is composed of polypropylene (PP), polyester (PE), polytetrafluoroethylene

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**Table 3**

Laparoscopic versus open ventral hernia repair: selected trials.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Study Type</th>
<th>N (open)</th>
<th>N (lap)</th>
<th>Open Technique</th>
<th>Follow-up (months)</th>
<th>SSO (open)</th>
<th>SSO (lap)</th>
<th>SSI (open)</th>
<th>SSI (lap)</th>
<th>Recurrence (open)</th>
<th>Recurrence (lap)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>P</td>
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<td>85</td>
<td>RM</td>
<td>24</td>
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<td>7.1%</td>
<td>7.1%</td>
<td>1.1%</td>
<td>1.0%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Itani</td>
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<td>RCT</td>
<td>73</td>
<td>73</td>
<td>Onlay</td>
<td>24</td>
<td>31.5%</td>
<td>13.7%</td>
<td>23.3%</td>
<td>5.6%</td>
<td>8.2%</td>
<td>12.5%</td>
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<tr>
<td>Kurmann</td>
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<td>P</td>
<td>56</td>
<td>69</td>
<td>Retrorectus</td>
<td>32.5</td>
<td>5.8%</td>
<td>14.3%</td>
<td>26.8%</td>
<td>5.8%</td>
<td>17.9%</td>
<td>15.9%</td>
</tr>
<tr>
<td>Colavita</td>
<td>2012</td>
<td>Registry</td>
<td>402</td>
<td>308</td>
<td>PP, IPOM, RM, Onlay, Inlay</td>
<td>10.2%</td>
<td>10.0%</td>
<td>3.2%</td>
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<td>6.0%</td>
<td>5.2%</td>
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<tr>
<td>Eker</td>
<td>2013</td>
<td>RCT</td>
<td>100</td>
<td>94</td>
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<td>35</td>
<td>19.0%</td>
<td>18.0%</td>
<td>5.0%</td>
<td>4.0%</td>
<td>14.0%</td>
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P, Prospective; RCT, Randomized Control Trial
(PTFE), or some combination of PP and PTFE. Additionally, PP and PE mesh may have an added barrier coating, designed to decrease visceral adhesion to the mesh and allow intraperitoneal placement for LVHR. Mesh density, weight, and pore size are also important characteristics when choosing mesh for hernia repair. Use of permanent mesh clearly reduces the risk of hernia recurrence,1 and is widely used for clean surgical cases. However, traditional surgical teaching warns against its use in the setting of contamination for fear of mesh infection, reoperations, and mesh removal. Due to these fears, biologic meshes were developed. Derived from human or animal tissue, biologic mesh theoretically provides an acellular scaffold, which promotes native tissue ingrowth, collagen deposition, and remodeling to strengthen a hernia repair, thus preventing recurrence. They are frequently used in the setting of contamination with the expectation that biologically derived tissue should be more resistant to infection, although this is not an approved indication for use by the US Food and Drug Administration (FDA). Biologic mesh has not proven to be a panacea as it was touted, and current evidence supporting its use is poor. Several studies have shown that SSI and mesh infection occur with similar frequency with both biologic and synthetic mesh.42,47 Equally disappointing is the long-term data that indicate a higher recurrence rate with the use of biologic mesh,42,47 with one study reporting a recurrence rate as high as suture repair (66%).43 These results are particularly discouraging, given the substantially higher cost of biologic compared to synthetic mesh, a difference of almost 200-fold.44

Contrary to traditional surgical dictum, a growing body of evidence suggests that synthetic mesh is actually safe and efficacious in contaminated hernia repair.48-50 The authors have significant experience with synthetic mesh in contaminated hernia repair. In 100 clean-contaminated and contaminated hernia repairs using a RM technique with large-pore PP mesh, the rate of SSI was 7.1% and 19.0%, respectively. Mesh explantation was required in 4 cases, none of which were a direct complication of the mesh or mesh infection.49 Another large retrospective study corroborates these results, even in the setting of intraabdominal sepsis, with an SSI rate of 17.9% without mesh and 26.3% with mesh reinforcement (non-significant difference), and decreasing hernia occurrence from 33.3% to 5.9% with onlay PP mesh reinforcement.40 A recent American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) study evaluated patients undergoing colorectal surgery with concurrent VHR with or without mesh.52 Superficial SSI occurred in 7.3% of patients with mesh repair and 10.5% of mesh-free patients, deep SSI in 3.8% and 2.7%, and organ space SSI in 6.5% and 4.2%, respectively (all non-significant differences). Two recent prospective randomized control trials utilizing PP mesh reinforcement after colorectal surgery demonstrated a significant benefit of mesh prophylaxis in hernia prevention, reducing hernia occurrence from 31.5% to 11.3% in one study37 and 35.9% to 1.5% in the second.39 The rate of SSI between mesh and non-mesh groups in both studies was similar (18.9% vs. 33.3% and 6.3% vs. 7.5%, respectively).

**Mesh Position**

The position of mesh placement relative to the abdominal wall is an important factor in both wound morbidity and recurrence. Mesh can be positioned as an onlay, in which a subcutaneous space is created and mesh placed over the closed anterior fascia; as an inlay, in which the mesh is simply sewn to the edge of the fascia around the hernia defect; or as a sublay, in which the mesh is below the rectus muscle. Sublay can be further divided into retromuscular, with mesh positioned directly dorsal to the rectus muscle, but ventral to the posterior rectus sheath, preperitoneal, with mesh positioned between the posterior rectus sheath, and peritoneum, or intraperitoneal (Fig. 2).
Mesh onlay is a straightforward technique and does not necessitate full entry into the abdominal cavity, making it an appealing option for patients with a potentially hostile abdomen. The approach, however, disrupts the blood supply of the abdominal wall and leaves only adipose tissue and skin above the mesh, resulting in higher wound morbidity compared with sublay, as well as a higher hernia recurrence rate. Intraperitoneal positioning is the most commonly performed technique. While recurrence rates and wound complications are lower than onlay, a tissue-separating (barrier coated) mesh is recommended to decrease visceral adhesions to the mesh. Mesh placed within the abdominal cavity has the potential to complicate future operations and result in delayed or secondary mesh complications, as noted above. In particular, should a prosthetic infection occur, it is rarely salvageable when placed within the abdominal cavity. Inlay of mesh, also referred to as interposition or bridging mesh, results in the highest rates of recurrence and wound complications and should not be performed.

Preperitoneal mesh placement has the benefit of hiding mesh between the layers of the abdominal wall, thus decreasing the chance of visceral adhesions. However, there is no relief of the tension required to close the midline unless some further myofascial release is performed, and the preperitoneal plane can be difficult to dissect, particularly in multiple reoperative cases. Results are favorable, with recurrence rates less than 10% and SSO/SSI rates between 9% and 12%. Retro muscular repair, as described by Jean Rives, is the authors preferred technique. Not only is the mesh placed in a contained, well-vascularized compartment separated from the viscera, but it also affords myofascial release of the posterior rectus sheath from the rectus muscle and decreases the tension of the midline closure. Most studies report recurrence rate of less than 10%, with wound events complicating 6% to 20% of cases.

Quality Improvement in Ventral Hernia Repair

Much attention has been given to improving outcomes in ventral hernia surgery. Focusing efforts to improve surgical outcomes also makes solid financial sense. The estimated total cost for hernia repair in the US is $3.2 billion. A reduction of the recurrence rate after surgical repair of just 1% would translate into $32 million in savings. Particular areas of focus for the improvement of hernia outcomes include efforts to optimize patient comorbidities prior to surgery, development of comprehensive centers of excellence, and creation of a national prospective database.

Known modifiable, patient risk factors exist in the literature. Morbid obesity, tobacco use, and glucose control can all have significant effects on postoperative wound outcomes and the long-term durability of the repair. Morbid obesity independently predicts SSI following open incisional hernia repair. In a series of patients undergoing LVHR, the recurrence rate is statistically higher in morbidly obese patients (8.4% vs. 2.9%). Nicotine significantly reduces the cutaneous and subcutaneous blood flow. The effects on wound healing at the cellular level take 4 weeks to resolve, once the patient stops smoking. In a series of patients undergoing complex open hernia repair with mesh, smoking was the only predictor of wound and mesh related complications. Since all the mesh infections occurred in tobacco users, the authors advocate smoking cessation prior to any elective incisional hernia repair. Glycemic control is another important modifiable risk factor in hernia surgery. Postoperative hyperglycemia has been shown to be an independent risk factor of SSI following elective general and vascular surgical pro-

**Figure 2**
Mesh position.

- **R**: Rectus muscle
- **EO**: External oblique muscle
- **IO**: Internal oblique muscle
- **TA**: Transversus abdominis muscle
- **P**: Peritoneum
  - **a**: Onlay
  - **b**: Retromuscular
  - **c**: Preperitoneal
  - **d**: Intraperitoneal (IPOM)

**Abbreviations and Acronyms**

- **US**: United States
- **VHR**: ventral hernia repair
- **CDC**: Centers for Disease Control and Prevention
- **SSI**: surgical site infection
- **SSO**: surgical site occurrence
- **TAR**: transversus abdominis release
- **OVHR**: open ventral hernia repair
- **LVHR**: laparoscopic ventral hernia repair
- **RM**: retromuscular
- **PP**: polypropylene
- **PE**: polyester
- **PTFE**: polytetrafluoroethylene
- **GHS**: Greenville Health System
- **ACS-NSQIP**: American College of Surgeons National Surgical Quality Improvement Program
- **AHSSC**: Americas Hernia Society Quality Collaborative
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Potential Conflicting Interests
Dr Warren and Dr Carbonell have served as consultants for Ethicon Inc. Dr Warren, Dr Cobb, and Dr Carbonell have served as consultants for MAQUET and W. L. Gore & Associates.

Cedures. The risk of postoperative wound infection is increased by 30% with every 40-point increase over normoglycemia (<110 mg/dL). Modifying patient factors to maximize outcomes is a crucial component of incisional hernia care.

Some authors have proposed the concept of centers of excellence for hernia care. Improved outcomes have been demonstrated by isolating care to a handful of centers for complex procedures, such as pancreaticoduodenectomy and esophagectomy. Due to the large volume of incisional hernias repaired every year, an attempt to centralize all care of incisional hernias is not feasible. However, the establishment of comprehensive centers of hernia care has resulted in focusing more complex cases to large volume centers. In one series at a high-volume hernia center, patients traveling greater than 100 miles had larger hernia defects and more active mesh infections. In an analysis of the National Inpatient Sample, Colavita and colleagues demonstrated a significant increase in percentage of ventral hernia cases being performed at high-volume centers in 2008-2009, compared to 10 years prior. Although regionalization seems to be occurring with ventral hernia surgery, complications and mortality rates have not significantly improved thus far, and patient comorbidities seem to influence outcome more than volume. Similarly, a comprehensive Hernia Center was created at our institution, the first of its kind in South Carolina. Since its inception, there has been a steady increase in the number and complexity of hernia repairs performed annually, with an increasingly wide referral area. The specialization of our practice allows for focused research in the area of hernia repair and abdominal wall reconstruction, along with development of novel techniques, the application of new technology, and standardization of practice for quality improvement. The impact of this approach on patient outcomes, however, remains unknown.

As stated above, the heterogeneity in technique and outcome reporting has contributed to the difficulty in reaching a consensus on the optimal VHR technique. The numerous possible combinations of technique and material essentially preclude this issue from being settled in any prospective randomized controlled trial. Large database analysis holds much greater promise for truly elucidating proper technique for a given patient in a given situation. However, all of the current national databases, such as the Healthcare Cost and Utilization Project-Nationwide Inpatient Sample, University Health System Consortium, Premier Healthcare database, and ACS-NSQIP, are based on administrative data obtained from chart abstraction. This data inherently misses any technical information regarding repair technique, such as mesh selection, mesh position, fixation, fascia closure technique, or component separation technique. The Americas Hernia Society Quality Collaborative (AHSQC) project was formed in 2013 by the Americas Hernia Society, in conjunction with hernia surgeons in both private practice and academic settings. As the most comprehensive and robust hernia database in existence, the AHSQC utilizes concepts of continuous quality improvement to improve patient outcomes and optimize costs. This is accomplished through surgeon and patient-centered data collection, ongoing performance feedback to clinicians, and improvement based on analysis of collected data and collaborative learning. This unique method of collecting data and continuously analyzing outcomes will allow us to answer the question of how best to repair ventral hernias.

Summary
Although VHR is among the most commonly performed operations in the US, many questions remain unanswered, and there is little consensus on best practice. Traditional clinical trials are unlikely to answer many of these questions due to the number of variables and possible combinations. Surgeons must carefully and critically review the surgical literature in order to discern the validity of the stated outcomes for their practice.

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MODERN MANAGEMENT OF ABDOMINAL WALL HERNIAS


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