



Staged Abdominal Wall Reconstruction

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It is often assumed by many healthcare providers, that a hernia “is a hernia.” And because of this assumption, caregivers assume that there is little variation between the many types of hernias. In the most basic terminology, the general definition of a hernia of the abdomen is “A weakness or defect in the wall of the peritoneal cavity ... (that) eventually push(es) out a pouchlike, serosal lined sac called a hernial sac.”⁸

In addition to many different types of hernias, there also are differing grades of hernia. One of the most challenging clinical scenarios facing the surgical team is when a hernia is present after multiple repairs and/or revisions of repairs. In addition to the surgical challenges with recurrent complex hernias, these scenarios often involve complications where the prosthetic mesh used in the original surgery can harbor a low-grade occult infection that can go years without diagnosis. There are often no perceptible symptoms for the patient other than the visible hernia, possibly some pain or obstructive symptoms associated with the hernia and an overall feeling of malaise. Occult mesh infections can sometimes continue until the severity of the infections grows to a point of skin ulceration and even near evisceration through the ulcerations that can be caused by the infected mesh. The presentation of infected prosthetic mesh within a complex multi-recurrent incisional hernia is

LEARNING OBJECTIVES

- ▲ Discuss the scenarios that may create recurrent complex hernias
- ▲ Review the anatomy of the anterior abdominal wall
- ▲ List the considerations taken during the preoperative planning
- ▲ Recall the procedural steps for the first stage of this surgery
- ▲ Evaluate the reasons why a soft tissue debridement may be necessary

always a challenging situation. In fact, once the condition has progressed to this extent, major invasive surgical procedures are needed, including the possibility of needing to perform a staged abdominal wall reconstruction or SAWR. The SAWR is a complex surgery that can require multiple operations during the same hospitalization, in efforts to remove the infected mesh, while at the same time, repair the complex recurrent hernia. The prognosis of these repairs varies according to comorbidities, overall patient health and an adherence to strict pre- and post-operative nutrition and therapy programs by the patient.

To have any discussion about complex redo abdominal wall hernia surgery, the anatomy of the anterior abdominal wall must first be considered. Aside from the obvious muscle and fascial anatomy, vascular and neurological anatomy also needs to be considered. Muscular anatomy that plays a key role in abdominal wall surgery includes the rectus abdominus, the internal- and external-oblique muscles and the transversalis muscles. In addition, the tendinous, fascial and other tissue landmarks are important. These landmarks include the linea alba, the anterior layer of the rectus sheath, the aponeurosis of the oblique muscles, Camper's fascia, Scarpa's fascia, the arcuate line and the umbilicus. Bone and cartilaginous landmarks include the xiphoid process, the costal margin, the pubis and the anterior superior iliac spine. Vascular considerations include the epigastric vessels, para-umbilical veins and venous plexus and the important peri-umbilical perforator vessels. Neural anatomical concerns include the abdominal and ninth-thoracic nerves, which if severed can cause abdominal wall pain and/or paresis. In essence, "When considering ... abdominal hernia repair, the underlying musculature, aponeurotic layers and adipocutaneous structures are important. The three components are interrelated and should be addressed systematically in order to optimize outcomes."⁶

Preoperative planning for SAWR begins weeks, and sometimes months, in advance of any attempted surgical intervention for such a complicated repair. Typically, nutrition and weight loss programs are designed for the patient. The patient must cease smoking, if currently a smoker, and must undergo basic physiologic and psychological review, and treatment if necessary. These programs are in place to provide the patient with all the tools to succeed and to avoid the many well-known complications that can occur after surgery. The patient needs to understand that their complex recurrent hernia (with or without infected prosthetic mesh) is a condition that will not go away without proper care and

treatment. This clinical entity may be life threatening if not cared for in the proper manner. Significant efforts are taken on the part of the surgical team to try and ensure that the patient, and their support system, are in complete understanding of the procedure (and potentially lengthy hospitalization) that they are about to undertake, so they may be able to regain control of their lives.

While the staged abdominal wall reconstruction has been shown to be effective in the treatment for patients with complex recurrent hernias with infected prosthetic mesh, this procedure is a last resort. There is no guarantee that the condition will not re-occur, as the patient has demonstrated tissue with a predisposition to structural failure. There is a high probability for surgical site infections, due to the pres-

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ence of infected prosthetic mesh and contaminated classification of the surgery. With all this education and preparation to surgery met, the patient, their support system and the surgical team begins a journey that can take months (and even years) to complete.

To prepare for the procedure, the room setup needs to include an operative table capable of safely holding the patient, as many of these patients are obese, even after adherence to pre-surgical programs. It is often necessary to install bed extensions or utilize a specially designed table for the morbidly obese. Other positioning aides such as a pillow for under the knees and ulnar padding need to be readily available. Patient warming pads are recommended, with an alternative being upper and lower body patient warming blankets. The patient will need to be positioned in the supine position with the arms extended. Pre-operatively, all hair will need to be clipped from approximately 10 centimeters above

the xiphoid process, to mid-thigh and circumferential to the table. The removal of body hair has the dual purpose of aiding in the limitation of post-operative infection and providing ease of access for wound closure. It also facilitates placement (and eventual change/removal) of the specialized post-surgical dressings.

The surgical prep that is preferred is a chlorhexidine solution, except in situations where there is an open wound, due to erosion of the abdominal wall and cutaneous layers, from pre-existing infected mesh. In the scenario that the previous mesh is infected and ulcerated through the skin, a betadine prep solution is preferred. Surgical skin prep will need to cover the entire surface area that was previously shaved, from 10 centimeters

towels, “squaring off” the abdomen by placing a towel at 10 centimeters above the xiphoid process, across the pubic bone, angling laterally following the iliac crest, angling laterally along the costals and finally securing towels laterally (which typically yields a hexagonal surgical field). All towels will be secured with clips or staples. The preferred drape for abdominal wall reconstruction is a universal drape and will be applied to follow the margins created by the sterile towels. Since there is often copious fluid and/or blood loss, drapes with pockets or plastic liners are preferred, to protect the operative team’s gowns from strike-through and to prevent fluids spillage onto the floor.

Suction, electrocautery and vessel-sealing cords will need to be passed to the circulating nurse for connection



above the xiphoid process to mid-thigh and down to the operative table laterally. Manufacturer and facility guidelines will need to be followed with the skin prep solution to ensure that the complete surface area is appropriately covered and all potential flammable solutions have dried, (which is typically a three-minute wait before draping).

Patient draping will be performed utilizing sterile

and the other equipment will need to be brought to the field. After a surgical time out, the incision will be made with a #20 blade on a #4 knife handle. The incision typically runs midline and elliptical in shape and often includes removal of the umbilicus, as the umbilicus often heals poorly and/or becomes infected in redo abdominal wall surgery. After the initial incision is made, cautery will be used to provide

hemostasis. As some larger abdominal wall vessels may be encountered, the vessel-sealing system will need to be utilized to control potential bleeding, in conjunction with ligatures as needed. Much of the central abdominal wall skin and subcutaneous tissue's blood supply comes from a set of vessels known as peri-umbilical perforators. There must be a conscious effort on the part of the surgical team to avoid dividing or injuring these vessels, as critical soft tissue ischemia typically occurs postoperatively. After the initial abdominal wall debridement, incision will be made into the peritoneal cavity through the existing hernia sac and an extension of the wound into the fascia will be made as needed. Once exposure is completed, examination of the bowel and other underlying structures, will be performed. A complete lysis of any adhesions will be accomplished by the appropriate methodology and any inadvertent enterotomy will be repaired. Evaluation of any strangulated bowel (which is not commonly seen in patients that present electively with massive abdominal hernia) is performed and a resection is done as needed. If the patient has been appropriately consented, removal of the gallbladder and the vermiform appendix may be considered, especially if pathology is found or if these structures are involved with the adhesions. These measures are taken during the staged abdominal wall reconstruction for recurrent, complex, incisional hernias. This is an attempt to avoid further abdominal surgery, which may result in failure of the repair. Irrigation with an antibiotic irrigation is performed, with a preference being a diluted chlorhexadine solution. However, a bacitracin irrigation or other option based upon the surgeon's preference may be acceptable. A final inspection of the abdomen will then be performed to ensure hemostasis.

After the initial exploration, abdominal wall debridement, lysis of adhesions and the performance of any indicated ancillary procedures, attention will turn to the abdominal wall. One of the most challenging portions of this operation is the potential removal of prosthetic mesh. Although there is some debate amongst surgeons about this topic, most surgeons agree that all infected mesh should be removed (including adjacent mesh that may be well-incorporated). The decision to remove non-infected mesh is more complex and can result in significant loss of autologous tissue that may be needed for the forthcoming repair. Additional skin and soft tissue debridement may be performed (especially if significant skin flaps or undermining has occurred) and the decision to incorporate any

remaining hernia sac into a portion of the layered repair, is made.

Proceeding with the repair, Kocher clamps are attached to the abdominal fascia and the compliance of the abdominal wall will be tested to see if primary fascial closure can be attempted. If primary tissue closure is deemed not possible, then component separation will be performed. Component separation is an advanced surgical technique and should not be performed without previous experience. This technique refers to many myofascial release procedures that may allow the surgery team to advance the autologous tissue edges and thereby, attain primary fascial closure. If, after the removal of the compromised prosthetic mesh and after component separation, primary fascial closure is still deemed not possible, then the decision to stage the reconstruction may be made. In this unusual situation, staging refers to a planned return to the operating room during the next few days, and thus the abdominal cavity is left open, and use of a wound vacuum-assisted closure may be appropriate. After placement of the peritoneal wound VAC is complete, tension sutures may be placed. Next, the rest of the wound VAC will be placed and the patient will be sent to the intensive care unit for recovery with a planned delayed closure. After two to three days, depending on the clinical situation, the patient will be brought back into the operating room for a second stage attempt at reconstruction.

For the second and/or third stage surgery, the first step is the removal of the wound VAC, followed by the superficial VAC sponges. A repeat betadine skin prep will be performed, and draping will be accomplished as described previously. After draping, the tension sutures will be removed, and the peritoneal vacuum sponge will be removed. Irrigation and debridement of the wound will be performed, with a culture obtained of any peritoneal fluid, and an evaluation of the abdominal contents will be accomplished. If a retro-muscular abdominal wall reconstruction technique will be utilized, the posterior fascial layer will be approximated, with use of an interposition graft, if needed, using an 0 polyglactin 910 suture. Appropriately sized biologic mesh will then be selected. Kocher clamps will be placed on each of the corners of the primary mesh, to hold it taut. The surgeon then will make a series of small stab incisions to create a pathway for body fluid to flow, thus preventing fluid collection above or below the biological mesh (ie, postoperative seroma). The type of mesh chosen will be secured in the retro-muscular space using #1 polydioxanone suture to the abdominal wall. This will be accomplished by placing three, full-length

sutures in the superior section of the biologic mesh followed by removal of the needles. The strands are then tagged with hemostats. Three small incisions will be made, in the skin of the bilateral abdominal wall, corresponding with the desired location of the suture placement with a #11 blade on a #3 knife handle. A disposable suture grasping closure device will be passed through the small incisions, beginning with the inferior end of the incision, immediately superior to the pubis, and the grasping jaws will be opened. The surgical assistant will then grasp the corresponding suture tails in the DeBakey forceps and will place the tails, one at a time in the grasping jaws while confirming to the surgeon the appropriate directionality, ie, down first. The process will be continued until all six tails are pulled through the abdominal wall and then the polydioxanone sutures will be tied securely and the excess suture will be cut. It is important to note that the suture tag remain prominent so a rat-tooth (or tissue with teeth) forceps will be used to lift the skin at the stab incision, thus burying the knot. This suture placement process will be repeated near the pubis and at least three sutures will be placed laterally to either side, using the space created during the component separation, instead of the suture grasper. If no component separation was performed, then lateral stab incisions will be utilized to allow suture placement. One to two drains of the surgeon's preference will be placed in the retro-muscular space, to aid in prevention of postoperative seroma in this space and will be secured with a #2-0 nylon suture.

Kocher clamps will then be placed on the bilateral exposed fascial edges to approximate the abdominal wall, and the primary fascial closure will be accomplished with use of 0-looped polydioxanone sutures running from the xiphoid process inferiorly, and from the pubis superiorly, with the two sutures being tied together securely. Interrupted 1-0 polydioxanone sutures may be placed in the anterior fascial closure to reinforce the primary running suture repair. After fascial closure, respiratory pressures (peak inspiratory airway pressures) are evaluated to diagnose if compartment syndrome will be a concern. Communication with the anesthesiologist is paramount at this point to prevent compartment syndrome. If the pressures are drastically elevated, and the primary fascial closure is thought to be prohibitive, then fascial closure may not occur at this

operation, and a third stage will be needed. If the pressures remain within the normal range, then the closure may proceed. Two more drains will be placed in the subcutaneous space and secured with 2-0 nylon suture. A critical component of the closure will involve minimizing the dead-space of the skin/subcutaneous wound, which is often quite large in this patient demographic. To accomplish this, Scarpa's fascia will be approximated with interrupted 2-0 poliglecaprone 25 suture and anchored to the plicated abdominal fascia to attempt to minimize dead space and limit fluid collection. In patients that have a significant excess of adipose, it may be necessary to approximate the extra adipose tissue above Scarpa's fascia as well. The sub-dermal layer then will be approximated with interrupted 3-0 poliglecaprone

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25 suture. If the incision site seems overly tight or appears ischemic, fluorescence imaging will be performed to evaluate perfusion to the skin and soft tissue layers of the wound. It is important to note that if the patient is in any way allergic to the dye. The main contraindication is a history of allergic reaction to iodides, due to anaphylaxis.⁴

At this point, if necessary, additional soft tissue debridement may be performed to avoid the common postoperative complications of seroma, tissue necrosis and/or wound dehiscence. Surgical staples will be used for skin approximation. The wound will be dressed, often with an incision management system with settings that are approximately -100 mm/Hg, on low continuous flow. If functioning appropriately, the wound VAC will be left in place for four to seven days, postoperatively. The surgical drains will be attached to 60 ml reservoirs, with appropriate dressings applied. An abdominal binder will be placed on the patient and all drains will be secured and labeled. The patient will then be transferred to an Intensive Care Unit (ICU) bed and transferred to the ICU for recovery.

Staged abdominal wall reconstruction is an unusual and complex operation that may offer hope to patients that are presenting with complex recurrent incisional hernias of the

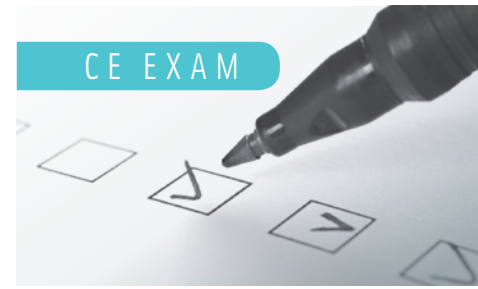
abdominal wall, often with loss of domain and/or infected prosthetic mesh. This advanced operation is performed in efforts to control the patient's hernia disease and, hopefully, to provide an improvement in the patient's quality of life. There are a relatively large number of patients suffering from chronic illness due to previous failed herniorrhaphy and the resultant gigantic incisional hernia, often with a concurrent compromised prosthetic mesh.

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1. Muscular anatomy that plays a key role in abdominal wall surgery includes the rectus abdominus, _____ and the transversalis muscles.
 - a. Umbilicus
 - b. Internal oblique muscles
 - c. External oblique muscles
 - d. Only b and c
2. If severed, these can cause abdominal wall pain and/or paresis:
 - a. Ninth-thoracic nerves
 - b. Epigastric vessels
 - c. Paraumbilical veins
 - d. Venous plexus
3. Due to the presence of infected prosthetic mesh, there is a high probability for _____.
 - a. Reoccurrence of the hernia
 - b. Surgical site infections
 - c. Sepsis
 - d. Seroma
4. If needed, soft tissue debridement may be performed to avoid common postoperative complications that includes:
 - a. Surgical site infection
 - b. Sepsis
 - c. Tissue Necrosis
 - d. Reoccurrence of the hernia
5. Component separation is an advanced surgical technique that allows the surgical team to attain _____.
 - a. Hemostasis
 - b. Primary fascial closure
 - c. Smooth tissue edges
 - d. Secondary fascial closure
6. In a planned delay closure, the patient will return to the operating room in _____ days.
 - a. 1-2 days
 - b. 2 days
 - c. 2-3 days
 - d. 3 days
7. For the second stage of surgery, the first step is to remove the _____.
 - a. Sponges
 - b. Wound VAC
 - c. Kocher clamp
 - d. DeBakey forceps
8. What is used to hold the mesh taut when placing?
 - a. DeBakey forceps
 - b. Kocher clamps
 - c. Rat-tooth forceps
 - d. Cushing forceps
9. The incision typically creates what shape?
 - a. Circle
 - b. Diamond
 - c. Triangle
 - d. Elliptical
10. The initial incision will be made with a _____ blade?
 - a. #4
 - b. #15
 - c. #20
 - d. #11

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