Discussion: Minimally Invasive Component Separation with Inlay Bioprosthetic Mesh (MCSIB) for Complex Abdominal Wall Reconstruction

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Complex abdominal wall reconstruction requires answering two independent and related questions: What is the best way to treat the abdominal wall, and what is the best way to treat the skin? Butler and Campbell present their solutions to these two problems in their article entitled "Minimally Invasive Component Separation with Inlay Bioprosthetic Mesh for Complex Abdominal Wall Reconstruction." Although I will bring up several technical questions and issues to help think critically about the procedure, I am fundamentally in agreement with its central tenets.

Like a fractured bone, a bowel suture line, or a vascular anastomosis, abdominal wall closures best heal in a vascularized soft-tissue envelope. The Achilles heel of the components separation procedure is the wide undermining performed to access the semilunar lines from a midline incision. I remember vividly a 1994 University of Pittsburgh plastic surgery morbidity and mortality conference that illustrated the potential severity of these postoperative wound problems. A patient had a large midline ventral hernia that developed after an open abdominal aortic aneurysm tube graft repair. After standard components separation, the patient suffered complete bilateral abdominal skin necrosis. Our conference discussion theorized that the loss of the iliolumbar vessels of the aorta at the time of the abdominal aortic aneurysm repair in combination with the division of periumbilical perforators at the time of hernia repair caused the severe skin loss. Dr. Jaime Garza sat next to me at that conference. In 1997, Garza presented a method of laparoscopically releasing the external oblique muscles for a components separation repair to avoid skin undermining and to decrease wound complications. The first seven patients treated in this manner were reported in 2000 by Lowe, Garza, and Rohrich.[1] In 2002, I demonstrated a statistical reduction in soft-tissue complications from 20 percent to 2 percent in 41 patients using tunnels elevated over the rectus muscles—much like Dr. Butler—with preservation of the periumbilical perforators.[2] However, it was Dr. Maas in Europe who beat us all to print with his description of lateral incisions in four patients to reach the semilunar lines in 1999.[3] Maintenance of the skin blood flow through narrow 3-cm incisions by Dr. Butler in the current article is a logical extension of these techniques. It avoids the transverse incisions and minimizes skin undermining to achieve the releases. With dependable skin for closure, there will be less skin dehiscence, fewer postoperative open wounds, and fewer infections despite field contamination. At the end of the procedure, discarding redundant skin (and usually the umbilicus in large hernias) serves to remove all scarred skin and the hernia sac, and any bacteria that may have inoculated the soft tissues during the course of a bowel procedure. Use of quilting sutures as performed by the authors to reduce dead space is also an important adjunct to primary wound healing. The well-vascularized soft tissues are especially important when a bridged repair is required.

Even when a fascial defect is so large that the medial aspect of the rectus muscles cannot be approximated, performing external oblique releases from far above the rib cage to below the anterior superior iliac spine as described by the authors is the critical first step in complex abdominal wall reconstruction. Chronic hernia formation causes a fibrosis and stiffening of the lateral abdominal wall muscles. Releases of the external oblique will improve abdominal wall compliance, which in turn will achieve a more lasting repair.[4] However, simple approximation of the rectus muscles with-

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out additional strengthening of the suture line will still lead to a hernia recurrence rate of 23 percent.[5] The concept of a direct supported repair is that addition of mesh to the suture line will disperse forces beyond the suture line. This may prevent the midline closure sutures from "pulling through" the tissues over time and leading to a recurrent hernia. Bioprosthetic mesh has been the material most used in the United States for this indication. Its ability to heal in the face of contamination melds well with the association of this procedure with local wound problems. In laboratory animals, bioprosthetic mesh has been shown by Burns et al. to be more "bowel friendly" than prosthetic mesh.[6]

Specific technical details are given by Drs. Butler and Campbell. Non–cross-linked porcine mesh is used for its properties of durability, tissue ingrowth, and large size. It is placed in the preperitoneal space, located immediately posterior to the rectus fascia and anterior to the peritoneum and preperitoneal fat. In the infraumbilical abdomen, this layer is easy to dissect and manipulate. High in the epigastrium, this fat exists as a continuation of the falciform ligament. The layer is more easily elevated as one dissects laterally from the midline. The reason for this placement is to have vascularized tissue on *both* sides of the bioprosthetic mesh. Other authors have described a retrorectus placement of mesh, between the rectus muscles and the posterior rectus fascia. Although he does not comment on this, Dr. Butler may have chosen this preperitoneal placement because of the poor handling of the rectus complex when the posterior fascia is mobilized as a separate layer. With preperitoneal placement of mesh, a generous central abdominal area is undoubtedly not covered by peritoneal fat, and therefore the mesh rests within the true abdominal cavity. The importance of having bioprosthetic mesh sandwiched between two tissue layers for proper ingrowth is unclear, and this technique is somewhere in-between the retrorectus and the intraabdominal techniques. Although I agree that the optimal hernia repair should be direct and supported, I tend to favor the use of cheaper and potentially more durable prosthetic mesh and have not found an increased rate of surgical complications despite the intraabdominal placement.[7]

Despite numerous details and beautiful illustrations, technical questions are raised by the article. The bioprosthetic mesh used in this study has a size of 20 × 20 cm, and the average mesh size implanted was 399 cm. However, the length of the linea alba is on the order of 30 cm. No mention of cutting or sewing the mesh into a better sized piece is made. The authors undermine the soft tissues to the medial row of perforators, which in my experience are located approximately 2 to 3 cm from the linea alba. For mesh with a width of 20 cm to be placed as a flat underlay, the sutures would need to be placed 10 cm from the medial aspect of the rectus muscles, so that half of the mesh would be on either side of the abdominal wall when the medial aspect of the muscles is approximated in the midline. Even with an obliquely angled needle, I would think it is difficult to place a suture 10 cm from the midline with only 3 cm of undermining. Another technical question concerns measurement of the hernia and how it was performed. Large differences in measurement are possible when the patient is measured upright, supine, or on an operating room table with all of the tissues dissected and tension applied on the muscles to close the defect. Standardized measurements taken from computed tomographic scans are one means of improving data collection and analysis. A third technical question relates to the feared issue of compartment syndrome. Although an elevation of peak inspiratory pressure of 12 mmHg *could* be a useful marker for impending compartment syndrome, other important concepts to keep in mind are the amount of expected bowel swelling, the compliance of the lateral abdominal wall, the patient's pulmonary history, the ease of ventilation, and the difficulty of the closure.

The final issue concerns the chosen name of the procedure. I am not sure how many surgeons would regard a 2.5- to 3.5-hour operation with a full laparotomy and closure to be a "minimally invasive" procedure. Could there be geographic variations at play? Perhaps this is the subject of another discussion.

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