It all doesn't always have to go: abdominal wall reconstruction involving selective synthetic mesh explantation with biologic mesh salvage

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Accepted Oct. 23, 2022

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Cite as: *Can J Surg* 2023 February 2; 66(1). doi: 10.1503/cjs.004422

Summary

The comparative performance of synthetic and biologic meshes in complex and contaminated abdominal wall repairs remains controversial. Though biologic meshes are generally favoured in contaminated fields, this practice is based on limited data. Standard dictum regarding infected mesh is to either explant it early or pursue aggressive conservation measures depending on mesh position and composition. Explantation is typically morbid, leaving the patient with recurrent hernias and few reconstructive options. We report a case in which a hernia repaired with synthetic mesh recurred and was reconstructed with underlay biologic mesh. Delayed wound hematoma occurred after initiating anticoagulation for late postoperative pulmonary embolism, which became chronically infected. After multiple failed attempts at medical and interventional salvage of the mesh infection, the patient underwent selective explantation of synthetic mesh with conservation of the underlying biological mesh. She recovered completely without recurrent abdominal wall failure at long-term follow-up. We suggest the "salvageable" characteristics of biologic meshes may allow conservation, rather than explantation, in select cases of infection.

The use of synthetic and/or biologic meshes have become standard of care in most abdominal surgeries involving ventral abdominal wall reconstruction. Surgeons have largely abandoned suture repair in favour of mesh repair for ventral hernias owing to the reduced hernia recurrence rate. Unfortunately, with increased mesh usage, chronic mesh infections have become more frequent, as might be expected with any foreign material. Although there are increasing reports of mesh salvage, the standard dictum regarding management typically involves explantation of the infected mesh, leaving the patient with many resultant problems. It has long been hoped that biologic meshes might be a solution to this challenge. Some have reported biologic meshes to be more resistant to infection[1,2]; however, this remains controversial as other recent evidence has brought into question the benefit of biologic meshes, particularly considering their comparatively high cost.[3] Given the great morbidity that accompanies blanket statements regarding mandatory mesh explantation, we report a case in which all attempts at mesh salvage failed until the selective removal of the infected prosthetic with preservation of an existing biologic mesh. There was complete resolution of symptoms and long-term abdominal wall durability.

Representative case

A 60-year-old woman presented with a recurrent ventral hernia containing incarcerated bowel. She had undergone a ventral incisional hernia repair with onlay Prolite polypropylene monofilament mesh 20 months prior. At laparotomy, the incarcerated viscera was dissected free of the deeply incorporated prosthetic mesh. As there was no enteric breach or

contamination, the pre-existing prosthetic mesh was not explanted, but the abdominal wall was repaired with a unilateral right-sided component separation over an intraperitoneal 20 cm × 30 cm Permacol (Medtronic) biologic mesh. Her recovery seemed uneventful until she developed pulmonary embolism requiring therapeutic anticoagulation.

Approximately 4 months after the initial operation, the patient returned with infected abdominal hematomas — 1 in the subcutaneous tissue, and 1 tracking below the fascia above the biologic mesh. Percutaneous drainage and systemic antibiotics were initially provided. As these were insufficient, the patient was taken to the operating room for attempts at mesh preservation involving abdominal wall débridement and application of negative-pressure wound therapy (NPWT). At the time, wound cultures were negative. However, 2 months later, her condition deteriorated with systemic symptoms, and she had purulent drainage from her midline incision. Computed tomography revealed several subcutaneous collections communicating with the skin, the largest measuring 8 cm × 10 cm × 2.2 cm. Drains were placed and fluid cultures were positive for methicillin-resistant *Staphylococcus aureus* (MRSA) and scant *Peptoniphilus* (Gram-positive anaerobic cocci) (Figure 1). Despite drainage and antibiotic therapy with vancomycin, flagyl and levofloxacin as recommended by infectious disease consultants, purulent drainage continued and the patient remained clinically unwell (Figure 2).

The infectious disease consultants then recommended complete mesh explantation. However, at elective laparotomy there was an abscess cavity overlying the synthetic mesh, and the synthetic mesh was explanted; the biologic mesh was intact and left in place (Figure 3). Presumably because of antibiotic administration, the explanted synthetic mesh grew no organisms; however, histological analysis revealed chronic inflammation and foreign-body giant-cell reaction consistent with an

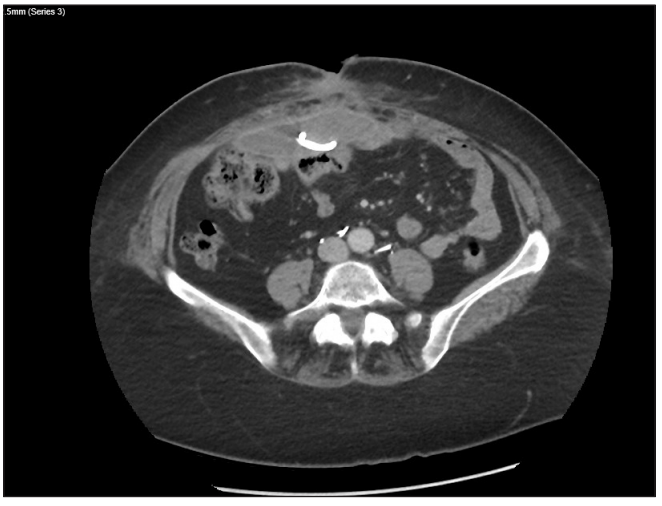

Fig. 1. Abdominal computed tomography scan obtained 1 month before prosthetic mesh explantation showing an intra-abdominal abscess measuring 9.5 cm × 2.3 cm deep within the abdominal wall and containing a few bubbles of gas. Percutaneous drains are seemingly well positioned.

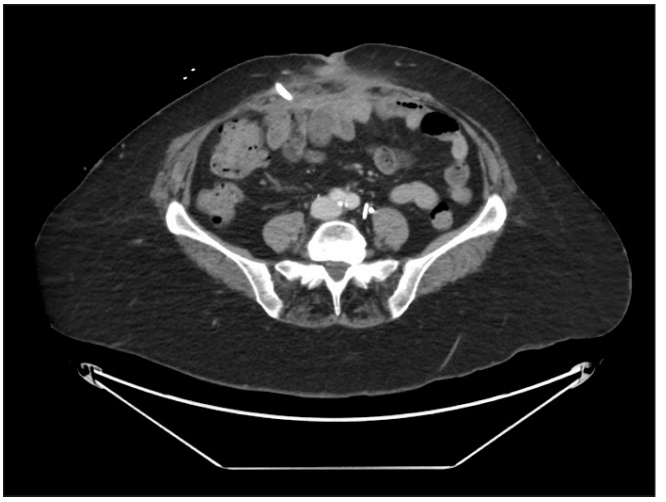

Fig. 2. Abdominal comuted tomography scan obtained immediately before prosthetic mesh explantation revealing improved but residual intra-abdominal abscess under the abdominal wall with percutaneous drains seemingly well positioned.

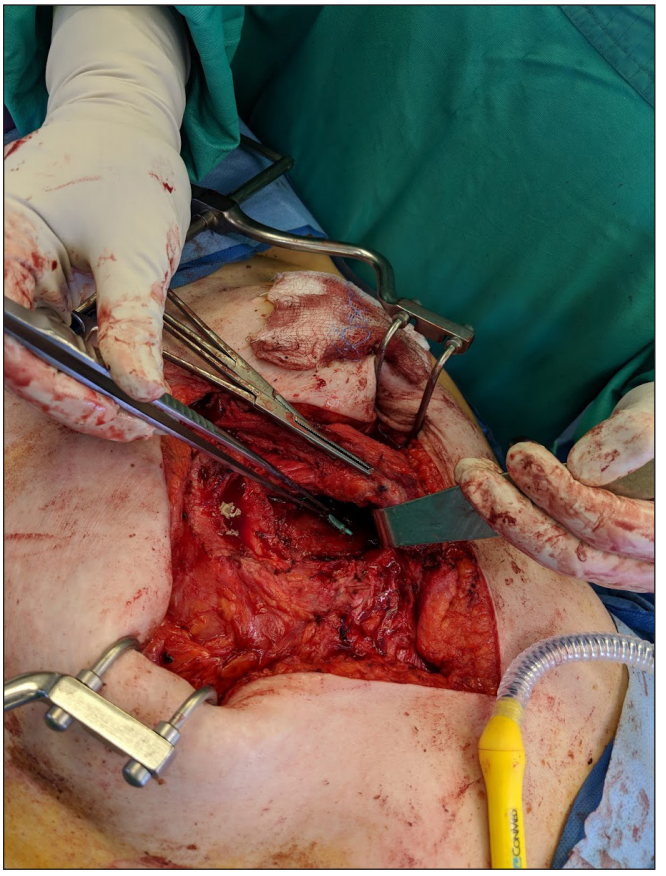

Fig. 3. Intraoperative photograph depicting the percutaneous drain after explantation of the overlying prosthetic mesh with salvage of the underlying bioprosthetic mesh.

abscess. The patient was continued on the preoperative antibiotic regimen for 1 week, followed by 2 weeks of home parenteral and oral antibiotic therapy. Thereafter, antibiotics were discontinued, and delayed wound closure by secondary intention was achieved using negative-pressure wound vacuum therapy. The patient's recovery thereafter was unremarkable. A magnetic resonance imaging scan obtained 6 months later showed no evidence of residual abscess or hernia recurrence, and 4 years after explantation the patient remained well and physically active.

Discussion

Despite the widespread availability and frequent use of biologic meshes in contaminated surgical fields, much controversy remains regarding their benefit in complex abdominal wall repairs. Given the paucity of evidence, particularly the ability to successfully clear or withstand infection, our patient's case suggests that an "infection-salvageable" nature of biologic mesh and caution with blanket admonitions regarding mandatory mesh explantation, even after failure of the typical measures used to try and salvage mesh infections.

There are increasing reports of mesh salvage, with salvageability appearing to be associated with mesh placement. Meshes can be considered salvaged if no removal of any infected mesh is required and partially salvaged if mesh débridement is required.[4] Macroporous polypropylene meshes implanted within the retro-muscular plane have been reported to be salvageable in as many as 89% of cases, presumably because of its placement in a well-vascularized anatomic location.[4,5] However, despite such evolving experience, the standard dictum regarding management of mesh infections typically involves explantation of the infected mesh, leaving the patient with many resultant problems. Although Warren and colleagues noted optimism regarding extraperitoneal polypropylene mesh salvage, these cases were a distinct minority of all infected mesh cases.[4] Thus, leaving an existing mesh intact is a complex undertaking with risks but ultimate benefits for the patient if successful. There is modest experience in successfully implanting a biologic mesh after explantation of an infected synthetic mesh in single-staged hernia repairs.[5,6] Some researchers have also incorporated antibiotic coated beads alongside implanted biologic mesh to prevent mesh infection following a contaminated single-staged repair.[7,8] However, there is little evidence to guide clinicians when leaving a biologic mesh in a pre-existing infected field where pre-existing synthetic mesh was explanted.

Even in surgical fields considered contaminated, and upon failure of standard conservative measures, biologic meshes may have salvageability related to their inherent characteristics. In a prospective animal study, it was shown that biologic mesh was better able to resist *S. aureus* infection than synthetic mesh, with this quality of biologic mesh attributable to its ability to fully vascularize and permit cellular growth from the host tissue.[9] This is a major theoretical difference between prosthetic and biologic meshes, in that the purported "vascularization" of the biologic mesh may allow the body to deal with biofilms. However, in a randomized trial involving single-staged repair of clean-contaminated and contaminated ventral hernias, Rosen and colleagues reported that although both groups had a similar safety profile, including surgical site infections, biologic meshes generally were associated with greater risk of deeper infections than synthetic meshes.[3] In the PRICE trial, biologic meshes had an infection recurrence rate of 39.7% compared with 21.9% with synthetic meshes at 2-year follow-up, but all patients underwent elective repair, and 63% of the patients had already undergone an average of at least 2 repairs.[10] However, although the overall postoperative complication profile was similar between mesh groups, the fact that 5 of 6 meshes requiring explanation were chronically infected synthetic meshes suggests that biologic meshes may have a better capacity to overcome infection, reducing the need for their explantation.[10] The biologic mesh used in the COBRA study showed a similar safety profile in contaminated hernias with a reassuring recurrence rate of only 17% at 2 years.[11] Thus, the literature is insufficient to truly answer the question of whether biologic meshes are "infection resistant," "infection tolerant," or even "infection salvageable" as has been variably claimed. There is also evolving research into new prostheses that incorporate favourable characteristics of both biologic and synthetic meshes; these biosynthetic meshes are still quite new and are being studied for their durability in repairing ventral wall hernias. One such prospective study examining the short-term performance of Phasix biosynthetic mesh reported a 26% rate of surgical site complication while being used in potentially contaminated surgical fields.[12] While only 11.9% of patients involved had a previously placed mesh explanted at the time of repair, overall the repair with biosynthetic mesh was found to be durable, with only 1 biosynthetic mesh needing to be explanted during 3 months of follow-up.[12]

Given the complexity of the field regarding patient comorbidities, wide variables of mesh type and options for anatomic placement, and ultimately the lack of high-quality clinical studies, we suggest that every patient with an infected mesh be carefully considered and have their therapy individualized after examining the characteristics of both the patient and the involved mesh. We also caution clinicians to exercise judgment when treating a biologic mesh infection involving unusual species (e.g., fungus), as the latter can compromise the very "resistive" ability of biologic mesh, as

previously reported by our group.[14] Furthermore, we believe surgeons should reject sweeping generalizations that all infected meshes should always be removed. There may be opportunities to salvage well-incorporated vascularized biologic meshes and thus spare patients the unnecessary morbidity. A carefully performed, well-powered prospective study in this field of surgery is still urgently warranted.

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Competing interests: C.G. Ball is co-editor in chief of *CJS*; he was not involved in the review or decision to accept this manuscript for publication. A.W. Kirkpatrick has consulted for Zoll, Acelity (3M/KCI), CSL Behring, Innovative Trauma Care and SAM Medical Corporations, and the Statesman Group of Companies, and is the principal investigator of a randomized trial partially supported by the Acelity Corporation (Closed or Open Abdomen for the Management of Abdominal Sepsis; ClinicalTrials.gov). No other competing interests were declared.

Contributors: All authors contributed substantially to the conception, writing and revision of this article and approved the final version for publication.

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