No-Touch Technique of Mesh Placement in Ventral Hernia Repair: Minimizing Postoperative Mesh Infections

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PATIENT SAFETY

Summary: Synthetic mesh is commonly used in ventral hernia repairs to reinforce the abdominal closure and minimize hernia recurrence rates. However, the use of synthetic mesh is associated with certain risks, most notably infection requiring explantation. This study sought to evaluate the use of a "no-touch" technique with antibiotic solution during synthetic mesh placement in ventral hernia repairs and its impact on complication/infection rates. The authors retrospectively reviewed a prospectively maintained database of patients undergoing abdominal wall reconstruction with synthetic mesh from 2013 to 2018 by a single surgeon with a minimum 1-year follow-up. Data collected included demographic data, medical comorbidities, hernia history, and the type of antibiotics used in the no-touch technique. Complications were stratified into short-term (<30 days), medium-term (30 to 90 days), and long-term (91 to 365 days) complications. Results were compared to previously published rates in the literature. Eighty-eight patients met inclusion criteria. Fourteen patients (15.9 percent) experienced postoperative complications (two patients had multiple complications); six of these patients (6.8 percent) were readmitted to the hospital for management. Subsequently, three of the readmitted patients (3.4 percent) required reoperations related to abdominal infection and required removal of the synthetic mesh. A total of 16 complication events occurred in the cohort: 13 short-term complications (81.3 percent), three medium-term complications (18.7 percent), and zero long-term complications. The authors conclude that the no-touch technique for mesh placement in ventral hernia repairs appears to be efficacious in minimizing infectious complications with mesh placement, although further prospective studies are required to further define this relationship. (*Plast. Reconstr. Surg.* 145: 1288, 2020.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

4 THERAPEUTIC

Complex abdominal wall defects are an increasingly common problem in the United States, with over 350,000 ventral hernia repairs performed annually.[1] The operative procedures used to address this prevalent problem have evolved over the years, driven in part by innovative surgical techniques and product development. A core set of surgical principles are used to achieve the goals of reconstruction: (1) maximize vascularity through minimizing perforator disruption; (2) using appropriate mesh reinforcement; (3) properly placing and fixating the mesh to promote intimate contact with vascularized tissue; (4) actively limiting dead space; and (5) extensive resection of marginal soft tissue.[2]

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Although it is common practice to use mesh to reinforce the abdominal closure[3,4] and minimize the hernia recurrence rate,[5] its implantation is associated with the risk of short- and long-term complications such as visceral adhesions, bowel obstruction, enterocutaneous fistulae, extrusion of material, and infection.[6–10] Specifically, the postoperative infection rates for ventral hernia repairs are higher (4 to 16 percent) compared to other clean surgical procedures (2 percent).[11]

Postoperative infection when implanting foreign bodies is not a new problem for surgeons. In an attempt to address this issue in the 1880s, Sir William Arbuthnot Lane developed the no-touch technique, which was later described by Dr. Fairbank in 1942 as never allowing the gloved finger to come in contact with the wound or anything introduced into it during orthopedic repairs.[12,13] Subsequently, this technique of minimizing the possible contamination of implants with bacteria by avoiding contact with the skin, has been successfully embraced by multiple surgical specialties when using implantable devices and shown to decrease the rates of infections.[14–22] This has led to meticulous handling and sterile techniques becoming the gold standard for almost all implantable devices. However, in ventral hernia repairs, even though synthetic mesh is frequently used, the no-touch technique is still an uncommon practice and not described in the literature.

Operations in which the no-touch technique has been widely implemented have clearly highlighted its success. In 1993, Dr. Mladick attributed his low rates of infection and capsular contracture in breast augmentation to the no-touch technique.[23] His theory was bolstered by Dr. Sanger's work showing that even brief contact with minimal microorganisms can adhere to the surface of synthetic material. Sanger et al. advocated that soaking implants in bacitracin foam would minimize the chance of bacteria contamination.[24] More recently, retrospective meta-analysis by Frois et al. supported these findings by indicating that the use of antibiotics in breast pocket irrigation and implant immersion resulted in lower infection rates (risk ratio, 0.52; $p = 0.004$).[25] In addition, infection rates as low as 0.3 to 1.0 percent have been noted in breast augmentation patients while using the no-touch technique.[19] Adams et al.[26] describe a 14-point plan to reduce bacterial contamination using many of the same principles used in the aforementioned clinical trials, including pocket irrigation, instrument cleaning, and skin repreparation with previously recommended[27,28] povidone-iodine triple-antibiotic solution (50 cc povidone, 50,000 U of bacitracin, 1 g of cefazolin, and 80 mg of gentamicin), non–povidone-iodine triple-antibiotic solution (50,000 U of bacitracin, 1 g of cefazolin, and 80 mg of gentamicin), or 50% (1:1 dilution) or stronger povidone-iodine, in addition to changing surgical gloves.

To apply best practices across surgical specialties, our team began using the no-touch technique in combination with antibiotic irrigation while placing mesh in ventral hernia repairs in an effort to decrease short- and long-term complication rates—specifically, infection rates. This pilot study was designed to evaluate the technique as a benchmark for future prospective studies. Using the aforementioned principles, our technique used the following steps during mesh implantation:

1. The skin was reprepared with a povidone-iodine solution, and the incision was irrigated with antibiotic solution.
2. The wound bed was copiously and thoroughly irrigated with triple-antibiotic solution. This consisted of 50,000 U of bacitracin, 80 mg of gentamicin, and 1 g of cefazolin in 500 cc of sterile saline for almost all patients. However, for patients with a penicillin allergy, a double-antibiotic solution was used consisting of only bacitracin and gentamicin.
3. All instruments used to place/position mesh were either replaced with sterile counterparts or dipped in an antibiotic solution before manipulating the mesh.
4. The surgeon and assisting resident put on a new set of sterile gloves immediately before handling the mesh.
5. The mesh was removed from its packaging only immediately before use (ensuring that the mesh had minimal exposure to the surrounding environment) and dipped in the antibiotic solution and povidone-iodine. The mesh never touched the Mayo stand, drapes, sponges, or other instruments at any time.
6. The surgeon placed the mesh in the appropriate abdominal wall position while avoiding skin contact.
7. The incision was again thoroughly irrigated with the antibiotic solution.
8. The surgeon completed the layered closure using standard surgical techniques.

In a preliminary analysis of the first 88 patients (Tables 1 and 2) who underwent this

Table 1. Demographic Summary of the Prospectively Collected Data from Our Institution for Patients Undergoing Complex Abdominal Wall Reconstruction

Characteristic	Value (%)
Average age, yr	55.2
Sex	
Male	37 (42.0)
Female	51 (58.0)
Average BMI, kg/m^2	33.1
BMI >40 kg/m^2	8 (9.1)
Race	
White	82 (93.2)
Black	4 (4.5)
Hispanic	2 (2.3)
Comorbidities	
HTN	49 (55.7)
DM	16 (18.2)
Dialysis	1 (1.1)
COPD	4 (4.5)
Current smoker	2 (2.)
Hernia history	
Recurrent incisional	45 (51.1)
No. of prior hernia repairs	
1	28 (31.8)
2–3	15 (17.0)
≥4	2 (2.3)
Prior mesh placed	35 (39.8)
ASA class	
1	3 (3.4)
2	61 (69.3)
3	24 (27.3)
Kanters grade	
1	24 (27.3)
2	64 (72.7)
3	0 (0)

BMI, body mass index; HTN, hypertension; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; ASA, American Society of Anesthesiologists.

Table 2. Hernia Characteristics of the Prospectively Collected Data from Our Institution for Patients Undergoing Complex Abdominal Wall Reconstruction

Characteristic	Value (%)
Average length, cm	13.3
Average width, cm	9.6
Patients that underwent concomitant procedures	25 (28.4)
Operative time	
120–179 min	1 (1.1)
180–239 min	3 (3.4)
>240 min	84 (95.5)
Wound class	
Clean	85 (96.6)
Clean-contaminated	2 (2.3)
Contaminated	1 (1.1)
Mesh placement	
Onlay	1 (1.1)
Open preperitoneal sublay	1 (1.1)
Open intraperitoneal sublay	20 (22.8)
Open retromuscular sublay (no TAR)	30 (34.1)
Open retromuscular sublay (with TAR)	36 (40.9)
Additional dissection	
Anterior component separation	55 (62.5)
No-touch technique	
Triple antibiotics	86 (97.7)
Double antibiotics	2 (2.3)

TAR, transversus abdominis release.

Table 3. Complication Rates for Analyzed Population

	Postoperative Days		
Complication Type	1–30	31–90	91–365
Seroma	1 (1.1)	—	—
Cellulitis	3 (3.4)	—	—
Superficial infection	1 (1.1)	—	—
Infected mesh	2 (2.3)	—	—
Abscess	—	1 (1.1)	—
Dehiscence	1 (1.1)	1 (1.1)	—
Wound necrosis	3 (3.4)	1 (1.1)	—
Other (PE)	2 (2.3)	—	—
Readmission	6 (6.8)	1 (1.1)	1 (1.1)
Reoperations with mesh removal	2 (2.3)	—	1 (1.1)

PE, pulmonary embolism.

modified no-touch technique, 14 patients (15.9 percent) experienced postoperative complications (two patients had multiple complications); six of these patients (6.8 percent) were readmitted to the hospital for management (Table 3). Subsequently, three of the readmitted patients (3.4 percent) required reoperations related to abdominal infection and required removal of the synthetic mesh. A total of 16 complication events occurred in the cohort: 13 short-term complications (0 to 30 days), three medium-term complications (30 to 90 days), and zero long-term complications (91 to 365 days) (Table 3). Median patient follow-up was 424 days, and no patients were lost to follow-up.

The analysis highlighted a few important findings. Surgical-site infection rates, surgical-site occurrence rates as defined by the Ventral Hernia Working Group, and recurrence rates in the study population were below those reported in comparable studies published in the peer-reviewed literature on similar patient cohorts. The rate of surgical-site infection, including cellulitis, superficial infection, infected mesh, and abscess, was 8.0 percent (Table 4). The surgical-site occurrence rate was 11.4 percent. No wound complications or hernia recurrence occurred between 91 and 365 days postoperatively. The Kanters grades 1 and 2 populations had 1-year total surgical-site occurrence complication rates of 4.2 and 23.4 percent, respectively, which is below published projected rates of 14 and 27 percent.[29]

These promising results indicated that the no-touch technique for mesh placement in ventral hernia repairs may be efficacious in minimizing infectious complications with mesh placement. Further studies are needed to prospectively directly compare the no-touch technique to conventional mesh placement techniques.

Table 4. Complication Rates for Analyzed Population Stratified into Kanters Grades

		1-Year Complications								
Kanters Grade*	No. of Patients	Seroma (%)	Cellulitis (%)	Superficial Infection (%)	Infected Mesh (%)	Abscess (%)	Dehiscence (%)	Wound Necrosis (%)	Other (PE) (%)	All SSO (%)
1	24	4.2	0	0	0	0	0	0	0	4.2
2	64	0	4.7	1.6	3.1	1.6	3.1	6.3	3.1	23.4
3	0	0	0	0	0	0	0	0	0	0
Total	88									

PE, pulmonary embolism; SSO, surgical-site occurrence.
*Kanters AE, Krpata DM, Blatnik JA, Novitsky YM, Rosen MJ. Modified hernia grading scale to stratify surgical site occurrence after open ventral hernia repairs. *J Am Coll Surg.* 2012;215:787–793.

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