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Prophylactic mesh augmentation: Patient selection, techniques, and early outcomes

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ABSTRACT

Background: Incisional hernias (IH) following abdominal surgery are frequent and morbid. Prophylactic mesh augmentation (PMA) has emerged as a technique to reduce IH formation. We aim to report patient selection, techniques and early outcomes after PMA.

Methods: Retrospective chart review identified descriptive characteristics, risk factors, operative technique, and early post-operative outcomes for PMA patients and matched non-PMA patients between January 1, 2016 and October 31, 2017.

Results: 18 consecutive PMA cases were performed (55.6% female, mean age 54.3 years and mean BMI = 29.5 kg/m^2). 88.9% of patients had at least two high-risk features for IH. Zero PMA patients developed IH compared to 5.3% non-PMA patients ($p = 0.314$) (6-months mean follow-up). No difference in surgical site occurrences (SSO) were identified between the two groups.

Conclusions: Early results are encouraging, demonstrating PMA is safe with equivocal SSO. Further studies are needed to assess if the reduction in IH formation is statistically significant with longer follow-up.

Summary: Studies in other parts of the world have shown that the selective, targeted use of prophylactic mesh augmentation (PMA) can reduce incisional hernias (IH). North America, and in particular the United States (U.S.), has been slow to adopt this technique. This study is one of the first in the U.S. to address patient selection, technique and early outcomes for PMA.

Background

Incisional hernias (IH) are prevalent, costly, and a cause of significant morbidity. Current estimates show that approximately 5–20% of all patients receiving a midline laparotomy develop IH.[1–3] This number increases to upwards of 50% in high-risk patients, such as those with obesity, history of smoking, surgical site infections (SSI), prior abdominal surgeries, or abdominal aortic aneurysms (AAA).[1,4–6] Despite advances in IH treatment, there are an unfortunate subset of these patients that enter into a chronic cycle of recurrence, resulting in increasing hospitalizations, escalating healthcare expenditures, and worsening quality of life.[7] By focusing on hernia prevention, there is an opportunity to decrease IH incidence and stop this cycle from propagating.

In discussing IH prevention, it is imperative to consider the method of fascial closure at the time of a laparotomy. Xing et al. have shown that failure of laparotomy incisions to appropriately heal is a principal mechanism for developing IH.[8] Classically, midline laparotomy incisions have been reapproximated primarily. Based on prior studies by Israelsson et al.[9] and Diener et al.[2] along with a meta-analysis by the European Hernia Society,[10] current guidelines suggest that after an elective laparotomy, fascia should in fact be closed primarily using small bites with slowly absorbable monofilament separated by 5–7 mm. Other parts of the world have adopted a 4:1 suture to wound ratio in addition to using small bites, but this has not been well-described in the U.S.

Using these guidelines, recent randomized controlled trials by Jairam et al.[11] and Brosi et al.[12] have shown there might be an adjunctive procedure that reduces IH occurrence even further. These studies demonstrate reduction of IH in high-risk patients from 30 to 39% with primary closure using the small bite, 4:1 method to 13–18% with prophylactic mesh augmentation (PMA).[11,12] Additional studies show that this reduction in IH after PMA may lead to decreased healthcare expenditures[13] and

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Abbreviations

AAA	Abdominal aortic aneurysm
BMI	Body mass index
CPT	Current procedural terminology
EMR	Electronic medical record
IH	Incisional hernia
PMA	Prophylactic mesh augmentation
SSI	Surgical site infection
SSO	Surgical site occurrence

improved quality of life[14] when compared to primary fascial closure. Furthermore, a recent crowdsourcing analysis showed that patients strongly favor avoidance of the hernia state and are accepting of using mesh to prevent the perceived risk of IH.[15]

Despite these apparent advantages, PMA has not been readily adopted in North America.[16] Barriers to PMA in the United States (U.S.) were recently highlighted by the Ventral Hernia Outcomes Collaborative consensus guidelines and included lack of support from Medicare and Medicaid, lack of support from the surgical department at hospitals, limited data on effectiveness, and unclear delineation of the risks.[17]

A key first step in addressing these concerns is to assess the outcomes of PMA in the literature. Our group has previously done this through a systematic review and meta-analysis showing that PMA has a higher risk of seroma when compared to primary closure, with all other surgical site occurrences (SSO) being equivocal.[18] Despite this increased seroma risk, there was still an 85% risk reduction of IH. We now aim to build on these positive findings and report one of the first U.S. experiences with patient selection, operative technique, and assessment of safety and early outcomes when compared to a similar group of patients not receiving PMA.

Material and methods

Cases of PMA performed by the senior author at the University of Pennsylvania between January 1, 2016 and October 31, 2017 were retrospectively identified. This study was approved by the Institutional Review Board of the University of Pennsylvania (Protocol #828285). Patients were selected for inclusion in the study by searching the senior author's operative log for cases where mesh was placed at the time of a laparotomy not categorized as a hernia repair. Descriptive factors, indication for PMA, index procedures at the time of laparotomy, wound class, mesh size, mesh type, location of mesh, method of mesh fixation, length of procedure, length of time for mesh inset, length of hospital stay, and early surgical outcomes were determined through the electronic medical record (EMR).

Primary outcomes were the development of an IH or SSO (defined as an SSI, delayed healing, seroma, hematoma, or wound dehiscence). These were assessed through follow-up visits and computed tomography (CT) scans within the EMR. Secondary outcomes included operative time, mesh inset time, method of mesh inset, and wound class which were documented in the operative-time record within the EMR. Additionally, a comparison group was established by querying the EMR for patients that had similar types of procedures based on Current Procedural Terminology (CPT) codes during the study period. This population was matched to the PMA cohort based on the surgeon performing the laparotomy, age, body mass index (BMI), and similar types of index procedures (Fig. 1).

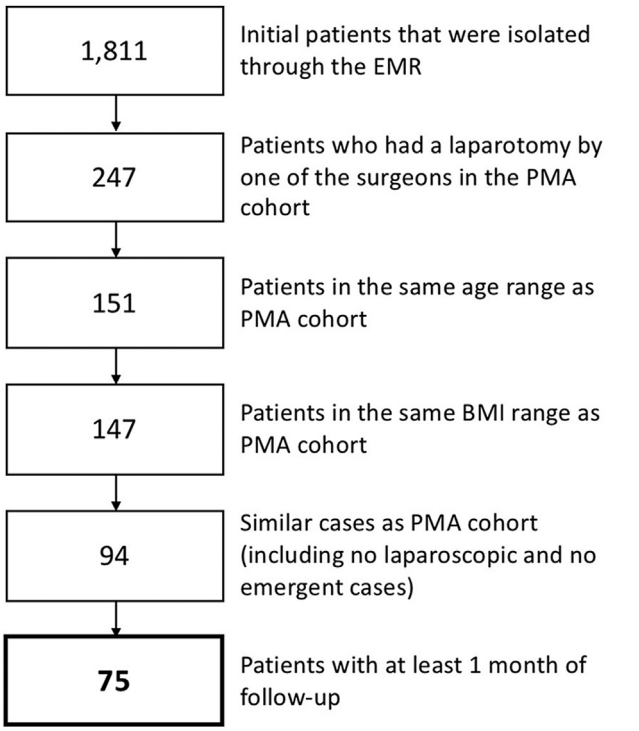

Fig. 1. Isolation of cohort not receiving PMA, matched on index case, surgeon, age, and BMI.

Patient selection for PMA

Once identified through the senior author's operative log, patients' charts were reviewed for the consultation visit and preoperative work-up. At the time of consultation, mesh characteristics, surgical complications and hernia morbidity as well as individual risk factors for IH formation were discussed. Patients were candidates for PMA if they were going to receive open surgery and had at least one risk factor for IH (multiple prior abdominal surgeries, BMI $> 30\ kg/m^2$, presence of a stoma, history of smoking, wound class ≥ 2, history of SSI, and AAA) as determined by a review of meta-analyses focusing on IH risk.[1,4–6] Once presented with the risks, benefits, and alternatives associated with PMA, patients had opportunities to ask questions and obtain clarification about the surgery. The senior author and primary surgeon then discussed an appropriate plan for each individual patient and confirmed the appropriateness of PMA.

Operative technique

Review of the senior author's operative reports showed a consistent technique for onlay mesh placement during PMA, outlined in Fig. 2. After midline laparotomy and completion of the index case by the primary surgeon (e.g., colorectal surgery, gynecology, urology), the senior author begins his portion of the case by raising 2–3 cm skin flaps off of the anterior abdominal wall bilaterally to better identify the fascia. Heavy, slowly-absorbing suture is used to close the midline fascia in a running fashion – one from above and one from below (Fig. 3a). This is accomplished by using a short stitch technique, taking 5–7 mm bites with 5–7 mm between each bite.

The wound is then irrigated with 1–2 L of normal saline. The skin flaps are further mobilized an additional 3–4 cm on each side and the length of the fascial closure is measured. A piece of

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