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# Cost of ventral hernia repair using biologic or synthetic mesh



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## ABSTRACT

**Background:** Patients undergoing ventral hernia repair (VHR) with biologic mesh (BioM) have higher hospital costs compared with synthetic mesh (SynM). This study compares 90-d pre- and post-VHR hospital costs (180-d) among BioM and SynM based on infection risk. **Methods:** This retrospective National Surgical Quality Improvement Program study matched patient perioperative risk with resource utilization cost for a consecutive series of VHR repairs. Patient infection risks, clinical and financial outcomes were compared in unmatched SynM ( $n = 303$ ) and BioM ( $n = 72$ ) groups. Propensity scores were used to match 35 SynM and BioM pairs of cases with similar infection risk for outcomes analysis.

**Results:** BioM patients in the unmatched group were older with higher American Society of Anesthesiologists (ASA) and wound classification, and they more frequently underwent open repairs for recurrent hernias. Wound surgical site infections were more frequent in unmatched BioM patients ( $P = 0.001$ ) as were 180-d costs (\$43.8k versus \$14.0k,  $P < 0.001$ ). Propensity matching resulted in 31 clean cases. In these low-risk patients, wound occurrences and readmissions were identical, but 180-d costs remained higher (\$31.8k versus \$15.5k,  $P < 0.001$ ). There were no differences in hospital 180-d diagnostic, emergency room, intensive care unit, floor, pharmacy, or therapeutic costs. However, 180-d operating room services and supply costs were higher in the BioM group (\$21.1k versus \$7.1k,  $P < 0.001$ ). **Conclusions:** BioM is used more commonly in hernia repairs involving higher wound class and ASA scores and recurrent hernias. Clinical outcomes after low-risk VHRs are similar; SynM utilization in low-risk hernia repairs was more cost-effective.

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## Introduction

Ventral hernias are extremely common, with over 350,000 repairs being performed annually in the United States.<sup>1</sup> Incisional hernias affect as many as 13.9% of patients undergoing

major abdominal surgery,<sup>2,3</sup> and as many as 23% of patients who undergo ventral hernia repair (VHR) require reoperation due to recurrence within 13 y.<sup>4</sup> Each subsequent repair increases the likelihood of recurrence resulting in increasing morbidity and health care costs.<sup>4,5</sup> Mesh-based repairs are the

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current standard of care for ventral hernia treatment and have been shown to be superior to suture-based repairs with a decreased risk of recurrence.<sup>5-7</sup> When considering all metrics, mesh-based repairs are not uniformly superior. A meta-analysis by Nguyen *et al.*<sup>7</sup> revealed that mesh repairs of primary ventral hernias are associated with an increased incidence of seroma and surgical site infection when compared with suture-only repair. Nevertheless, prior randomized controlled trials of clean VHR have demonstrated a 50% reduction in recurrence when mesh repair is used, compared with suture-only repair at both 3- and 10-y follow-up.<sup>5,8</sup>

Synthetic mesh (SynM) has enjoyed widespread use in clean VHR due to its high tensile strength, low cost, and versatility<sup>9</sup>; however, it promotes a local foreign body reaction and has been shown to lead to various complications, including infection, adhesions, bowel obstruction, and development of enterocutaneous fistulae, which have raised debate in regard to use in contaminated fields.<sup>10</sup> Biologic mesh (BioM) materials derived from human or animal extracellular matrices have been described in cases of recurrent, complex, and contaminated or grossly infected repairs. Although the safety of BioM in the setting of contamination is well established, long-term clinical efficacy is frequently questioned.<sup>11</sup> Repairs with BioM in a contaminated field result in fewer wound complications than SynM repairs<sup>12</sup> and infrequently result in mesh removal.<sup>13</sup> However, hernia recurrence rates of nearly 50% with BioM have been reported.<sup>14</sup>

Little is known about the cost-effectiveness of SynM and BioM in high-risk patients, especially when considering the costs of recurrence, postoperative complications, reoperation, and rehospitalization. Retrospective studies in unmatched groups demonstrate greater hospital costs with BioM repairs,<sup>11</sup> including mesh cost which is, on average, 10-20 times more costly than similar synthetic products.<sup>15</sup> The aim of the present study was to compare the cost-effectiveness of BioM and SynM and determine whether the use of BioM is financially viable in patients undergoing VHR at the University of Kentucky Medical Center.

## Methods

The University of Kentucky Medical Institutional Review Board reviewed and approved this retrospective database study. Patient demographics and risk and clinical outcomes data were extracted from our local American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database for patients undergoing VHR at University of Kentucky Medical Center from April 1, 2009 through June 30, 2013. Although suture-only VHRs were collected initially, these cases were excluded. The total number of cases using SynM versus BioM was analyzed as unmatched cohorts, calculating differences in perioperative characteristics, postoperative outcomes, and 180-d net profit using Mann–Whitney *U* test of medians, *t*-test for unequal variances for financial parameters, and Fisher's exact or chi-square test of proportions, as appropriate. A *P* value of <0.05 was considered significant. Propensity scores were used to closely match 35 SynM and BioM pairs of cases with similar wound class, recurrent hernia status, approach, inpatient versus outpatient surgery, and

American Society of Anesthesiologists (ASA) class in our matched analysis. Clinical outcomes using NSQIP stratification of infection and complication were compared. The University of Kentucky Hospital accounting department provided the revenue, direct and indirect costs, contribution and profit margins each patient accrued from 90 d preoperatively to 90 d postoperatively for VHR. *T*-test was used to calculate the difference in mean values related to the total 180-d cost associated with biologic versus synthetic ventral hernia mesh repair.

## Results

In total, 448 VHRs were performed during the period with NSQIP data collected. Eleven of these (2.5%) were repeat operations, one of which occurred within 6 mo of the first procedure. This operation was considered a readmission and excluded as an index case, leaving 447 index cases for analysis performed on 437 patients. Cases performed without mesh (*n* = 44, 10.1%), a combination of synthetic and biologic mesh (*n* = 10, 2.3%), or absorbable SynM (*n* = 8, 1.8%) were excluded from analysis. A total of 375 patients were included in final analysis to compare the risks and outcomes between the groups of patients receiving SynM (*n* = 303, 69.3%) and BioM (*n* = 72, 16.5%).

As summarized in Table 1, numerous patient and operative characteristics differed between unmatched groups, as did most outcomes. Patients repaired with BioM had higher ASA class, higher wound class, more recurrent hernia repairs, or preoperative open wounds and were performed more frequently on an inpatient basis via an open approach. Clinical and financial outcomes were worse in BioM patients, reflecting the disease severity.

Propensity matching was successful on about half of the BioM cases, resulting in 35 patients in each group who were similar with respect to ASA class, inpatient status, laparoscopic versus open approach, medical comorbidities, wound class, diagnostic-related group, and recurrent status (Table 2). Operative characteristics of this matched cohort were similar including largely open, elective, clean cases with recurrent or incarcerated hernias. The only significant difference was median duration of the operation (SynM 124 min, BioM 197 min; *P* = 0.002). Based on our data set, it is unclear why BioM repairs required longer operative times, potentially secondary to mesh position or additional sutures required for fixation. Clinical outcomes were comparable for matched cases including percentage of surgical site infections (11% in both groups), emergency room postoperative evaluation (8.6% SynM, 20% BioM; *P* = 0.306), and readmissions for any reason (26% in both groups) (Table 3).

Hospital financials summarized in Table 4 report the net revenue for the 180 d surrounding VHR. Direct hospital costs are higher for BioM repairs, as expected, due to increased material cost, with a negative contribution margin of \$2895 compared with gain of \$5046 with SynM repairs. Ultimately, both repairs, regardless of the type of mesh, are performed at a net loss for the hospital system. The total cost of the procedure is tabulated to include both direct and indirect costs summarized in Table 5. The mean cost by category in Table 5 for matched low-risk patients undergoing VHR is illustrated in Figure with dramatic differences in operating room services and supplies.

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