Cost-utility analysis of the use of prophylactic mesh augmentation compared with primary fascial suture repair in patients at high risk for incisional hernia

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Background. *Although hernia repair with mesh can be successful, prophylactic mesh augmentation (PMA) represents a potentially useful preventative technique to mitigate incisional hernia risk in select high-risk patients. The efficacy, cost-benefit, and societal value of such an intervention are not known. The aim of this study was to determine the cost-utility of using prophylactic mesh to augment fascial incisions.*

Methods. *A decision tree model was employed to evaluate the cost-utility of using PMA relative to primary suture closure (PSC) after elective laparotomy. The authors adopted the societal perspective for cost and utility estimates. A systematic review of the literature on PMA was performed. The costs in this study included direct hospital costs and indirect costs to society, and utilities were obtained through a survey of 300 English-speaking members of the general public evaluating 14 health state scenarios relating to ventral hernia.*

Results. *PSC without mesh demonstrated an expected average cost of $17,182 (average quality-adjusted life-year [QALY] of 21.17) compared with $15,450 (expected QALY was 21.21) for PMA. PSC was associated with an incremental cost-efficacy ratio (ICER) of −$42,444/QALY compared with PMA such that PMA was more effective and less costly. Monte Carlo sensitivity analysis was performed demonstrating more simulations resulting in ICERs for PSC above the willingness-to-pay threshold of $50,000/QALY, supporting the finding that PMA is superior.*

Conclusion. *Cost-utility analysis of PSC compared to PMA for abdominal laparotomy closure demonstrates PMA to be more effective, less costly, and overall more cost-effective than PSC. (Surgery 2015;158:700-11.)*

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Incisional hernia (IH) is a common and costly complication after operative interventions requiring abdominal fascia incisions, with an incidence approaching 70% in high-risk patients[1] and an annual cost upwards of $3.2 billion dollars in the United States alone.[2] Hernia decreases quality of life, impairs function, and causes pain, imparting added morbidity and mortality for patients.[3] Additionally, IH represents a financial loss for institutions,[4] and with each recurrence, successful repair becomes less likely and more costly.[5] Owing to the significant incidence, cost, and impact on patients there is a continued need for prevention and mitigation of IH risk.

Despite advances in operative technique, hernia repair outcomes have unfortunately not improved significantly in recent years.[5] Mesh reinforcement can reduce long-term hernia recurrence, but the long-term overall incidence of recurrences still approaches nearly 1 in 3.[6,7] Despite established evidence regarding the benefits of mesh reinforcement, there are wide and continued variations in the use of mesh and overall practice patterns.[8] As with many other common health issues such as diabetes, hypertension, and cardiovascular disease, primary prevention may offer the most cost-effective strategy for addressing IH.[9-13]

Incisional access through the abdominal wall is the prime culprit of hernia, and its prevention can begin at the index operation with targeted use of mesh prophylaxis in high-risk patients. Such high-risk patients are generally considered to be those with multiple comorbidities, including morbid obesity, diabetes, and hypertension.[14-25] This may afford the most effective and cost-efficient strategy, however to date there is no such analysis comparing prophylactic mesh augmentation (PMA) to primary suture repair (PSC) alone from a cost-utility standpoint. Studies have demonstrated relative benefits of PMA in reducing hernia formation after laparotomy in select high-risk patients, particularly in overweight individuals, including recent metaanalyses.[20,21] Many of these studies have been smaller, randomized controlled trials and have demonstrated potential risk reduction with PMA.[22,23] The aim of this analysis is to perform a cost-utility analysis of PMA versus PSC without mesh.

METHODS

This study, which was exempt from institutional review board review, employed a decision tree model to evaluate the cost-utility of using PMA compared with PSC after elective laparotomy. A cost-utility analysis is composed of costs, probabilities, and utilities of various outcomes (health states) used to evaluate the cost effectiveness of a novel intervention relative to the standard of care. The decision to utilize PMA is conventionally surgeon preference; as such, we designed our decision model with no mesh/PSC as the "standard of care" compared with PMA. The cost-utility analysis was performed in the United States surgical sector using TreeAge Pro 2013 (Williamstown, MA) with methodology based on guidelines set forth by the United States Panel on Cost-Effectiveness in Health and Medicine.[26] Study time horizon was the average remaining life expectancy of subjects from our survey (30 years on average), assuming that the average patient undergoing ventral hernia repair is 50 years old with life expectancy of 78.3 years (assumed 80 years for ease of calculation).

Perspective. We adopted the societal perspective for cost and utility estimates, which incorporates direct costs related to management of complications from hospital/provider perspective, indirect costs to the patient (travel, costs of lost wages from recovery), and to society (productivity loss owing to employment absenteeism) for a given intervention. These indirect costs can either be modeled fiscally or included in utility estimates (as performed here).

Health states and probabilities. Health states are equivalent to postoperative outcomes. The relevant surgical literature was reviewed to identify clinically relevant outcomes reported with consistent definitions, including primary hernia formation, infection, hematoma, seroma, wound dehiscence, small bowel obstruction requiring operation, and enterocutaneous fistula. Hernia was defined by clinical examination or an imaging study. Wound infection was classified as either superficial (outpatient antibiotics), infection requiring admission for intravenous antibiotics, or deep-space infection (operative). Successful repair was defined by the absence of postoperative complications.

A systematic literature review was conducted in MEDLINE and EMBASE using the search terms "laparotomy," "mesh," "prophylactic," "prophylaxis," "incisional hernia," "surgical complication," "hernia prevention," "surgical mesh," along with Boolean operators "AND"/"OR" to determine health state probabilities for PSC and PMA for English articles published after 1995 with the following inclusion criteria:

a) cohort design of patients undergoing open midline laparotomy for any indication;

b) directly compared PSC and PMA; and

c) adequate reporting of operative technique and outcomes.

Case series describing only PSC or PMA and those involving laparoscopic surgical approaches were excluded. "High-risk patients" were considered to be adults undergoing abdominal surgery at higher risk for IH owing to the presence of comorbidities including being obese (body mass index >30 kg/m^2), hypertension, and diabetes. Pertinent data was extracted, pooled, and weighted relative to individual study sample size. The I^2 statistic, an estimate of heterogeneity, was judged low for an I^2 of <50%, borderline heterogeneous 50–75%, and unacceptable >75%. All analyses were conducted in Stata IC 13.1 (StataCorp 2013. Stata Statistical Software: