The American Journal of Surgery 213 (2017) 1042–1045

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Hospital wide porcine mesh conversion results in cost savings with equivalent clinical outcomes

Nickolas Byrge, MD, Mary C. Mone, RN, BSE, Daniel Vargo, MD *

Department of Surgery, University of Utah School of Medicine, Salt Lake City, UT, USA

ARTICLE INFO

Article history:
Received 8 November 2016
Received in revised form
8 January 2017
Accepted 19 January 2017

Keywords:
Ventral hernia
Cost
Biologic mesh
Permacol™
Strattice™

ABSTRACT

Background: A variety of biologic mesh is available for ventral hernia repair. Despite widely variable costs, there is no data comparing cost of material to clinical outcome.
Methods: Biologic mesh product change was examined. A prospective survey was done to determine appropriate biologic mesh utilization, followed by a retrospective chart review of those treated from Sept. 2012 to Aug. 2013 with Strattice™ and from Sept. 2013 to Aug. 2014 with Permacol™. Outcome variables included complications associated with each material, repair success, and cost difference over the two periods.
Results: 28 patients received Strattice™ and 41 Permacol™. There was no statistical difference in patient factors, hernia characteristics, length of stay, readmission rates or surgical site infections at 30 days. The charges were significantly higher for Strattice™ with the median cost $8940 compared to $1600 for Permacol™ ($p < 0.001$). Permacol™ use resulted in a savings if $181,320.
Conclusions: Permacol™ use resulted in similar clinical outcomes with significant cost savings when compared to Strattice™. Biologic mesh choice should be driven by a combination of clinical outcomes and product cost.

1. Introduction

In the current climate of health care with the goal of providing high quality care while decreasing cost, one of the main means for reducing cost is by examining the cost of medical products and evaluating cost comparisons. Health care systems are undertaking in-house studies to ascertain if introducing products based on lower cost will not sacrifice existing quality standards. Many products such as pacemakers[1] and orthopedic joint components[2] are examples of products in which cost and outcomes have been examined and directed product purchasing.

In the general surgical practice, the type of biologic mesh used for ventral hernia repair (VHR) is an example of cost variation that could result in potential savings. VHR for primary hernias, incisional hernias, and recurrent hernias is a common surgical procedure. These surgeries range from a simple outpatient umbilical hernia repair to inpatient abdominal wall reconstruction or a complex incisional hernia repair. Not only does the surgeon need to consider the anatomy relevant to each hernia but also the potential techniques of hernia repair, the degree of contamination, the appropriate timing of a repair, and when and how to use the mesh implants available, if indicated.

Well over 200 meshes are now available in the United States for use in hernia repairs.[3,4] Mesh can either be synthetic, slowly resorbing, or biologic and can have numerous indications for use. The type of mesh implanted can be driven by several variables including patient condition, type of hernia, and surgeon preference. The Ventral Hernia Working Group (VHWG) has established guidelines for use of the various types of mesh with regards to patient characteristics, hernia characteristics and degree of contamination.[5] It is not clear if these guidelines are utilized as intended and as such, there may be either under- or over-utilization of more costly mesh repair products. The purpose of this study to assess the use of biologic mesh in a single academic center and determine if conversion from one biologic mesh product to another of lesser cost would have any affect on patient outcomes in the thirty-day post operative period. Additionally, the indication for utilization was reviewed to assure that VHWG guidelines were being followed. Our hypothesis is that, using the best technique known for hernia repair, the type of implant used will not impact

* Corresponding author. 3B-312 SOM, 30 North 1900 East, Salt Lake City, UT 84132, USA.
E-mail address: daniel.vargo@hsc.utah.edu (D. Vargo).

http://dx.doi.org/10.1016/j.amjsurg.2017.01.027
0002-9610/

the short-term outcome for the procedure.

2. Material and methods

A survey was created to collect data at the time of ventral hernia repair in patients 18 years and older. Implementation of the survey coincided with a change in biologic mesh product from Strattice™ (Lifecell, Bridgewater, NJ) to Permacol™ (Covidian, Mansfield, MA). During this data period Permacol™ was the sole biologic mesh product available for VHR. The survey contained the date, the type of hernia, the size of mesh used, the type of mesh used and several patient related factors such as history of diabetes, tobacco use, chronic obstructive lung disease, obesity, coronary artery disease, age, immunosuppression, chronic steroid use, active infection, active bacterial colonization, previous skin infection, presence of an intestinal stoma near the repair and any violation of the gastrointestinal tract. This survey was limited to patients who had biologic mesh implanted at the time of the procedure. The survey was attached to each box of biologic mesh used and completed perioperatively. The survey was completed for all cases in which a biologic mesh was chosen for use by the surgeon. Implant choice was made by the surgeon alone and not driven by any institution protocol. Completed questionnaires were collected by a Nurse Coordinator and delivered to the research team on a weekly basis.

A comparison group was generated by retrospective data collection. Patients undergoing VHR with biologic mesh were identified via an operative database. At the time of data collection, the only biologic mesh available for use was Strattice™. Data collected was identical to that of the prospective group and was obtained by review of the electronic medical record, operative report, and NSQIP database.

Study data was collected and managed using electronic data capture tools hosted at University Of Utah. The system employed was REDCap (Research Electronic Data Capture) which is a secure, web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources. The data contained in the surveys were then assessed for accuracy by cross verification of data from each patient's inpatient and outpatient electronic medical record. In those cases without a complete survey, the operative dictation, electronic medical record, and NSQIP database were used to complete the survey.

Of note, while the specific operative technique was not standardized across all patients, the concepts of repair were consistent. These included placement of the biologic mesh in either the intraperitoneal or retrorectus space, establishing midline closure (utilizing component release if needed), preservation of umbilical perforators, excision of all potentially non-viable skin and scar, and skin closure over drains if skin flaps were generated. Antibiotic use post-operatively was limited to <24 h if no infection was noted at the time of the procedure.

The cost of biologic mesh was obtained from the hospital billing department and were based on contractual agreements for each brand and sizes that were available.

Data were exported from REDCap into Microsoft Excel (Version14.4.3, Redmond, WA) and statistical analysis was completed using Stata (Version 13.1, College Station, TX) Results are reported as frequency distribution percentages and mean ± standard deviation. Univariate analysis was performed by employing a *t*-test for normally distributed variables and a non-parametric Mann-Whitney *U* test for non-normally distributed variables. Categorical variables were analyzed using chi-square testing and Fisher's Exact test. A p-value of <0.05 was considered to be statistically significant.

3. Results

At our institution, retrospective data was collected from September 2012 to August 2013, a time when only Strattice TM was used (STR, n = 28). Prospective data was collected from September 2013 to August 2014, a time when only Permacol TM was used (PER, n = 41). Table 1 summarizes the general characteristics of these two groups. There were no differences in the gender, age, BMI and ASA score between the two groups. Both groups also had similar incidence of comorbidities such as diabetes, COPD, chronic steroids, cancer and immunosuppression. The groups also had similar incidence of active infection, active colonization and current mesh infections. Immunosuppression trended toward significance with more patients in the PER.

Hernia characteristics are shown in Table 2. The most common type of hernia was recurrent incisional hernia. Hernia working group classification, wound classification, violation of the GI tract and nearby stoma was similar between the groups. Overall the groups are quite similar with regards to patient and hernia characteristics.

Patients were followed for 30 days to assess for early post-operative occurrences (Table 3). There was no significant difference between PER and STR with regards to overall surgical site occurrences. Additionally, there was no difference in specific occurrences, such as surgical site infections, deep space infections, skin necrosis, hematoma and seroma.

Cost data is shown in Table 4. STR implant costs were significantly higher than PER costs. STR used 28 sheets of implant and PER used 41 sheets of implant, one per patient. Overall cost of the 41 sheets of Permacol™ was $90,352 compared to the overall cost of the 28 sheets of Strattice™ at $239,892. Comparing the sizes of the implants utilized, there was no difference in product utilized based on square centimeter/case.

4. Discussion

Value is becoming an important aspect in making decisions in healthcare.[6,7] The value equation is defined as quality or perceived benefit over cost. Thus, improved quality can be attained by either

Table 1
Patient charactersitics.

	Permacol™ (n = 41)	Strattice™ (n = 28)	p-value
Gender (Male)	53.7 (22)	60.7 (17)	0.56
Age	55.8 ± 13	56.1 ± 13	0.94
BMI	33.99 ± 9.7	35.2 ± 7.5	0.56
Current Smoker	9.8 (4)	14.3 (4)	0.42
Diabetes	26.8 (11)	28.6 (8)	0.87
COPD	2.4 (1)	3.6 (1)	0.65
Chronic Anticoagulation	7.3 (3)	0	0.2
History of Cancer	22 (9)	14.3 (4)	0.42
Chronic Steroid	29.3 (12)	7.1 (2)	0.025
Immunosuppression	39 (16)	17.9 (5)	0.061
Previous Infection	75.6 (31)	75 (21)	0.95
History of SSI	65.9 (27)	71.4 (20)	0.63
Active Colonization	19.5 (8)	25 (7)	0.59
Active Infection	43.9 (18)	28.6 (8)	0.197
History of Mesh Implant	46.3 (19)	67.9 (19)	0.078
Current mesh infection	14.6 (6)	14.3 (4)	0.63
ASA Score			
2	29.3 (12)	50 (14)	
3	51.2 (21)	39.3 (11)	0.2
4	19.5 (8)	10.7 (3)	