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Implementation of an abdominal closure bundle to reduce surgical site infection in patients on a gynecologic oncology service undergoing exploratory laparotomy

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HIGHLIGHTS

- Closing bundle did not reduce SSI in patients who underwent exploratory laparotomy.
- Patients with advanced malignancy may benefit from the closing bundle.
- Patients with benign pathology do not benefit from the closing bundle.
- The abdominal closure bundle is an inexpensive intervention that is easily implemented.

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ABSTRACT

Objective. Surgical site infections (SSI) are associated with increased morbidity, mortality, and healthcare costs. This study investigated whether implementation of an abdominal closure bundle reduces surgical site infection rates. We aimed to identify sub-populations that would benefit the most from this intervention.

Methods. We conducted a retrospective cohort study of all patients that underwent exploratory laparotomy by a Gynecologic Oncologist from January 1, 2011 to April 1, 2017. The abdominal closure bundle was implemented on May 6, 2014. SSI rates were assessed overall and within subgroups.

Results. 875 patients were included in the analysis. Overall, SSI rate was reduced, albeit not significantly, from 48/471 (10.2%) to 32/404 (7.9%) ($p = 0.148$) with implementation of the closing bundle. In patients that underwent a tumor debulking procedure, SSI was noted in 36/277 (13.0%) in the pre-bundle group and 14/208 (6.7%) in the post-bundle cohort ($p = 0.017$). In patients with malignant pathology, the pre-bundle cohort had an SSI rate of 38/282 (13.5%), which reduced to 18/215 (8.4%) in the post-bundle group ($p = 0.049$). In patients with FIGO stage III or IV disease, the SSI rate was reduced from 21/114 (18.4%) to 8/87 (8.4%) with implantation of the closure bundle ($p = 0.028$). In patients with intra-operative ascites, SSI rate decreased from 19/119 (15.9%) pre-bundle to 4/104 (3.8%) in the post-bundle group ($p = 0.002$).

Conclusions. Implementation of an abdominal closure bundle was not associated with a significant reduction in overall SSI rate. However, multiple subpopulations associated with advanced gynecologic cancer benefited from this intervention.

1. Introduction

Surgical site infection (SSI) is a significant cause of morbidity and mortality and leads to increased utilization of resources. Patients with SSI are 60% more likely to spend time in an intensive care unit, carry a five-fold increased risk of readmission, and have twice the mortality rate compared to their uninfected counterparts [1]. In addition, SSI adds a $3.5 to $10 billion per year burden to the healthcare system of the United States [2]. Therefore, in 2009 the United States Department of Health and Human Services set SSI reduction goals via the *National Action Plan to Prevent Health Care Associated Infections* [3].

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Gynecologic procedures pose a difficult challenge because pathogenic organisms may originate from the skin or ascend from the vagina and cervix into the operative site [4]. Although gynecologic procedures span across a variety of benign surgeries, many laparotomy cases occur within the purview of gynecologic oncology. These patients often belong to a more elderly or obese population and tend to have multiple comorbidities [5]. These procedures tend to be more radical, which further increases the risk of postoperative SSI. Therefore, it is worthwhile to not only stratify SSI by specialty, but also by benign and malignant pathology.

Given the broad impact of SSI, quality improvement measures are being implemented in many institutions across the United States. The development of a combination of best practices (known as "bundling") to decrease SSI can involve interventions in the preoperative, intraoperative, and postoperative setting. They often involve elements such as preoperative antibiotic administration, bowel preparation, preoperative chlorhexidine body cleansing, intra-operative skin preparation, changing of gown and gloves prior to abdominal closure, usage of new sterile instruments for closure, and strict postoperative wound management [6]. Though much of the original data was in colorectal surgery [7–19], in more recent years, SSI bundles have been applied to the fields of benign gynecology and gynecologic oncology [2,6,20,21]. Pellegrini et al. published a consensus bundle for prevention of SSI after major gynecologic surgery [1]. Additionally, teams at the Mayo Clinic, Memorial Sloan Kettering Cancer Center, and Johns Hopkins University reported significant improvement in SSI rates in gynecologic oncology patients that underwent exploratory laparotomy for malignancy with or without bowel resection after implementation of a multi-point surgical site infection reduction bundle [2,6,8].

Despite this positive data, it is important to consider that large bundles may be difficult to apply effectively in community and safety net institutions. These hospitals may not have the resources or staff to follow up with patients and ensure compliance, so it is important to determine if individual practices within the larger bundles have value in reducing SSI rates. For these reasons, we investigated whether implementation of an abdominal closure bundle alone successfully reduced SSI rates in patients that underwent exploratory laparotomy in the department of gynecologic oncology. In addition, we aimed to identify specific patient populations that could particularly benefit from the abdominal closure bundle.

2. Methods

This retrospective cohort study was approved by the Institutional Review Board at Abington Hospital in Abington, Pennsylvania. All patients that underwent exploratory laparotomy by a gynecologic oncologist at our institution from January 1, 2011 to April 1, 2017 were identified. The closing bundle was instituted in all divisional cases as a quality improvement project and did not differentiate between heterogeneous populations. All procedures and follow-up care were performed by a gynecologic oncologist, and an upper year gynecology resident was also involved in each case. All patients were seen as an outpatient at two weeks and four-to-six weeks post-operatively.

The gynecologic oncology service at Abington Hospital implemented an abdominal wound closure bundle on May 6, 2014 for all patients undergoing exploratory laparotomy. The bundle includes changing of the surgical gown and gloves, repeat surgical scrub (either Avagard or Sterillium), and usage of new instruments for closure of fascia, subcutaneous tissue, and skin. Instruments and disposable items included in the closing tray are summarized in Tables 1 and 2. No other interventions were actively implemented during this study period. In 2012, Abington Hospital systematically implemented the Surgical Care Improvement Program (SCIP) initiatives, including appropriate prophylactic antibiotics, administration of antibiotics within 60 min of surgery start, removal of hair at operative site, perioperative temperature management, and postoperative blood glucose control. All patients included in the study received appropriate pre-operative antibiotics within 60 min of incision, and were re-dosed if procedure time exceeded 4 h or if blood loss exceeded 1500cm^3. Pre-operative interventions such as chlorhexidine antibacterial body scrub and mechanical bowel prep were not recorded in this study and their use was left to the discretion of the surgeon. All patients received chlorhexidine abdominal preparation. Closure technique, type of suture, and placement of subcutaneous drains were not specified in the closure bundle. All patients with greater than two centimeters of subcutaneous tissue received subcutaneous tissue reapproximation. All surgical dressings were removed on the second post-operative day. Adherence to these measures was verified via review of the operative record.

Table 1
Instruments included on the abdominal closure tray.

Adson forceps (2)
Debakey forceps (1)
Ferris smith forceps (1)
Straight kocher (2)
Mayo needle holder (2)
Mayo scissors curved (1)
Malleable retractor 1 1/2″ (1)
Malleable retractor 2″ (1)
Richardson retractor (2)

Operative, anesthesia, and nursing records were reviewed to obtain patient demographic and surgical data. Inpatient and post-operative outpatient electronic medical records were reviewed for surgical site infection within 30 days of procedure. Surgical site infection was defined per the Centers for Disease Control and Prevention surgical site infection guidelines [3].

Patient demographics, surgical characteristics, and SSI rates were compared between the pre-bundle and post-bundle cohorts. All categorical variables were analyzed using chi-squared and Fisher's exact tests. For non-parametric variables, a Mann-Whitney *U* test was used. A p-value <0.05 indicated a statistically significant difference for all comparisons of primary and secondary outcomes. Two-sided statistical assessment was used for comparisons of patient demographic data and surgical characteristics, while a one-sided assessment was used for all surgical site infection analysis.

Multivariate regression analysis of surgical site infection was also completed. A univariate analysis of all SSI risk factors was first performed. Covariates with $p < 0.05$ as well as closing bundle ($p = 0.148$) were included in the multivariate analysis. A backward elimination analysis was then completed until only variables with $p < 0.05$ remained. All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 20.

3. Results

During the study period, 951 patients underwent exploratory laparotomy by a gynecologic oncologist. Of those identified, 76 patients

Table 2
Itemized cost of disposable items in the abdominal closure bundle.

Item	Cost (US dollars)
Pitcher (1)	$1.55
Surgical gowns (3)	$3.56
Suction tip (1)	$0.28
Needle box (1)	$1.03
Lap sponge pack (1)	$0.23
1 Mayo stand cover (1)	$0.75
Surgical gloves (4)	$2.52
Bovie tip (1)	$4.13
Light handle (2)	$0.80
Total	$14.85

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