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Comparison of surgical incision complete closure versus leaving skin open in wound class IV in emergent colon surgery

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ABSTRACT

Introduction: Our aim was to compare the effect of techniques of wound closure in the emergent colon surgery with wound class IV.

Methods: Using 2014 the colectomy targeted ACS-NSQIP dataset; we identified patients undergoing emergent colectomy with wound class IV. Comparison of surgical incision complete closure versus leaving the skin open and multivariate logistic regression analyses was performed.

Results: Of 1792 patients undergoing emergent colectomy with wound class IV, the complete closure cohort had 1376 patients and the incision skin open cohort had 416 patients. The incidence of deep SSI was 2.3% in the complete closure cohort vs. 1.2% in the incision skin open, $p = 0.15$, and intra-abdominal abscess rate was 11.8% in the complete closure cohort vs. 12.3% in the incision skin open, $p = 0.78$. The dehiscence rate, readmission rate, and reoperation rates were not statistically significant between two cohorts. A multivariate model for dehiscence did not yield significant association between the complete closure cohort and incision skin open cohort.

Conclusions: Surgical incision complete wound closure in the emergent colon surgery with wound class III/IV is safe and effective.

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1. Introduction

Fascial closure with leaving surgical incision skin open to heal by secondary intention is frequently performed following in emergent colorectal surgery in wound class III and IV.¹ However, it is associated with higher pain and resource utilization with suboptimal cosmetic outcomes. Primary closure of skin allows healing with primary intention and does not require daily dressing changes or negative-pressure wound therapy and has been shown to be cosmetically superior.

Surgical Site infection (SSI), intra-abdominal abscess, a length of stay (LOS) and readmission are the leading parameters in the evaluation of the quality of care and resources utilization in colorectal surgery.^{2,3} In wound class III and IV because of a higher rate of wound infections many surgeons are hesitant to close the skin. We believe the complete closure of surgical incision in emergent

colectomy with class IV wound does not increase the rate of deep wound infection, dehiscence, and intra-abdomen abscess and leaving the skin open of surgical incision in emergent colectomy with class IV is associated with increased length of stay reflecting increased resource utilization.

In this study, we reviewed the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) database with the primary goals to determine the outcomes of techniques of wound closure in the emergent colon surgery with wound class IV. Our secondary goals were to evaluate perioperative factors associated with the decision to perform surgical incision complete closure versus leaving the skin open after emergent colectomy in wound class IV and to construct multivariate logistic regression models to identify independent predictors of fascial dehiscence after emergent colectomy in wound class IV.

2. Methodology

2.1. Data source

The ACS-NSQIP and targeted ACS NSQIP is a risk-adjusted data

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collection mechanism that collects and analyzes clinical outcomes data. Participating hospitals use their collected data to develop quality initiatives that improve surgical care and to identify elements in provided healthcare that can be improved when compared with other institutions. The ACS-NSQIP collects data on a variety of clinical variables, including preoperative risk factors, intraoperative variables and 30-day postoperative mortality and morbidity outcomes for patients undergoing major surgical procedures in both the inpatient and outpatient setting. A site's surgical clinical nurse reviewer (SCNR) captures outcomes data using a variety of methods including medical chart extraction. To ensure the data collected are of a high quality, the NSQIP has developed different training mechanisms for the SCNR and conducts an inter-rater reliability audit of participating sites. The processes of SCNR training, inter-rater reliability auditing, data collection, and sampling methodology have been previously described in detail.⁴

2.2. Data selection

From 2014, the colectomy-Targeted ACS NSQIP and ACS NSQIP datasets were used for this study. This data source contains prospectively collected information on perioperative variables, which are of specific importance when considering the outcomes of patients who undergo colectomy, including the indication for index operation, steroid/immunosuppressant use for inflammatory bowel disease, bowel Prep, chemotherapy within 90 Days, anastomotic leak, wound closure technique and other preoperative risk factor. We included all the patients who underwent emergent colectomy for various etiologies with wound class IV. The exclusion criteria for the study was patients with missing information about the wound closure technique, elective colectomy, patients who require keeping abdomen open with temporary closure device at the end of surgery and patients with wound class II and III. The colectomy-targeted dataset and general ACS NSQIP records of the patients meeting the aforementioned inclusion and exclusion criteria were subsequently merged to capture the full extent of perioperative variables available for each patient.

The primary predictor variable for our analysis was wound closure technique, which was considered as a binomial nominal categorical variable - surgical incision complete closure and leaving the skin open. Other potential predictor variables included patient sex, race/ethnicity (white, black, Hispanic, or other/unknown), age, diabetes mellitus (none, non-insulin requiring, or insulin requiring), ongoing tobacco use, chronic obstructive pulmonary disease (COPD), congestive heart failure, hypertension requiring medication, disseminated cancer, chronic steroid use, weight loss more than 10% within 6 months before index operation, bleeding disorder, preoperative shock, wound closure technique, operative time, ASA, anastomotic leak, deep surgical site infection.

2.3. Outcomes

The outcome variables for our analysis were 30-day postoperative incidences of deep incisional surgical site infection, abscess, dehiscence (fascial closure disruption), post operative septic/shock, still in hospital at 30 days, mortality, unplanned reoperation, unplanned operation related to primary procedure, unplanned readmission, unplanned readmission related to primary procedure and length of hospital stay.

2.4. Statistical analysis

The preoperative and intraoperative characteristics of patients in the 2 cohorts - surgical incision complete closure versus leaving the skin open were assessed. We described categorical data as

absolute numbers and percent prevalence (%) in the study cohort and continuous variables as means \pm standard deviation. Categorical variables were compared by use of the Chi-squared test or Fisher's exact test for discrete values. Independent two-sample t-tests were used for normally distributed continuous variables, and the Wilcoxon rank-sum test was used for non-normally distributed continuous and ordinal variables.

Multivariable logistic regression modeling was used to assess the perioperative factors associated with the decision to perform surgical incision complete closure versus leaving the skin open after emergent colectomy in wound class IV and to identify factors independently associated with fascial dehiscence after emergent colectomy in wound class IV while controlling for possible confounders. Adjusted multivariable models were created by all candidate covariates potentially associated with ischemic colitis and 30-day mortality on univariate analysis with P value ≤ 0.2 . Candidate covariates were evaluated for inclusion in adjusted models using forward selection with $P < 0.05$ as the entry criterion. The model selection was based on a stepwise procedure, which alternates between dropping the least significant variable from the model and then reconsidering all potential variables for reintroduction into the model until no more variables can be added. The discriminatory capacity was tested using the Harrell's concordance index. Harrell's C statistic was used to estimate the proportion of correct predictions. Harrell's C index ranges from 0.5 (no discrimination) to 1 (perfect discrimination). So, the overall model fit was obtained using the C statistic, the Hosmer-Lemeshow goodness-of-fit test, and the Pearson χ^2 statistics. We analyzed data using IBM SPSS, Version 21.0. Armonk, NY.

3. Results

3.1. Study population characteristics

A total of 1792 patients underwent emergent colectomy for various etiologies with wound class IV in 2014, of which 416 were in the fascia only closure (incision skin open) cohort and 1376 were in the complete closure cohort. Comorbidities, demographics and patients characteristics data of the two study cohorts are summarized in [Table 1](#). The mean age at presentation was similar in both cohorts (complete closure cohort 62.22 ± 15.49 versus 63.22 ± 14.74 incision skin open cohort with P -value 0.24). There was 50.9% female in the complete closure cohort as compared to the 53.4% in the incision skin open cohort; there was no statistical difference. There was a significant statistical difference in body mass index (BMI) between the two cohorts; complete closure cohort 26.13 versus 27.65 for incision skin open cohort with P -value 0.01. In the incision skin open cohort, perforation as an indication for emergent surgery was 84.6% as compared 70.8% in the complete closure cohort with the P value < 0.01 however, preoperative serum albumin was significantly low in the incision skin open cohort 3.08 as compared to 3.22 in the complete closure cohort, P -value < 0.01 .

3.2. Outcomes

The mean operation time was same between both cohorts (mean operation time: complete closure cohort, 141.16 ± 64.17 min; incision skin open cohort 142.09 ± 60.85 min; P -value 0.79). The incidence of superficial surgical site infection (SSI) was 10.3% in the complete closure cohort; superficial SSI was not applicable for the incision skin open cohort. The rate of deep SSI and intra-abdominal abscess did not differ statistically (Deep SSI: complete closure cohort, 2.3% versus incision skin open cohort 1.2%; P -value 0.15 and intra-abdominal abscess: complete closure cohort, 11.8% versus incision skin open cohort 12.3%; P -value 0.78). The rate of

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