

Clinical Science

Smoking as dominant risk factor for anastomotic leak after left colon resection



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Risk factors

Abstract

BACKGROUND: Some risk factors for anastomotic leak have been identified, but the effect of smoking is unknown.

METHODS: This study aimed to evaluate the effect of smoking on clinical leak after left-sided anastomoses. Adult patients who underwent elective left colectomy between January 1, 2008 and December 31, 2012 were included. Those with stomas and inflammatory bowel diseases were excluded. Primary outcome was anastomotic leak requiring percutaneous drainage or operative intervention within 30 days.

RESULTS: There were 246 patients included; 56% were female. Most had a diagnosis of diverticular disease (53%) or cancer (37%). Anastomotic leak rate was 6.5% (n = 16). The rate in smokers was 17% versus 5% in nonsmokers ($P = .01$). Smokers had over 4 times greater chance of leak (odds ratio 4.2, 95% confidence interval 1.3 to 13.5, $P = .02$).

CONCLUSION: Smoking is a risk factor for leak after left colectomy. Consideration should be given to delaying elective left colectomy until smoking cessation is achieved.

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Clinically significant leak occurs in 1% to 12% of colorectal operations and up to 14% after distal colorectal resections.¹⁻⁵ Anastomotic leak significantly increases morbidity and mortality, with mortality reported between

6% and 13%.^{2,5,6} Length of hospitalization can increase up to 4 times for those patients with a leak compared with those without a leak.^{3,7} Although anastomotic leak remains a challenging complication following colon and rectal surgery, solid evidence evaluating specific risk factors for anastomotic leak is lacking. A recent prospective study evaluating risk factors for leak after colorectal surgery found that low anastomosis, increasing number of comorbidities, high ligation of the inferior mesenteric artery, intraoperative complications, and male sex are significant risk factors.² However, smoking was not specifically evaluated in this study.

In 2013, the Surgeon General released an updated report on the health consequences of smoking.⁸ Important to the colorectal patient population, the report linked smoking with colorectal cancer and inflammatory bowel disease.

The authors declare no conflicts of interest.

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The report demonstrates tobacco's continued burden to the nation's health with its clear impact on all-cause mortality in men and women. The annual cost for direct medical care of adults attributable to smoking between the years 2009 and 2012 was \$132.5 to 175.9 billion. Smoking is known to cause microvascular disease, tissue ischemia, and hypoxia, which are contributing factors to poor anastomotic healing.

The purpose of this study was to evaluate smoking as an independent, modifiable risk factor for clinical leak after left-sided colorectal anastomoses.

Patients and Methods

Study design and data sources

A retrospective cohort study was performed including adult patients who underwent left colectomy between January 1, 2008 and December 31, 2012, by one of the 4 board-certified colorectal surgeons at a single, tertiary care center. These patients were identified from the Vanderbilt Procedural Outcomes Database—an institutional database that includes clinical and administrative information on patients undergoing procedures. Exclusion criteria were postoperative stoma, diagnosis of inflammatory bowel disease, or emergent operation.

Variables collected from the Vanderbilt Procedural Outcomes Database included current procedural terminology code, date of operation, age, American Society of Anesthesiologists classification, case level (emergent, urgent, or elective), length of operation, perioperative antibiotic compliance, sex, race, and date of death (if applicable). The electronic medical record was used to determine intraoperative and postoperative details including indication for surgery, level of anastomosis, type of anastomotic leak test performed, body mass index, current smoking status, diagnosis of diabetes mellitus, history of chronic obstructive pulmonary disease, current steroid use, and preoperative chemotherapy or radiation therapy. Smoking status was collected as a dichotomous variable: current smoker or not current smoker. A current smoker was defined as anyone smoking within 30 days of the procedure.

The colorectal surgeons at our institution have developed a standardized technique for left colon resections. All patients underwent preoperative mechanical bowel preparation. When feasible, the majority of resections were performed using a laparoscopic approach with a hand-assist port. Anastomoses were preferentially stapled. An intraoperative leak test was routinely performed for left-sided colorectal anastomoses. The type of leak test performed, rigid proctoscopy or flexible sigmoidoscopy, was collected, as this varied by surgeon preference. If a leak was detected intraoperatively, the method of management was also recorded (ie, reinforcing or repairing the anastomosis vs resecting and redoing the anastomosis). The level of anastomosis was classified as below the peritoneal

reflection (low anterior), at the level of the sigmoid, or above the level of the sigmoid.

The primary outcome measure was postoperative clinical anastomotic leak within 30 days of surgery. A clinical leak was defined as air or fluid near the site of the anastomosis, requiring either return to the operating room or percutaneous drainage. Secondary outcome measures included organ space infection and 30-day mortality. The study was performed with approval of the Vanderbilt University Institutional Review Board and Human Research Protection Program.

Statistical considerations

Descriptive statistics for the overall study population were calculated, as well as for the group of smokers compared with nonsmokers. Chi-square and Fisher's exact tests were used to compare proportions, as appropriate. Multivariable logistic regression was performed, with covariates determined a priori with a 2-tailed alpha level of .05 determining significance. The number of events limited the inclusion of all possible factors, so those that were known, strong risk factors, were given priority. The final model included smoking and anastomotic level. Additional covariates which were given consideration in the modeling process included sex, body mass index, recent chemotherapy or radiation therapy, diagnosis, and type of leak test performed. Stata version 13.1 (StataCorp LC, College Station, TX) was used for statistical analysis.

Results

There were 246 patients who met inclusion criteria. The mean age was 58.5 years (± 13 standard deviation), and 56% ($n = 137$) were female. Current smokers made up 12% ($n = 29$) of the study population, and smokers were more likely to be male and were younger than nonsmokers. Detailed demographic characteristics of the overall population, smokers, and nonsmokers can be seen in [Table 1](#). Notably, the nonsmoking group tended to be older, female, and with higher American Society of Anesthesiologists classification.

Operative details are found in [Table 2](#). In the overall population, 75% ($n = 184$) had flexible sigmoidoscopy performed for a leak test. The rate of positive intraoperative leak test was 12.6% ($n = 31$), with no difference between rigid or flexible endoscopy. Most commonly, these leaks were managed by oversewing the area and repeating the leak test ($n = 28$). In 3 patients, the anastomosis was taken down and redone. The majority of patients, 53% ($n = 130$), underwent an operation for diverticulitis, 37% ($n = 90$) for malignancy, and 8% ($n = 20$) for an endoscopically unresectable polyp. Other indications included endometriosis ($n = 2$), volvulus ($n = 2$), ischemic colitis ($n = 1$), and anastomotic stricture ($n = 1$). Smokers were more likely to have a diagnosis of diverticulitis. Of the

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