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Predictive Risk Factors of Early Postoperative Enteric Fistula in Colon and Rectal Surgery

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Early postoperative enteric fistula (PEF) is a complication associated with a high rate of morbidity and mortality in colon and rectal surgery. We evaluated the effect of patient characteristics, comorbidities, pathology, resection type, surgical technique, lysis of adhesions, and admission type on the rate of PEF in colorectal surgery. Using the National Inpatient Sample database, we examined the clinical data of patients who underwent colon and rectal resection from 2009 to 2010. A total of 646,414 patients underwent colorectal resection during this period. Overall, the rate of PEF was 0.37 per cent (2407 patients). Using multivariate regression analysis, Crohn's disease (adjusted odds ratio [AOR], 4.68), lysis of abdominal adhesions (AOR, 4.25), open procedure (AOR, 3.18), and transverse colectomy (AOR, 2.13) significantly impacted the risk of PEF. Although teaching hospitals (AOR, 1.69), obesity (AOR, 1.40), male gender (AOR, 1.30), emergent surgery (AOR, 1.27), age older than 65 years (AOR, 1.24), and diabetes mellitus (AOR, 1.21) also had statistically significant impact on rates of PEF, these were less clinically significant than the other factors. The presence of Crohn's disease and lysis of abdominal adhesions are strongly associated with the development of PEF after colorectal surgery. Laparoscopic surgery was associated with a lower rate of PEF; further studies would be needed to evaluate the importance of this finding.

An enterocutaneous fistula, like any fistula, represents an abnormal communication between two epithelial surfaces. Postoperative enteric fistulas (PEFs) are now the most common cause of intestinal fistulas in modern surgical practice. Unquestionably the most common cause of PEF is anastomotic failure.^{1,2} PEFs occur as the result of intestinal anastomotic dehiscences or unavoidable or inadvertent enterotomies, which generally become clinically evident between the fifth and tenth postoperative days. Failure to recognize an enterotomy at the time of surgery will lead to one of the several postoperative complications; 1) the patient may develop peritonitis within 24 to 48 hours after surgery or 2) the patient may also may present with a PEF with enteric drainage from the incision or wound later in the postoperative course. An enterotomy in and of itself is not necessarily a complication; rather, it is the failure to recognize and adequately repair the enterotomy that leads to trouble.³ Enterocutaneous fistulas that arise spontaneously without antecedent iatrogenic injury are usually manifestations of progression of underlying Crohn's disease, large bowel malignancy, diverticular disease, radiation enteritis, or infections such as tuberculosis and actinomycosis.^{3,4}

Despite progress in the management of fistulas, PEF is correlated with high morbidity and mortality rates, greater costs, and extended hospital stays.⁴ There are

limited available studies in colorectal surgery evaluating of risk factors of PEF. Knowledge of risk factors of PEF may help surgeons to inform patients about this possible postoperative complication and might assist surgeons to decrease the risk of this complication. The primary end point of this study is to identify risk factors associated with the development of PEF after colon and rectal surgery.

Methods and Materials

Because rates of PEF after colorectal surgery are low, analysis of factors that may predict PEF requires a large series of patients that is not frequently available from a single institution; therefore, we used the Nationwide Inpatient Sample (NIS) database, which is the largest inpatient care database in the United States. Approximately 1000 hospitals (1051 hospitals in 2010) contribute data to the NIS, resulting in a database of information from nearly 8 million hospital stays each year.⁵ The NIS is comprised of a nationally representative sample of approximately 20 per cent of U.S. hospitals, resulting in a sampling frame that comprises approximately 95 per cent of all hospital discharges in the United States. Data elements within the NIS are drawn from hospital discharge abstracts that allow determination of all procedures performed during a given hospital admission. It also contains discharge information on inpatient hospital stay including patient characteristics, length of stay, specific postoperative morbidity, and observed in-hospital mortality. The NIS database has no information available on complications occurring after discharge. Not all data elements in the NIS are provided by each state data source. These data elements are provided by the NIS because they can be valuable for research purposes, but they should be used cautiously. For example, ethnicity data are missing from a number of states; therefore, race-specific estimates may be biased. Approval for use of the NIS patient-level data in this study was obtained from the Institutional Review Board of the University of California, Irvine Medical Center and the NIS.

Data Analysis

Using the NIS database, we analyzed discharge data on patients who underwent elective/emergent laparoscopic or open colon and rectal resection in 2009 and 2010, which are the latest available years from this database. Patients who underwent colon and rectal surgery without resection (e.g., simple ostomy closure, rectopexy) were excluded from this study. We used International Classification of Disease, 9th Revision (ICD-9) procedure codes and principal diagnosis codes to identify the type of colorectal resection performed and the indication for surgery. To identify postoperative enteric fistula after colorectal surgery, the ICD-9 diagnosis code of 998.6 for “persistent postoperative fistula” was used. Patients included in our study did not have the principal admission diagnosis of enteric fistula. Also, we used ICD-9 codes of lysis of abdominal adhesions (54.5, 54.51, and 54.59) to identify patients who had previous abdominal surgery.

Preoperative factors that were analyzed include patient characteristics (age, sex, and ethnicity), patient comorbidities, admission type (emergent or elective), pathologic conditions (malignancy, diverticulitis, ulcerative colitis, Crohn’s disease, benign tumor), surgical site (right colon, transverse colon, left colon, sigmoid, and rectum), surgical

techniques (laparoscopic vs open), and hospital teaching status. The overall rate of PEF after laparoscopic and open colon and rectal resection and the rate of PEF by surgical site, pathology type, and admission type were examined.

Risk-adjusted analysis was performed to identify independent predictors of PEF after colorectal surgery. Female gender, age younger than 65 years, white, right colectomy, laparoscopic technique, benign tumor pathology, elective admission, no lysis of abdominal adhesions, and nonteaching hospital were used as a reference.

Statistical Analysis

Univariate and multivariate logistic regression analyses were performed and odds ratio with a 95 per cent confidence interval were calculated to determine the combined effect of various preoperative factors on PEF. All statistical analyses for the NIS database were conducted using SAS Version 9.2 (SAS Institute, Cary, NC), incorporating recommended discharge and hospital weights. Discharge weight was used to create national estimates for all analyses. Statistical significance was set at P values < 0.05 and odds ratios and 95 per cent confidence intervals that excluded 1.

Results

A total of 646,414 patients underwent colon or rectal resection in 2009 and 2010. The majority of patients were female (53.25%) and white (77.72%). The mean age was 61.67 years with 47.72 per cent of patients older than 65 years (Table 1). The most prevalent comorbidities were hypertension (48.47%), smoking (21.49%), and chronic lung disease (15.42%). The most common payer type was Medicare (46.73%). Almost half of these operations were performed in teaching hospitals (49.4%). The majority of procedures were performed electively (58.14%). The overall rate of laparoscopic surgery was 27.65 per cent (elective surgery: 37.30% vs emergent surgery: 14.30%). The overall rate of lysis of abdominal adhesions was 14.89 per cent (open procedure: 15.69% vs laparoscopic procedure: 12.81%; $P < 0.01$). Overall in-hospital mortality was 4.10 per cent.

TABLE 1. Colorectal Resection in the United States, 2009–2010

Characteristics	Frequency
Total no.	646,414
Mean age (years)	61.67 ± 17.39
Age ≥ 65 years	47.72
Female	53.25
Race (%)	
White	77.72
Black	9.88
Hispanic	7.23
Asian/Islander	1.93
Native American	0.64
Other	2.60
Comorbidity (%)	
Hypertension	48.47
Smoker	21.49
Chronic lung disease	15.42
Diabetes mellitus	15.34
Obesity	9.31
Congestive heart failure	6.72
Chronic kidney disease	6.04
Peripheral vascular disease	4.95
Alcohol abuse	2.13
Liver disease	1.88
Elective admission rate (%)	58.14
Teaching hospitals (%)	49.41
Laparoscopic procedure (%)	27.65
In-hospital mortality rate (%)	4.08
Length of hospital stay	
Median (days)	7
Mean (days)	10.3 ± 9.8

The overall rate of PEF was 0.37 per cent (elective surgery: 0.29% vs emergent surgery: 0.49%; $P < 0.01$). Table 2 shows PEF rates in different types of surgery and pathologies. The most common indication for colorectal resection was colorectal malignancy (32.3%) followed by diverticulitis (20.1%). The most common procedure type was right colectomy (35.38%) followed by sigmoid colectomy (27.78%). Considering procedure type, the highest rate of PEF was observed in transverse colectomy (0.94%). Considering pathologic conditions, the highest PEF was observed in patients with Crohn's disease (0.67%). PEF was less frequent after laparoscopic procedures compared with open procedures (0.09 vs 0.48%; $P < 0.01$). Patients who experienced PEF had significantly higher abdominal abscess and/or leak rate (48.73 vs 6.72%; $P < 0.01$), higher wound infection (16.51 vs 2.42%; $P < 0.01$), higher wound dehiscence (7.87 vs 0.64%; $P < 0.01$), inhospital mortality rate (9.95 vs 4.06%; $P < 0.01$), longer mean length of hospital stay (36.70 vs 10.29 days; $P < 0.01$), and higher mean total hospital charges (\$298,242 vs \$84,036) compared with patients who did not experience PEF.

TABLE 2. Frequency of Procedure, Pathology, Admission Type, Procedure Type, and Related Postoperative Enteric Fistula (PEF) and Abdominal Abscess/Leak in the Colon and Rectal Surgery

	Frequency (%)	Frequency of PEF (%)	Frequency of Abdominal Abscess or Leak (%)
Procedures			
Right colectomy	35.38	0.34	6.69
Transverse colectomy	3.66	0.94	9.60
Left colectomy	8.91	0.36	8.52
Sigmoid colectomy	27.78	0.25	5.66
Total colectomy	4.30	0.36	8.08
Proctectomy	14.53	0.32	6.37
Other*	5.44	1.02	10.19
Pathology			
Malignant tumor	32.29	0.14	Not applicable (N/A)
Diverticulitis	20.06	0.14	N/A
Benign tumor	7.88	0.04	N/A
Ulcerative colitis	1.80	0.13	N/A
Crohn's disease	2.50	0.67	N/A
Other†	35.48	0.78	N/A
Admission type			
Elective	58.14	0.29	5.56
Emergent	41.86	0.49	8.72
Procedure type			
Open	72.35	0.48	8.02
Laparoscopic	27.65	0.09	3.89

* Included 1) open and other multiple segmental resection of large intestine; 2) other and unspecified partial excision of large intestine.

† Included bowel injury, obstruction, bleeding, perforation, and bowel ischemia.

Table 3 lists the multivariate logistic regression analyses for in-hospital PEF after colorectal surgery. Multivariate regression analysis (risk-adjusted) showed that for patients' characteristics, factors associated with a higher PEF rate were male gender (adjusted odds ratio [AOR], 1.30), and age older than 65 years and male gender (AOR, 1.24). For comorbidities, obesity (AOR, 1.40) and diabetes mellitus (AOR, 1.21) were independent factors associated with increased PEF. Considering procedure type, after multivariate regression analysis, transverse colectomy (AOR, 2.13) had independently increased rates of PEF compared with right colectomy. Considering pathologic conditions compared with benign tumor (polyps) pathology, Crohn's disease (AOR, 4.68) was independently associated with a higher rate of PEF. Also, lysis of abdominal adhesions (AOR, 4.25), open procedure (AOR, 3.18), teaching hospitals (AOR, 1.69), and emergent admission (AOR, 1.27) were all associated with higher rates of PEF in this patient population. There was no association with race, hypertension, chronic lung disease, congestive heart failure, chronic kidney disease, liver disease, peripheral vascular disease, smoking, sigmoidectomy, total colectomy, proctectomy, malignant tumor, diverticulitis, or ulcerative colitis and PEF.

TABLE 3. Risk-adjusted Analysis for Postoperative Fistula in the Colon and Rectal Surgery

Factors	Adjusted Odds Ratio (95% CI*)	P Value
Patient-specific Factors		
Age group		
< 65 years	Reference	Reference
≥ 65 years	1.24 (1.12–1.37)	< 0.01
Gender		
Female	Reference	
Male	1.30 (1.19–1.42)	< 0.01
Race		
White	Reference	Reference
Black	1.05 (0.92–1.20)	0.41
Hispanic	1.08 (0.92–1.25)	0.61
Asian	1.30 (0.97–1.73)	0.26
Native American	1.46 (0.93–2.31)	0.17
Other	0.92 (0.69–1.21)	0.11
Comorbidities		
No comorbidities	Reference	Reference
Hypertension	0.77 (0.70–0.85)	< 0.01
Chronic lung disease	1.13 (1.00–1.28)	0.05
Diabetes mellitus	1.21 (1.07–1.37)	< 0.01
Congestive heart failure	0.67 (0.55–0.82)	< 0.01
Chronic kidney disease	1.02 (0.86–1.23)	0.79
Liver disease	0.80 (0.57–1.10)	0.16
Obesity	1.40 (1.22–1.61)	< 0.01
Peripheral vascular disease	0.85 (0.69–1.04)	0.10
Alcohol abuse	0.93 (0.69–1.24)	0.61
Smoking	0.83 (0.74–0.93)	0.01
Procedures		
Right colectomy	Reference	Reference
Transverse colectomy	2.13 (1.81–2.51)	< 0.01
Left colectomy	1.12 (0.95–1.32)	0.44
Sigmoid colectomy	0.94 (0.82–1.07)	< 0.01
Total colectomy	0.87 (0.68–1.11)	< 0.01
Proctectomy	0.98 (0.84–1.15)	< 0.01
Pathology		
Benign disease	Reference	Reference
Malignant tumor	2.60 (1.60–4.20)	0.17
Diverticulitis	2.51 (1.53–4.13)	0.13
Ulcerative colitis	2.39 (1.19–4.80)	0.38
Crohn's disease	4.68 (2.72–8.05)	< 0.01
Admission type		
Elective	Reference	Reference
Emergent	1.27 (1.15–1.40)	< 0.01
Procedure type		
Laparoscopic	Reference	Reference
Open	3.18 (2.66–3.80)	< 0.01
Lysis of abdominal adhesions	4.25 (3.88–4.65)	< 0.01
Hospital teaching status		
Nonteaching	Reference	Reference
Teaching	1.69 (1.54–1.86)	< 0.01

CI, confidence interval.

Discussion

There are limited studies available on PEF after colorectal surgery, particularly evaluating risk factors. This report with data from a large number of patients who underwent colon and rectal resection from 2009 to 2010 showed a low overall rate of in-hospital PEF (0.37%). This rate is comparable with study of Hughes and Rogers⁴ who observed 14 PEFs after 335 major colorectal resections for cancer (0.42%). Patients who experienced PEF had significantly higher in-hospital mortality rate (2.5 times) compared with patients without PEF. Mortality associated with enterocutaneous has been reported from 3 to 65 per cent.^{2, 4, 6, 7} Based on our data, patients with PEF had a 3.6 times longer mean hospital stay than patients without PEF. The hospital costs required to treat these patients is also enormous, involving the expense of prolonged hospital treatment, extra nursing support, appliances, and repeat operation. Consistent with prior experiences in management of enterocutaneous fistula, our study showed that mean total hospital charges in patients with PEF were 3.5 times higher than in patients without PEF. This is not even including subsequent admissions and operations, which are not available with the NIS database.

We identified multiple independent risk factors of PEF after colorectal resection. We classified these risk factors into two groups: 1) potent risk factors, which had at least twice a higher risk of PEF ($\text{AOR} \geq 2$) including Crohn's disease, lysis of abdominal adhesions, open procedure, and transverse colectomy; and 2) less clinically significant risk factors, which had $\text{AOR} < 2$ including teaching hospitals, obesity, male gender, emergent surgery, age older than 65 years, and diabetes mellitus. Certain patient characteristics were found to confer a higher risk for PEF. We found that patient age older than 65 years old (AOR , 1.24) and male gender (AOR , 1.30) were associated with slightly higher risks of PEF. Furthermore, we found that obesity (AOR , 1.40) and diabetes mellitus (AOR , 1.21) are independent risk factors for PEF. Unfortunately, not all of the risk factors we have identified can be easily corrected or modified before the operation. However, clinicians may be able to optimize them before surgery to minimize the risk of PEF.

Anatomical location appears to be a useful predictive factor for determining risk of PEF. Compared with right colectomy, we found that transverse colectomy (AOR , 2.13) was associated with a higher risk of PEF. Because anastomotic failure was reported as the most common cause of PEF,⁴ we evaluated the abdominal abscess or leak rate in different types of colorectal resection and found that transverse colectomy was associated with the highest rate abdominal abscess or leak rate (9.60%), which was consistent with the risk-adjusted analysis outcome.

Not surprisingly, our study revealed patients with Crohn's disease had 4.68 times higher chance of PEF compared with benign tumor pathology. However, McIntyre et al.² reported Crohn's disease and colorectal cancer as the two most common pathologies associated with PEF. Furthermore, our study showed that patients with malignant tumor, ulcerative colitis, and diverticulitis are not at higher risk of PEF. In Britain, Northern Europe, and North America, approximately 20 to 30 per cent of all the enterocutaneous

fistulas are the result of Crohn's disease, but this proportion is much higher if the enterocutaneous fistulas occurring after resection are considered.^{2, 8} In our current study, patients with Crohn's disease have the highest rate of PEF after colorectal surgery, but still the rate of this complication is quite low (less than 1%). However, we did not have information on internal fistula rate in our study; the rate of internal fistula has been reported to be significantly higher than external fistula in patients with Crohn's disease. Michelassi et al.⁹ in evaluation of 290 intra-abdominal fistulas in 22 patients operated on for complications for Crohn's disease showed that only 17 per cent of all fistulas were external fistula and the majority of fistulas were internal fistula. Also, although we were unable to identify the source of enterocutaneous fistula (enteric vs colonic), the majority of postoperative fistulas in patients with Crohn's disease have a small bowel source. Michelassi et al.⁹ reported that none of the 46 enterocutaneous fistulas was from the colon. Also, in the series reported by Zera et al.¹⁰ of 68 patients with colocutaneous fistulas, only one case was the result of Crohn's disease.

With regard to the type of procedure, patients who underwent open colon and rectal resection had 3.18 times higher risk of PEF than those undergoing laparoscopic procedures. This finding could be related to a lower risk of abscess and/or leakage or to a more meticulous procedure in laparoscopic procedures. Our study showed a lower rate of abdominal abscess or leak in the laparoscopic group (3.89%) compared with the open group (8.02%). Also, our findings correlate with recent studies that comparing the rate of abdominal abscess and/or leak rate in laparoscopic versus open colorectal surgery.¹¹⁻¹³ However, further studies are needed to evaluate the importance of this finding. Like with other disease processes, the use of laparoscopy has been increasing in colorectal surgery. Improved accessibility to laparoscopic equipment and better training have led to laparoscopic colectomy becoming more widely used in the treatment of benign and malignant colorectal disease. Our study showed that the overall rate of elective laparoscopic surgery was 37.3 per cent in 2009 and 2010, which is 10 times higher than the laparoscopic rate in 1998 to 2000 using a similar database.¹⁴

Failure to recognize and/or inadequately repair enterotomy is one of the known risk factors of PEF.³ The NIS database does not reveal if the patients had previous abdominal surgery, which is one of the important predisposing risk factor for enterotomy creation and subsequent PEF. However, using lysis of abdominal adhesions as a marker of prior abdominal surgery, our study showed that patient who had lysis of abdominal adhesions had 4.25 times higher risk of PEF compared with patients without lysis of adhesions.

Limitations of our study include using an immense database for collection of our data. Like with any retrospective chart review, information on patient selection tends to be a limiting factor for the study. The NIS database is compiled from discharge abstract data and is limited to in-hospital data without outpatient follow-up data. For example, an enteric fistula, which occurred after discharge, would not be captured in this database. Also, we were unable to identify the origin of fistula (small bowel vs large bowel), which is an important prognostic factor in PEF. The mortality and complication rate is higher in patients with a small bowel fistula than in those with fistula arising the colon.¹⁵ Sitzes-Serra et al.¹⁶ found that 92 per cent of colonic fistulas closed spontaneously. Additionally, we were unable to identify high- versus low-output fistula, and it has been shown that mortality is significantly increased in high-output fistula compared with lowoutput

fistula.¹⁷ Lastly, although we used adhesiolysis code as a characteristic of prior abdominal surgery, adhesions could be present in inflammatory conditions such as diverticulitis or Crohn's disease with no history of prior abdominal surgery and this code could be used by some surgeons in this circumstance. This omission may also help explain the higher risk in open surgery cases. Nevertheless, this retrospective review is presently one of the most comprehensive and largest studies investigating independent risk factors for PEF in colorectal surgery.

In conclusion, our study has shown that the rate of PEF after colon and rectum resection is relatively low (0.37%); however, PEF continues to remain a menacing problem for both the patient and the surgeon. The high morbidity, mortality, and the financial burden of this complication demand, we investigated the specific risk factors leading to postoperative PEF. Although larger, more prospective studies may need to be executed, our investigation has identified specific characteristics, most notably Crohn's disease, lysis of abdominal adhesions, open surgery, and transverse colectomy, as potent risk factors for this condition. Thus, we hope our results will impact the clinical decision made by surgeons by facilitating the implementation of certain prophylactic measures in high-risk patients for the future prevention of PEF.

REFERENCES

1. Hill GL, Bouchier RG, Witney GB. Surgical and metabolic management of patients with external fistulas of the small intestine associated with Crohn's disease. *World J Surg* 1988;12:191–7.
2. McIntyre PB, Ritchie JK, Hawley PR, et al. Management of enterocutaneous fistulas: a review of 132 cases. *Br J Surg* 1984;71: 293–6.
3. Dietz DW. Postoperative complications. In: Beck DE, Robles, PL, Saclarides TJ, et al., eds. *The ASCRS Textbook of Colon and Rectal Surgery*. New York, NY: The Springer. 2011:157–8.
4. Keighley MR, Williams NS. Intestinal Fistulas. *Surgery of the Anus, Rectum & Colon*. 2nd ed. New York, NY: WB Saunders, 1999. pp. 2335–416.
5. Overview of the Nationwide Inpatient Sample (NIS). Available at: www.hcup.us.ahrq.gov/nisoverview.jsp. Accessed January 7, 2013.
6. Kaur N, Minocha VR. Review of a hospital experience of enterocutaneous fistula. *Trop Gastroenterol* 2000;21:197–200.
7. Martinez JL, Luque-de-Leon E, Mier J, et al. Systematic management of postoperative enterocutaneous fistulas: factors related to outcomes. *World J Surg* 2008;32:436–43.
8. Fazio VW, Coutsoftides T, Steiger E. Factors influencing the outcome of treatment of small bowel cutaneous fistula. *World J Surg* 1983;7:481–8.
9. Michelassi F, Stella M, Balestracci T, et al. Incidence, diagnosis, and treatment of enteric and colorectal fistulae in patients with Crohn's disease. *Ann Surg* 1993;218:660–6.
10. Zera RT, Bubrick MP, Sternquist JC, Hitchcock CR. Enterocutaneous fistulas. Effect of total parenteral nutrition and surgery. *Dis Colon Rectum* 1983;26:109–12.
11. Masoomi H, Buchberg B, Nguyen B, et al. Outcomes of laparoscopic versus open colectomy in elective surgery for diverticulitis. *World J Surg* 2011;35:2143.

12. Kang CY, Chaudhry OO, Halabi WJ, et al. Outcomes of laparoscopic colorectal surgery: data from the Nationwide Inpatient Sample 2009. *Am J Surg* 2012;204:952–7.
13. Alves A, Panis Y, Slim K, et al. French multicentre prospective observational study of laparoscopic versus open colectomy for sigmoid diverticular disease. *Br J Surg* 2005;92:1520–5.
14. Guller U, Jain N, Hervey S, Purves H. Laparoscopic vs open colectomy: outcomes comparison based on large nationwide databases. *Arch Surg* 2003;138:1179–86.
15. Fischer JE. The management of high-output intestinal fistulas. *Adv Surg* 1975;9:139–76.
16. Sitges-Serra A, Jaurrieta E, Sitges-Creus A. Management of postoperative enterocutaneous fistulas: the roles of parenteral nutrition and surgery. *Br J Surg* 1982;69:147–50.
17. Le´vy E, Frileux P, Cugnenc PH, et al. High-output external fistulae of the small bowel: management with continuous enteral nutrition. *Br J Surg* 1989;76:676–9.

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