Postoperative Ileus: It Costs More Than You Expect

Theodor Asgeirsson, MD, Khaled I El-Badawi, MD, Ali Mahmood, MD, Jeffrey Barletta, PharmD, FCCM, Martin Luchtefeld, MD, FACRS, Anthony J Senagore, MD, MS, MBA, FACS, FACRS

BACKGROUND: The clinical impact of postoperative ileus (POI) after colectomy is difficult to quantify financially because of administrative coding limitations. Accurate data are important to allow pharmaco-economic analysis of methods aimed at reducing POI. The aim of this study was to assess the financial impact of POI for the 30-day episode of care for colectomy.

STUDY DESIGN: We reviewed all colectomy patients at our institution from July 2007 to June 2008. Primary POI was defined as more than three episodes of emesis with return to NPO diet status and/or reinsertion of nasogastric tube; secondary POI was associated with intraabdominal complications. Readmission for gastrointestinal failure was defined as delayed POI (no radiologic or surgical identification of small bowel obstruction). All other complications requiring readmission were grouped together for analysis. Data reviewed included primary admission and readmission costs, reason for readmission, intervention, index and total length of stay, narcotic use, time to ambulation, and time to enteral feeds.

RESULTS: One hundred eighty-six colectomies were eligible for analysis, with 45 cases (38 primary and 7 secondary) of POI during the index admission. The total cost was significantly higher for patients with POI ($16,612 versus $8,316; $p < 0.05$). However, readmission costs were not statistically different for delayed POI and other complications ($3,546 versus $6,705).

CONCLUSIONS: POI occurred in 24% (84% primary) of colectomy patients and disproportionately affected cost at the index admission. Interestingly, delayed POI was similar in cost to readmission for other serious adverse surgical complications. (J Am Coll Surg 2010;210:228–231. © 2010 by the American College of Surgeons)

Although colectomy is associated with high morbidity, most emphasis has been on surgical site infection and anastomotic leak, which are associated with obvious and direct outcomes.[1] Conversely, the impact of postoperative ileus (POI) has been difficult to quantify because it is typically regarded as a nonlife-threatening sequela that is unpreventable. The limitations in clinical documentation and administrative coding have resulted in an underestimation of the clinical and financial impact of POI. However, there has been a documented negative impact of POI on length of stay (LOS), even in uncomplicated abdominal surgery.[2,3] The absence of a clearly identified population by administrative datasets creates difficulty in performing pharmaco-economic analyses of newer POI treatment modalities. The economic impact of POI has been estimated at $750 million per year in the US.[3-5]

POI has been defined as transient cessation of coordinated bowel motility after surgical intervention for >5 days, which prevents effective transit of intestinal contents and/or tolerance of oral intake. But this designation tends to confuse the true impact of POI when patients without any precipitating complication (primary POI) are grouped with patients suffering from a precipitating complication (secondary POI).[5] In addition, rarely is the impact of delayed POI resulting in readmission without any obvious surgical complication considered. We chose to define primary POI operationally, as described in the Methods section—return to NPO status or reinsertion of a nasogastric (NG) tube—to describe a clinically relevant scenario requiring significantly different clinical care. Patients will require more monitoring and parenteral support using this definition.

Although a variety of clinical strategies have been proposed to reduce primary POI, including early feeding, ambulation, epidural analgesia, fluid restriction, and minimally invasive surgery, none has been completely successful in prevention.[6-10]

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From the Department of Surgery, Michigan State University (Asgeirsson, El-Badawi, Mahmood, Luchtefeld, Senagore); the Grand Rapids Area Medical Education and Research Center (Asgeirsson, El-Badawi, Mahmood); the Departments of Surgery (Senagore) and Pharmacy (Barletta), Spectrum Health; and Department of Colon-Rectal Surgery, Ferguson Clinic (Luchtefeld, Senagore), Grand Rapids, MI.

Correspondence address: Anthony J Senagore, MD, MS, MBA, 25 Michigan Ave NE, MC 038, Grand Rapids, MI 49546.

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Abbreviations and Acronyms

HALS = hand-assisted laparoscopic surgery
LOS = length of stay
NG = nasogastric
POD = postoperative day
POI = postoperative ileus

Recently a new class of drugs that compete with narcotics for the intestinal μ-opioid receptor have shown promise.[11-13] Ultimately, widespread adoption requires a compelling case for clinical cost-effectiveness in the prevention or treatment of POI after colectomy. The purpose of this study was to assess the financial impact of an operationally defined occurrence of primary, secondary, and delayed POI during a 30-day episode of care for colectomy at a single institution.

METHODS

A retrospective review, which obtained institutional review board approval, was performed on a prospectively maintained database at our institution. The episode of colectomy care was defined as 30 days beginning on the day of admission for operation. All same day admit elective colectomies performed from June 2007 to July 2008 by any of six board-certified colorectal surgeons at our institution were eligible for study. Enhanced Recovery Protocol (ERP) was used in the postoperative phase for all elective colectomies at our institution, as previously described by the senior author.[14] Key components are 2 hours of 80% oxygen high flow in the postanesthesia care unit, early feeding and ambulation, and limited IV narcotic use. Primary POI was defined as >3 episodes of emesis in 24 hours and return to NPO and/or insertion of an NG tube; secondary POI was associated with an intraabdominal complication. Readmission for gastrointestinal failure was defined as delayed POI (in the absence of radiologic or surgical identification of small bowel obstruction). All other complications requiring readmission were grouped together for analysis. Cost data were obtained through the hospital accounting system for both index and any readmissions within 30 days. Reason for readmission was also identified and any subsequent intervention was recorded. Data reviewed included primary admission and readmission costs, reason for readmission, index operation, interventions, LOS, time to ambulation, and time to enteral feeds. Data are reported as mean $\pm$ SD by ANOVA, with significance set at 0.05.

RESULTS

During the study period, 186 elective colectomy patients were eligible for study and 45 (24%) cases of POI were identified during index admission. Demographics of the patient population based on either primary (38, 84%) or secondary (7, 16%) POI during the index admission and patients without POI are described in Table 1. In 19 (50%) of the primary POI patients, reinsertion of an NG tube was required (Table 2). The primary POI patients had longer duration of narcotic use and longer LOS and time to first feeding compared with secondary POI patients. There was no significant difference in the incidence of POI between the techniques, although there was a trend toward a lower incidence in the straight laparoscopic group (Table 3). There were 27 (14.6%) readmissions at 30 days for the study population, with the majority of cases (9 of 27; 33%) a direct result of delayed POI (Table 4).

The average cost per patient for either primary or secondary POI was similar, but these costs were significantly higher when compared with costs for non-POI patients ($15,914 and $17,311 versus $8,316) (Table 5). The POI patients accounted for 38% of the total cost for the entire cohort despite the fact that they comprised only 24% of the population. Interestingly, the readmission cost was not statistically significantly different for delayed POI and other complications ($3,546 versus $6,670).

Table 1. Patient Demographics

Demographic	POI* (n = 45)	Non-POI (n = 141)
Male, n	25	62
Female, n	20	79
Age, y, mean (range)	58 (16–89)	60 (16–88)
Cancer, n	28	48
Polyps, n	10	34
Diverticular diagnosis, n	5	41
Crohn's disease, n	1	13
Ulcerative colitis, n	2	3
Other, n	1	2

*Primary and secondary postoperative ileus.
POI, postoperative ileus.

DISCUSSION

This is the first single institution study attempting to assess the impact of operationally defined POI on the 30-day cost

Table 2. Descriptive Statistics for Variables

Variable	Primary POI (n = 38*)	Secondary POI (n = 7)	Non-POI (n = 141)
Requiring NG, n (%)	19 (50)	1 (14)	N/A
Return to NPO, n (%)	19 (50)	6 (86)	N/A
Length of stay, d	8.9*	7	4
Duration of narcotics, h	142*	47	43
Time to first feeding, h	37*	7	3
Time to ambulation, h	13	23	11

*$p < 0.05$ ANOVA.
NG, nasogastric tube; POI, postoperative ileus.

Table 3. Operation Characteristics

	Open, n		HALS, n		Lap, n	
Characteristic	**POI**	**Non-POI**	**POI**	**Non-POI**	**POI**	**Non-POI**
Segmental	4	9	5	16	20	79
LAR	6	8	3	7		3
TAC	2	8	5	4		
TPC		2	2		2	1
Total (n = 186), n (%)	12 (31)	27	15 (36)	27	22 (21)	83

HALS, hand-assisted laparoscopic surgery; Lap, laparoscopy; LAR, low anterior resection; POI, postoperative ileus; TAC, total abdominal colectomy; TPC, total proctocolectomy.

Table 4. Readmission Diagnosis

Diagnosis	POI, n	Non-POI, n
Delayed POI	9	
Leak	1	3
Abscess	2	2
DVT/PE		2
SSI		1
Dehydration		2
Other		5

DVT, deep vein thrombosis; PE, pulmonary embolism; POI, postoperative ileus; SSI, surgical site infection.

of a colectomy. The data are compelling in that primary POI was as costly as the management of severe postoperative complications that may or may not also produce an ileus. In addition to increasing length of stay, we identified prolonged narcotic use in primary POI patients, which may increase the risk and duration of impaired gastrointestinal dysmotility.[15] Although patients with colectomy procedures are at higher risk for POI, our data suggest a trend toward a lower risk straight laparoscopic compared with either open or hand-assisted laparoscopic surgery (HALS) techniques.

Our data indicate that patients with primary POI and readmission for delayed primary POI accounted for 35% of the total cost for the entire cohort despite being only 24% of the population. This disproportionate impact on cost per patient with POI at the index admission was magnified by the similar additional cost structure of readmission for delayed primary POI compared with readmission for serious adverse surgical complications. In fact, POI accounted for 38% of the total cost for the episode of care for the entire cohort of colectomy patients. The additional component cost is explained by increasing LOS, labor costs, parenteral nutrition, and diagnostic studies.

There are several illustrative cases of the cost and resource impact of POI from our dataset. The least expensive patient in the entire group was a 43-year-old woman with Crohn's disease who had a laparoscopic ileocolectomy and was discharged on postoperative day (POD) 2. The most costly patient was a 59-year-old man, suffering from COPD and sleep apnea, who had a HALS subtotal colectomy for multiple polyps and required an NG tube because of POI. On POD 14 he an anastomotic leak developed requiring reoperation with a diverting ileostomy and was discharged on POD 22. Two patients exemplify the significant risk of primary POI: a 78-year-old obese woman with hypertension, who presented for open low anterior resection, required an NG tube, and was discharged on POD 18 with a total admission cost of $27,500; and a 62-year-old woman, managed by NG tube after a HALS sigmoid colectomy, in whom fascial dehiscence developed with evisceration on POD 7 requiring exploratory laparotomy and secondary closure, with a total admission cost of $56,800.

The capabilities of administrative datasets for evaluating POI are limited by the accuracy of clinical documentation, consistency of billing and coding, and definitional differences among clinicians. Our definition is an expansion of the consensus panel definition derived in 2007 that delineates primary from secondary POI.[5] The use of the clinical impact definitions of "need for reinsertion of NG tube" or "return to NPO status" defines two scenarios that lead to

Table 5. Cost

	Index, $ (SD)			Readmission, $ (SD)	
Variable	**Primary POI (n = 38)**	**Secondary POI (n = 7)**	**Non-POI (n = 141)**	**Delayed POI (n = 9)**	**Other complications (n = 18)**
Overall cost	604,742	121,176	1,172,529	31,913	120,064
Average cost/admission	15,914 (13,756)	17,311 (24,022)	8,316* (4,808)	3,546 (2,404)	6,670 (4,820)
Hospital	7,258 (4,110)	6,794 (10,272)	3,165* (2,641)	3,088 (2,223)	4,890 (3,654)
Pharmacy	2,639 (3,254)	3,588 (8,431)	454* (1,128)	217 (162)	371 (266)
Radiology	153 (110)	324 (649)	37 (116)	58 (79)	125 (83)
Operating room	4,823 (1,261)	5,433 (2,481)	4,260 (11,222)	N/A	670 (1,469)
Laboratory tests	579 (342)	741 (1,276)	252* (282)	171 (117)	257 (277)
Other	485 (198)	420 (1,093)	146* (379)	N/A	357 (679)

*$p < 0.05$ ANOVA.
POI, postoperative ileus.

significantly different resource allocations. In addition, we were able to identify potential downstream sequelae of POI (ie, wound dehiscence and delayed anastomotic leak).

POI is related to extrinsic and intrinsic factors and must be dealt with in a multimodal manner.[2,16-18] To date, fast-track protocols or enhanced recovery protocols have been the predominant methods of instituting multimodal care, primarily because of accelerated recovery of gastrointestinal function.[19] Use of opioid analgesic is known to effect the return of normal bowel function after surgery.[20] Epidural analgesia has been shown to minimize systemic opioid use and effect POI, but to date its use has not become mainstream, which may be related to unreliability and added complexity of postoperative care.[21,22] Other potential components of enhanced recovery programs are goal-directed postoperative fluid management, early ambulation, and enteral feeding.[7,19,23] Laparoscopy reduces the risk of POI compared with laparotomy, but does not eliminate that risk, which is a trend we identified in our dataset.[9] New classes of adjunctive medication aimed directly at POI may provide benefit, but the pharmaco-economics of these agents remain to be defined.[11,12,24]

In conclusion, the disproportionate clinical and cost impacts of POI are a significant component of the initial 30-day episode of care for a colectomy patient. In addition to considering the impact of patient and health care team education on compliance with enhanced recovery protocols, careful pharmaco-economic data should be analyzed to describe a potential "colectomy care bundle," which includes avoidance or treatment of POI.

Author Contributions

Study conception and design: Asgeirsson, El-Badawi, Mahmood, Senagore

Acquisition of data: Asgeirsson, El-Badawi, Barletta

Analysis and interpretation of data: Asgeirsson, El-Badawi, Mahmood

Drafting of manuscript: Asgeirsson, El-Badawi, Mahmood, Luchtefeld, Senagore

Critical revision: Asgeirsson, El-Badawi, Luchtefeld, Senagore

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