

Feasibility and Safety of Ambulatory Surgery as the Next Management Paradigm in Colorectal Resection Surgery

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Background: Current clinical dogma favors universal inpatient admission after colorectal resection particularly in the presence of an anastomosis.

Objective: We evaluate the feasibility and safety of ambulatory surgery in carefully selected patients undergoing colorectal resection/anastomosis.

Methods: Between October 2020 and October 2021, all patients undergoing colorectal resection/anastomosis meeting specific criteria {no major comorbidity [American Society of Anesthesiologist (ASA) <4], not on therapeutic anticoagulation, compliant patient/family} were counseled preoperatively for ambulatory surgery (discharge <24 h post-surgery). Complicated surgery (ileoanal pouch, enterocutaneous fistula repair, reoperative pelvic surgery, multiple resections) and/or ostomy creation (loop/end ileostomy, Hartmann's, abdominoperineal resection) were exclusions. Discharge was at 6 to 8 hours postoperatively if all predetermined factors (no ostomy teaching needed, ambulating comfortably, tolerating diet, stable vitals, and blood-work) were met and patients were willing, or was postponed to the next day at patient request. All discharged patients received phone checks the next day with the option also given for voluntary readmission if inpatient care was preferred by patient. Patients discharged <24 hours postop (AmbC) were compared to those staying on as inpatients admitted (InpC) and also to a comparable historical (October 2019–October 2020) group when ambulatory surgery was not offered (HistC).

Results: Of 184 abdominal colorectal surgery patients, 97 had complicated colorectal resection and/or ostomy. Of the remaining 87, 29 (33.3%) were discharged <24 hours postoperatively [7 (24%) patients at 8 h]. Of these 29 AmbC patients, 4 were readmitted <30 days (ileus: 1, rectal bleeding: 2, nausea/vomiting: 1), 1 readmission was on first post-discharge day, none were voluntary post phone-check. AmbC and InpC (n = 58) had similar age, sex, race, body mass index, and comorbidity. InpC had greater estimated blood loss (109 vs 34 mL, $P < 0.001$) while length of stay was expectedly significantly longer (109 vs 17 hours, $P < 0.001$). There was no mortality in either group. AmbC and InpC had similar readmission, reoperation, anastomotic leak, ileus, and surgical site infection. Mean length of stay for HistC was 83 hours. AmbC and HistC had similar age, sex, race, body mass index, and ASA class. Complications including readmission, reoperation, anastomotic leak, ileus, and surgical site infection were also similar for AmbC and HistC.

Conclusions: With careful patient selection, preoperative education, perioperative management, and postoperative follow-up, ambulatory surgery is feasible in up to a third of patients undergoing colorectal resection/anastomosis and can be performed with comparable safety to the time-honored practice of routine inpatient hospitalization. Refinements in inclusion/exclusion criteria and postoperative outpatient follow-up will allow a paradigm shift in how such patients are managed, which

has huge implications for patient experience, care-giver workload and health care finances.

Keywords: colorectal, ambulatory surgery, laparoscopic surgery, outcome (*Ann Surg* 2022;276:562–569)

Colorectal resection has historically been associated with significant complication rates, as high as 38.3% for open procedures.¹ In addition, postoperative pain, nausea, and ileus are often associated with extended hospital stays, with the more recent adoption of minimally invasive techniques offering relatively small benefits over the open approach.² In an effort to improve postoperative outcomes and reduce length of stay (LOS), “fast-track” recovery protocols have been established and are now considered standard of care. These Enhanced Recovery After Surgery (ERAS) protocols include evidence-based recommendations for perioperative care, with the goal of optimizing recovery. Colorectal-specific protocols have been formulated, providing standardized recommendations for perioperative issues, such as the use of preoperative bowel preparations, nausea prevention, nasogastric tube use, early ambulation, early oral feeding, and postoperative pain control.³ Recommendations have evolved based on newly available evidence, and the latest guidelines for elective colorectal surgery published by the ERAS Society is the fourth since the group's inception.⁴ Studies that investigated the success of ERAS protocols in improving outcomes in elective colorectal surgery support its adoption as standard of care, revealing shorter hospital stays and lower morbidity.^{5,6} A Cochrane meta-analysis has reaffirmed ERAS protocol's safety in colorectal surgery, with an overall reduction in rate of all complications (but not major complications) and a significant improvement in postoperative LOS.⁷

The use of ERAS protocols in colorectal surgery has broadened to include emergency operations and elderly patients, with success.^{8,9} There is a burgeoning interest in further reducing LOS following select colorectal resections, in the progression of ERAS-driven care. Early discharges following elective laparoscopic colorectal surgery have been reported, and 82 patients who were discharged within 72 hours following elective laparoscopic colorectal surgery included 10 discharges on postoperative day (POD) 1. Discharge within 72 hours was associated with low rates of complications and readmissions.¹⁰ For the specialty of colorectal surgery, ambulatory colectomy would be the next natural step along this continuum. This however would require demonstration of its safety and feasibility, the comfort of the patient at home, and the buy-in of the multiple stakeholders including patients, caregivers, institutions, and the surgeons themselves (particularly related to patients with anastomoses), to step outside their usual comfort zone within the traditional practice of universal inpatient admission after colorectal resection.

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In this study we evaluate the safety and feasibility of ambulatory surgery (discharge <24 h) of patients undergoing colorectal resection with anastomosis.

METHODS

Inclusion/Exclusion Criteria

This study was approved by the Columbia University Medical Center Institutional Review Board (IRB). All patients undergoing segmental colon resection with anastomosis between October 2020 and October 2021 were evaluated for eligibility for ambulatory surgery. Eligibility criteria included informed consent for surgery, age > 18 years, elective status of the operation, American Society of Anesthesiologist (ASA) class of <4, not receiving therapeutic anticoagulation, expressed understanding of perioperative course, and a favorable support system for the patient at home. Only patients who could understand the perioperative pathway and had engaged family members who could together follow the principles of a stepwise approach to managing diet, pain medications, and the other potential other setbacks after surgery were included. Since distance traveled could be a problem for patients needing to seek immediate care, all patients who could reliably get to a hospital within 30 minutes, and those coming from out of state were often discharged to a hotel close enough.

Exclusion criteria included emergency surgery, major medical comorbidities (ASA >4), complex surgery (including ileal pouch-anal anastomosis, enterocutaneous fistula repair, reoperative pelvic surgery, or multiple complicated resections), surgery with ostomy creation (loop/end ileostomy, Hartmann's type resection, abdominoperineal resection) where postoperative education was needed, and poor patient adherence/family support.

In order to create a comparable historical groups of patients, an IRB-approved institution-specific surgical database was queried to identify all patients between October 2019 and October 2020 who underwent segmental colon resection with anastomosis and who would also have met eligibility criteria for ambulatory surgery. These patients were classified as "Historical Colectomy" or HisC group.

Perioperative Care

All eligible patients were counseled during the preoperative surgical consultation about same-day discharge and the perioperative recovery protocol. To minimize variations in education, as a first step, all operations were performed by the same experienced colorectal surgeon. The criteria for discharge are listed in Table 1. Patients were managed using an enhanced recovery pathway that routinely included preoperatively preemptive analgesia, combined mechanical bowel preparation with oral antibiotics, clear liquids until 6 hours prior to surgery, and antiseptic showers. Intraoperatively, intravenous antibiotics at induction of anesthesia, wound protectors for specimen extraction and routine foley catheter removal at the completion of surgery were employed. Postoperative analgesia included opiate-reducing measures, including intraoperative wound infiltration with liposomal bupivacaine, multimodality pain control with Tylenol and NSAIDs, and antiemesis agents as needed. Following surgery, all patients were further evaluated in the postanesthesia care unit (PACU) with physical examination and labwork. Exam included evaluation of pain level, ability to tolerate oral intake, ambulate and void independently, stability of vital signs and assessment of dressings/drains (if any), and

labwork to demonstrate a normal complete blood count and basic metabolic panel at 6 hours after surgery. All patients who met the criteria were offered the option of discharge from PACU at 8 hours after surgery or instead the alternative of an overnight admission with a further assessment for discharge the next day. Patients discharged <24 hours after surgery were classified as our "Ambulatory Colectomy" or AmbC group. All patients in the AmbC group received a postoperative check telephone call by a nurse practitioner the day postdischarge during which patients had the option of voluntary readmission if not managing at home or if admission was their preference. Patients who did not meet discharge criteria within 24 hours postsurgery and those who preferred to remain in the hospital beyond 24 hours inpatient despite meeting discharge criteria or would remain admitted until they were deemed ready for discharge and were classified as our "Inpatient Colectomy" or InpC group.

Demographic and Clinical Variables

Patient demographic and clinical information was collected for patients in all groups, including age, sex, race/ethnicity, body mass index (BMI), smoking status, medical comorbidities, ASA Grade, and primary diagnosis. Demographic characteristics, operative, and 30-day postoperative outcomes were evaluated across all groups.

Outcome Measurements

The primary outcome was any postoperative morbidity. Secondary outcomes included readmission, reoperation, anastomotic leak, ileus, surgical site infections (SSIs), and transfusion.

Statistical Analysis

Categorical data are expressed as frequencies and percentages. Continuous variables are expressed as either mean (SD) or median (interquartile range). Statistical analysis between the AmbC and InpC groups was performed by the Pearson χ^2 test/the Fisher exact test for categorical variables, and Mann-Whitney U test for nonparametric continuous variables. Analysis between all 3 groups (AmbC, InpC, and HisC) was performed by χ^2 test/the Fisher exact test between the 3 groups for categorical variables, Kruskal-Wallis test for noncategorical variables. A P value <0.05 was considered to be significant. SPSS Version 27 statistical (IBM Corp, Armonk, NY,) software was used for statistical analyses.

RESULTS

A total of 184 patients underwent segmental colorectal resection between October 2020 and October 2021. Of these patients, 87 (47.2%) met criteria for inclusion in the study and were eligible for ambulatory surgery. The majority of the other 97 patients [58 patients (60%)] underwent complex operations, such as complex pouch procedures, extensive reoperative or corrective surgery, and repair of enterocutaneous fistulae, or ostomy creation needing perioperative education. Of the 87 patients who met preoperative criteria for ambulatory surgery, 29 (33%) patients were discharged \leq 24 hours after surgery (AmbC group) while the remaining 58 patients (67%) remained inpatient > 24 hours. The historical control group (HisC) included 88 patients operated between October 2019 and October 2020 who underwent segmental colorectal resection surgery and met the eligibility criteria for ambulatory surgery.

TABLE 1. Discharge Criteria

Normal and stable vital signs
Pain adequately controlled*
Ambulating comfortably
Voiding freely without urinary catheter
Tolerating oral liquids and solid food
No or minimal nausea
Dressing and drains clear/serosanguinous without concern for bleeding
Stable lab values as compared to preoperative values

*Patient discharged with oral pain medication prescriptions: tylenol 500 mg to 1g Q8 hours pro re nata (PRN) and/or Ibuprofen 600 mg Q8 hours PRN, Tramadol 50 mg Q6 hours PRN and/or Gabapentin 300 mg Q8 hours PRN.

AmbC Patients

For the 29 AmbC patients, mean age was 55.2 ± 14.7 years, 18 (62%) were white, 13 (45%) were female, mean BMI was 27 kg/m^2 , 69% of patients were ASA Class 1 and 2, 31% were ASA Class 3, and 2 patients (7%) were smokers (Table 2). The most common indication for surgery was malignancy or adenoma, followed by diverticular disease and inflammatory bowel disease. Operations performed included laparoscopic ileocolic resection (11%), laparoscopic right colectomy (30%), laparoscopic sigmoid colectomy (44%), laparoscopic low anterior resection (11%), laparoscopic subtotal colectomy (4%) (Table 3).

TABLE 2. Patient Characteristics

	AmbC (N = 29), n (%)	InpC (N = 58), n (%)	P*	HisC (N = 88), n (%)	P*
Age, years, mean (SD)	55.2 (14.7)	58.3 (18.4)	0.3	60.2 (18.1)	0.1
Female sex	13 (44.8)	34 (58.6)	0.2	47 (53.4)	0.4
Race/ethnicity			0.5		0.3
White	18 (62.1)	42 (72.4)		64 (72.7)	
Non-White†	11 (37.9)	16 (27.6)		24 (27.3)	
ASA class			0.2		0.1
1/2	20 (69)	31 (53.4)		47 (53.4)	
3	9 (31)	27 (46.6)		41 (46.6)	
BMI, kg/m ² , mean (SD)	27.0 (6.1)	26.1 (6)	0.6	27.6 (5.8)	0.4
Medical comorbidities					
HTN	5 (17.2)	19 (32.8)	0.1	40 (45.5)	0.007
DM	2 (6.9)	8 (13.8)	0.5	17 (19.3)	0.2
Cardiac comorbidity†	0	6 (10.3)	0.2	2 (2.3)	1.0
COPD	0	6 (10.3)	0.5	4 (4.5)	0.6
CKD	1 (3.4)	3 (5.2)	1.0	1 (1.1)	0.4
Chronic steroid use	0	2 (3.4)	0.5	2 (2.3)	1.0
Nonsmoker	27 (93.1)	56 (96.6)	0.6	87 (98.9)	0.2
Primary diagnosis					
Malignancy/adenoma	15 (52)	25 (43.1)		37 (42)	
Diverticular disease	5 (17)	17 (29.3)		20 (23)	
IBD	5 (17)	10 (17.2)		14 (16)	
Other	4 (14)	6 (10.4)		17 (19)	

*P values calculated by the Pearson χ^2 /the Fisher exact test for categorical variables, Mann-Whitney U test for noncategorical variables after testing for normality.

†Non-White includes Black, Hispanic, Asian, and Other/undisclosed. Cardiac comorbidity includes patients with a history of CHF, recent MI, or history of recent percutaneous cardiac intervention.

AmbC indicates Ambulatory Colectomy Group; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; HisC, Historical Colectomy Group; HTN, hypertension; IBD, inflammatory bowel disease; InpC, Inpatient Colectomy Group.

Mean operative time was 113.3 minutes. Mean estimated blood loss (EBL) was 34 mL, and there were no intraoperative complications or blood transfusion.

The majority of patients in AmbC were discharged between 9 and 24 hours (76%) with 7 patients (24%) being discharged between 6 and 8 hours following surgery. The mean LOS was 17.2 ± 7.4 hours. Since patients underwent surgery at various times of the day, including in the evening, 75% of them stayed overnight. Some stayed in the PACU overnight from where they were discharged home the next morning. Of the 29 AmbC patients, 4 (13.8%) were readmitted <30 days. Reasons for readmission included ileus (n=1), rectal bleeding not requiring transfusion or intervention (n=2), and nausea/vomiting (n=1). One readmission was within 24 hours of discharge but was not a voluntary readmission from the postdischarge phone call. The other 3 readmissions were between postdischarge days 2 to 5. There were no reoperations, anastomotic leaks, SSIs, or significant bleeding complications in the 30-day postoperative period (Table 4).

Comparison of AmbC, InpC, and HistC Patients

Patient baseline characteristics between the 3 groups were similar (Table 2). The mean age was similar between groups and the majority of patients in all groups were White, nonsmoking, ASA Class 1 or 2, with a slightly overweight mean BMI. The HisC group had a greater proportion of patients with hypertension when compared to the other groups. The most common indication for surgery (Table 3) was malignancy or adenoma, followed by diverticular disease and inflammatory bowel disease.

All operations in the AmbC group were laparoscopic, most common being laparoscopic sigmoid colectomy with colorectal anastomosis (44%). The most common operation in the InpC group was laparoscopic sigmoid colectomy (36%) and laparoscopic right colectomy in the HisC group (28%).

As expected, hospital LOS was shortest in the AmbC group (Table 4). The mean LOS was 17.2 ± 7.4 hours, as compared to 109 hours ± 102.9 (4.5 days) in the InpC group and 83.2 ± 67.3 hours (3.5 days) in the HisC group ($P < 0.001$). Patients in the AmbC groups also had lower EBL as compared to the InpC and HisC groups (Table 3). This could be attributed to the fact that there were no open operations in the AmbC group. Readmission rate (13.8%) in AmbC was higher than InpC (6.9%) and HisC (8%) but this difference was not statistically significant. The overall 30-day postoperative complication rate in AmbC (13.8%) was lower than InpC (29.3%) and HisC (22.7%) but this was also not statistically significant.

Comparison of AmbC and InpC Patients

AmbC and InpC (n=58) had similar age, sex, race, BMI, and comorbidity (Table 2). There was no difference in mean operative time between the groups (113.3 vs 129.7 minutes, $P=0.1$). InpC had greater EBL (109 vs 34 mL, $P < 0.001$) while LOS was significantly longer (109 vs 17 hours, $P < 0.001$), as expected. There was no mortality in either group. AmbC and InpC also had similar readmission, reoperation, anastomotic leak, ileus, SSI, and other postoperative complications. InpC had a higher incidence of transfusion as compared to AmbC (15.5% vs 0%, $P=0.03$).

Comparison of AmbC and HistC Patients

AmbC and HistC had similar age, sex, race, BMI, and ASA class. Complications including readmission, reoperation, anastomotic leak, ileus, and SSI were rare in HistC and almost never occurred in AmbC.

TABLE 3. Surgical Characteristics

	AmbC (N = 29), n (%)	InpC (N = 58), n (%)	HisC (N = 88), n (%)
Operation type			
Laparoscopic			
Ileocolic resection	4 (11)	9 (16)	14 (16)
Right colectomy	8 (30)	8 (14)	25 (28)
Transverse colectomy	0	3 (5)	1 (1)
Left colectomy	0	4 (7)	5 (5)
Sigmoid colectomy	12 (44)	21 (36)	22 (25)
Low anterior resection	4 (11)	6 (10)	12 (14)
Subtotal colectomy	1 (4)	2 (3)	4 (4)
Open			
Ileocolic resection		1 (2)	0
Right colectomy		1 (2)	0
Transverse colectomy		1 (2)	1 (1)
Sigmoid colectomy		2 (3)	3 (3)
Low anterior resection		0	3 (3)

AmbC indicates Ambulatory Colectomy Group; HisC, Historical Colectomy Group; InpC, Inpatient Colectomy Group.

DISCUSSION

Ambulatory elective colon resection is the ultimate and ambitious aim of ERAS-driven perioperative care in colorectal surgery. This study presents our institution's experience with the safety and feasibility of developing an ambulatory surgery plan for selected patients undergoing elective colorectal surgery. In the 29 patients who met selection criteria and were discharged within 24 hours of laparoscopic colon resection we showed safety (minimal complications) and efficacy (low readmission rate). This experience proves the feasibility of ambulatory elective colonic resection and serves as a template for expanding the practice.

Prior studies reporting outcomes of "fast-track" recovery pathways following elective colorectal surgery have been

encouraging. Few studies have, however, reported the safety and feasibility of colectomy with a <24 hour postoperative in-hospital stay in small numbers of patients. A study from the University of Surrey in the UK assessed the safety and feasibility of 23-hour postoperative in-hospital stay in 10 patients (25% of the patients who met inclusion criteria) who underwent laparoscopic colorectal surgery (right, left, and sigmoid colectomy, anterior resection and total mesorectal excision without diverting ileostomy). They reported no complications and no readmissions.¹¹ Gignoux and colleagues similarly published a report of 5 patients who underwent laparoscopic sigmoid colectomy (for both malignant and benign conditions) and were discharged on the day of surgery. They describe their specific protocol, which included postoperative surveillance by a visiting nurse, labwork on POD 2, 4, and 8, and in-person office visits between postoperative weeks 3 to 4. Only 2 minor complications were reported, without the need for readmission.¹² This group followed up with a larger study of 157 patients in 2 institutions that underwent ambulatory laparoscopic colon resection for malignant and benign disease. The patients who met eligibility for ambulatory surgery represented 30.5% of the total patients who underwent elective colon resections during the study period. They reported a 6.1% readmission rate, with a 3.8% reoperation rate, and an overall morbidity rate of 24.8%.¹³ All patients in that study were admitted to the ambulatory surgery unit at 7 AM with the intent of being discharged at or prior to 7 PM. A NSQIP study of laparoscopic colon resections examined patients who were discharged before POD 5, including 905 patients who were discharged within 24 hours of surgery. Two percent of the early discharge group (POD 0–1) required early readmission, most commonly due to ileus/obstruction (41%). There were equivalent rates of anastomotic leak, ileus and readmission between all discharge groups.¹⁴ A study of 37 patients discharged on the day of surgery following laparoscopic colectomy or loop ileostomy reversal reported a 17% complication rate and 6% readmission rate, compared to 15% and 4%, in their standard ERAS group, respectively.¹⁵

In terms of the timing of discharge, our study differs in some characteristics from the previous reports relating to ambulatory surgery from the Centers in France and the UK. The study from the UK¹¹ admitted all patients overnight and discharged them home

TABLE 4. Outcomes

	AmbC (N = 29), n (%)	InpC (N = 58), n (%)	P*	HisC (N = 88), n (%)	P*
Length of stay, hours, mean (SD)	17.2 (7.4)	109 (102.9)	<0.001	83.2 (67.3)	<0.001
0–8 h	7 (24)				
9–24 h	22 (76)				
Operative Time, min, mean (SD)	113.3 (38.4)	129.7 (44.5)	0.1		
EBL, mL, mean (SD)	34.1 (75.5)	109 (134.7)	<0.001	122.5 (188)	<0.001
30-day postoperative complications					
Any complication	4 (13.8)	17 (29.3)	0.1	20 (22.7)	0.3
Readmission	4 (13.8)	4 (6.9)	0.4	7 (8)	0.5
Postdischarge day 0–1	1 (25)	1 (25)			
Postdischarge day 2–5	3 (75)	3 (75)			
Reoperation	0	2 (3.4)	0.5	0	0.1
Anastomotic leak	0	3 (5.2)	0.5	1 (1.1)	0.3
Ileus	1 (3.4)	4 (6.9)	0.7	5 (5.7)	0.8
SSI (any)	0	2 (3.4)	0.5	4 (4.5)	0.7
Transfusion	0	9 (15.5)	0.03	9 (10.2)	0.08

*P values calculated by the Pearson χ^2 /the Fisher exact test for categorical variables, Mann-Whitney U test for noncategorical variables after testing for normality. AmbC indicates Ambulatory Colectomy Group; EBL, estimated blood loss; HisC, Historical Colectomy Group; InpC, Inpatient Colectomy Group; SSI, surgical site infection.

the next AM. The 2 reports from Europe by Gignoux et al^{12,13} on the other hand, included a protocol that predetermined patients to undergo ambulatory colectomy. Since we were evaluating the feasibility of discharge <24 hours within the specific complexities of the health care system in the USA, we chose to instead allow patients to make the decision of either going home or staying in hospital if discharge criteria were met. Thus, the discharge decision relied on patient choice based on comfort and preference in the immediate postoperative period. Since patients underwent surgery at different times of the day, including later in the afternoon, we chose to assess them at 6–8 hours after surgery. If discharge criteria were not met or desired, patients were offered discharge the next morning. We hence chose to include discharge <24 hours as a definition for ambulatory colorectal resection for this study since all such patients would eventually be eligible for surgery within an ambulatory setting once the management protocol is further developed. Our study provides evidence that same-day discharge following laparoscopic colorectal surgery is feasible in a large number of patients. Of the 87 patients who met preoperative criteria for ambulatory surgery, 33% of these patients were successfully discharged <24 hours after surgery and 24% of those patients within 6–8 hours. Our mean hospital LOS was 17.2 (± 7.4) hours, as compared to 10.4 (± 3.4) in the Gignoux et al¹³ study. They reported their shortest LOS as 7 hours, but did not specify how many patients were discharged that early. Lee et al¹⁵ did not report hourly LOS times in their study of same-day discharge.

Successful ambulatory colorectal surgery relies on a combination of preoperative counseling, safe and efficient surgery, attentive perioperative care with accelerated goals, and access for patients that allows for close postdischarge follow-up. Institution-support and a multidisciplinary approach for the development of an ambulatory care colorectal practice is crucial, as nurses, nurse-practitioners, and other health care workers all are intricately involved in the patient's recovery and postoperative planning at discharge and during follow-up. Considering that our AmbC and InpC groups were similar in all characteristics, reluctance to break with "traditional" practices may have resulted in a longer LOS for certain patients who could have otherwise been discharged. However, it is inevitable that some patients regardless of preoperative eligibility have longer recoveries, and require and benefit from longer stays in hospital.

The data from our study suggests that discharges within 24 hours of surgery can be undertaken safely without conferring undue risk of postoperative mortality or morbidity. Our same-day discharge group held a 13.8% complication and readmission rate, with only a single major complication (ileus) that did not require invasive treatment. The rate of complications in our same-day discharge group (AmbC) was actually lower than in the standard recovery groups, which may indicate that patients who meet strict discharge criteria earlier in their postoperative course are also less likely to develop complications in the 30-day postoperative period. There were no significant differences between our same-day discharge group outcomes and the standard recovery patient outcomes, signaling that indeed same-day discharge can be safe for select patients.

In order to evaluate the generalizability, we compared postoperative outcomes between ambulatory patients and a similar historical group of patients that were not offered or counseled regarding same-day discharge there were no significant differences. Considering that the 2 groups were comparable, our results suggest that ambulatory surgery criteria can be applied to the majority of patients undergoing colectomy. During the reported period, nearly all the patients who underwent colorectal resection with an anastomosis were offered

ambulatory surgery. Of the 184 patients who underwent surgery, 31.5% underwent complicated operations, such as complex pouch procedures, extensive reoperative or corrective surgery, repair of enterocutaneous fistulae or ostomy creation needing perioperative education. Thus, even within a practice with a high proportion of complex, reoperative and reconstructive colorectal surgery, 47.2% of patients were found to be eligible for ambulatory colectomy. Further, 40% of eligible patients who underwent anterior resection as well as 33% of those who underwent subtotal colectomy could also be discharged <24 hours after surgery, further supporting the generalizability of ambulatory colectomy in a large group of patients. At the present time, a total of 41 patients have undergone ambulatory colectomy in our institution. The characteristics and outcomes for these patients mirrors those of the 29 included in this study, once again confirming the applicability of the approach. There are 3 important aspects of ambulatory colorectal resection that must apply to achieve success. The first is the selection criteria. We used criteria to eliminate high risk patients and to include those with surgeries where recovery could be predictable. The second is the use of minimally invasive techniques. Avoiding a significant abdominal wall incision reduced pain levels to those that can be quickly controlled by outpatients. The third is the quality of the surgery. Attention to dissection in planes, with minimal trauma, results in minimal bleeding, faster return of bowel function and, in a general sense, less trauma to the patient as a whole. Judicious anesthesia is also necessary to avoid to consequences of over medication, which may prolong recovery.

While there is limited previous information suggesting the safety or ambulatory colectomy, there are some unique characteristics of the current study. To our knowledge, this study is the first of its kind published out of the United States and the first in North America to report its findings studying ambulatory colorectal resections exclusively (not including loop ileostomy closures). Our study includes patients who were discharged within 6 to 8 hours following elective laparoscopic colorectal resection, not previously systematically reported. Patients who underwent surgery at various times of the day were offered the option of discharge at this time-point or subsequently the next morning. Since all patients over the period who met predetermined criteria were offered the possibility this minimized selection bias. The demonstration of the safety and feasibility of the approach even in a practice with a high volume of complex and reoperative surgery and its applicability in patients undergoing anterior resection and subtotal colectomy further supports the ability to evolve the concept for more universal adoption.

One limitation to the widespread adoption of outpatient colectomy is the risk of major complications. While the most worrisome complication is an anastomotic leak but leaks typically do not manifest quickly and severely. The biggest concern is intraperitoneal postoperative bleeding, which can often be picked up in the postoperative period, based on the intraoperative findings, immediate postoperative response and laboratory values. Bleeding from an anastomosis is in fact the most unpredictable outcome although this might occur after discharge even in patients who go home after colectomy that is non-ambulatory. The other 2 serious complications could happen with early discharge are myocardial infarction and pulmonary embolism. Selecting patients at a lowest risk for these complications reduces this risk while monitoring patients closely and having a low threshold to identify the complications helps prevent major setbacks. The insurance ramifications of converting an inpatient procedure to an outpatient procedure are also worth discussing and at present likely depend partly on whether

colectomy procedures are reimbursed based on a pay-for-performance or a pay-per-service model. Regardless, the advantages to the patient and the health care system as a whole are huge.

Some limitations of this study bear discussion. These include the relatively small patient numbers arising from this being an initial feasibility study, and the inclusion of the cohort of an experienced single surgeon's results at a tertiary care center. Since we wanted to assess the feasibility of ambulatory colectomy as a first step, we chose to include all patients who could be discharged <24 hours since this would help determine the possibility of offering the procedure within an ambulatory care setting. Health literacy and other social factors may impact whether a patient would feel comfortable participating in ambulatory surgery and could explain our 33% inclusion rate. Further patient education and multidisciplinary involvement could broaden eligibility and expand our pool of patients who undergo ambulatory colorectal surgery. However, our protocol continues to be applied successfully in our department, and at the time of writing nearly 45 patients have had ambulatory colorectal surgery under these guidelines suggesting the feasibility and safety of ambulatory colectomy. The lack of information on patient reported outcomes such as comfort at home and patient satisfaction is another potential drawback. However, patients were offered the option of early voluntary readmission the next day after surgery in the event of an inability to cope with their symptoms. The absence of a single voluntary readmission suggests that the postoperative symptoms of patients could be adequately managed at home.

In conclusion, ambulatory surgery is safe and feasible for select patients undergoing colorectal resection and represents an important shift in how colorectal surgery patients can be managed. With careful preoperative education, perioperative management, and postoperative follow-up, ambulatory surgery is feasible in up to a third of patients undergoing colorectal resection/anastomosis and can be performed with comparable safety to the time-honored practice of routine inpatient hospitalization. Further refining inclusion and exclusion criteria and postoperative outpatient follow-up will allow a paradigm shift in how such patients are managed, which has huge implications for patients, caregivers, and health care systems.

DISCUSSANT

Dr. Gregory Kennedy (Birmingham, AL)

I'd like to thank the program committee for asking me to comment on this well-done paper and the authors for sending me a copy of the manuscript. The postoperative management of patients undergoing colorectal surgery has been revolutionized through the utilization of the enhanced recovery programs. The benefits of this protocolized management has been seen in many specialties, making it really the standard of care for most postoperative patients in my mind. While there are many advantages of using enhanced recovery pathway, one from which nearly every patient has benefit is reduction of length of stay. In one recently published series of colorectal surgery patients, a one-day reduction in length of stay was demonstrated in those managed on the enhanced recovery pathway, leading to over \$1000 in savings per patient per hospital stay.

Overall, most series demonstrate an average of two-and-a-half- to three-day length of stay for colorectal surgery patients,

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and in our own series of over 2200 patients managed on the enhanced recovery pathway in Alabama, nearly 10% of our patients are discharged on day one. This really makes this idea of outpatient colectomy in my mind the next step, and I congratulate you, Dr. Kiran, for taking that next step. You've clearly demonstrated in my opinion the safety of this approach to the first 29 patients, and it looks like the same through your first 41, but I do have a few questions for you.

Number one related to inclusion criteria. Do you have limits on distance traveled for an operation? In the more rural states, patients may come from hundreds of miles away, and I guess I worry a little bit about generalizability of your results from New York City to those of us in the more rural states.

Number two, what about social determinants of health as far as inclusion criteria? Should we be thinking about that? Is it appropriate to include patients with low health literacy or with low financial and social support available to them in these outpatient pathways for colectomy?

Number three, percent of patients who spent one night in the hospital, and do those patients in your hospital take up a hospital bed, so the bedded-out patients, if they stay in the

PACU, do you still free up hospital beds? If they're taking up a hospital bed, it seems to defeat the purpose, I guess.

Number four, have you considered insurance implications of these outpatient colectomies? As we enter into the bundled care realm, what's going to be the implications on bundled care? I don't expect you to have an answer. I certainly don't, but I think we need to be thinking about these as we move into these types of novel pathways.

And then finally, I do think one limitation to the widespread adoption of outpatient colectomy is the risk of major complications. Enhanced recovery pathways have certainly decreased the incidence of minor complications, but the major complications, anastomotic leak, postoperative bleeding, MI, et cetera, really have not been significantly improved by our use of ERP. If these life-threatening complications are going to limit the generally risk-averse group of surgeons from widely adopting this outpatient protocol, in my opinion, how do we mitigate this risk and a potential failure to rescue event in the patients? I think that's what's really going to limit us. Is it through scheduled appointments, patient engagement technology? What do you have on your horizon for this? Again, congratulations on this spectacular work, and I really do look forward to the future as we move into this. Thank you.

Response from Ravi Kiran

Thank you, Dr. Kennedy, for those very kind comments, and thank you for reviewing the manuscript. With regard to your questions, the question about distance and geography of the patient is also a particular problem in New York City. We have several patients coming from the tri-state area around us, and for us in addition, knowing the traffic problems in New York City, it's also the time taken for the patient to get to a hospital. We included all patients, those who could reliably get to a hospital within 30 minutes, and those coming from out of state were often discharged to a hotel close enough because that's what they often do before they go home, but that's a very valid point regarding rural areas.

With regard to social determinants, we only included patients who could understand the perioperative pathway and, you know, typically what happens in our hospital the patients needed to understand. It's a stepwise understanding of what is expected to happen in terms of their diet, in terms of their pain medications, potential other setbacks after surgery and having a first line, second line, third line kind of strategy towards their management.

With regard to the percent of patients who spent the night in the hospital, about 75% of our patients were actually overnight since we operated on patients throughout the day, some as late as 5 o'clock in the evening, and when the patients had the surgery late, they stayed in the PACU and were discharged directly from the PACU whereas those patients who at eight hours were offered discharge and decided to defer discharge were admitted to a hospital bed.

With regard to the insurance implications, I think that's a very valid point, and I think it's a very interesting question for the future. I think it really depends upon whether we have a pay-for-performance kind of a view or whether it's a pay-per-service kind of a viewpoint as to how this is eventually dealt with, but regardless, the advantages to the patient and to the hospital but also to the surgeon – you know, I have certainly been doing rounds of less duration because one-fourth of my patients are able to go home – are enormous with this regardless of the implications to the health system. It has to be good for all of us in terms of freeing up beds, in terms of reducing nosocomial

infections, and especially in this era of COVID that has come to stay, the patients are able to go home. In fact, it was during the peak of the COVID pandemic that I started eventually toying with the idea of sending patients home the same day so that they won't have to stay in hospital.

With regard to complications, I think that's a very valid question. I think as colorectal surgeons, everybody including me is most worried about an anastomotic leak, but as we know, these leaks typically do not manifest quickly and severely. Quite often it is us having to keep in touch with these patients and having a low threshold to identify the complications. The biggest worry for me really is postoperative bleeding, and typically while an intraperitoneal bleed is something that, you know, as a surgeon we can expect or we can catch in the immediate postop period, it's really the anastomotic bleeding that we sometimes don't have control over, and that's why I think this reflects the higher transfusion in our inpatient colectomy group.

The other two serious complications that I think could happen with early discharge are an MI, which could be fatal, of course, or a PE, so those are things that I think we need to eventually figure out which patients have the lowest risk for these complications so that we could select out patients that could be sent home sooner. Thank you.

Dr. David Rothenberger (Minneapolis, MN)

Congratulations and thank you for presenting your experience. It is an interesting evolution of a trend that has been going on for some time, as you pointed out. Can you say a little bit more about what you call “favorable social support at home” and how you assess that? Also, please tell us about your analgesia protocols and who does the postoperative calls to the patient? How are they trained and supervised? What process is followed if there are some concerns raised by the patient?

Response from Ravi Kiran

Yeah, I make sure that we speak extensively to the patient prior to surgery. They are educated at the time of the preoperative visit. I make sure that there is a reliable family member at home who also understands the perioperative pathway and what to expect after surgery, and the same discussion is once again had in the preoperative bay so that the family understands what the usual things we face in the hospital because they could very well happen at home.

With regard to the second question about analgesia, all of our patients get pre-emptive analgesia with Toradol, Tylenol that starts preoperatively and in the preoperative day. They usually get gabapentin and tramadol for breakthrough. They are discharged home with a similar set of medications with clear guidelines as to what to use and when.

And then the third question?

Dr. David Rothenberger (Minneapolis, MN)

Postoperative calling.

Response from Ravi Kiran

The postoperative calling is typically done by the nurse practitioner who works closely with me, and they go through a predetermined set of questions as to how the patients are doing. If there is any concern about the patient, you know, we have a low threshold to bring them back to be followed up or the opportunity for admission. Thank you.

Dr. Mickael Lesurtel (Paris, France)

Mickael Lesurtel from Beaujon Hospital in Paris. I thank you for those interesting data. Thank you for mentioning the French leadership in this area. I have a short question. It would be very important to know what are the independent predictive factors of failure of the ambulatory strategy. Did you look at that?

Response from Ravi Kiran

I think that was one of the reasons that we broke up the patients into the ambulatory colectomy, the inpatient colectomy, and the historical colectomy group. As I showed in the various tables, there was really no significant difference in the p value. Obviously, all of our patients had a very, very low complication rate, which I think is important. Before somebody embarks on discharging patients, you need to know predictably what your risk for complications might be. I would not recommend this for anybody starting out. In terms of the factors, I think it's the small numbers in the groups that prevented us from finding a difference. We probably had a type 2 error, although we did find that the blood transfusion requirements probably relate to the lower GI bleed, which is really my concern because if you send the patient home, they don't have a bowel movement for a day or two, and they have bleeding, and that can be really dramatic sometimes. I suspect that that is what is going to be the difference as we have more patients in our groups.

Dr. Jose Guillem (Chapel Hill, NC)

Thank you Dr. Kiran for a great presentation and for sharing your excellent experience with this very highly selected patient population. I wonder if you can comment on the role that

the navigators are playing preoperatively in terms of setting the expectations for the patients. What should they expect, specifically in terms of minimizing opioid usage. The second point I want to make is that according to my math, 29/184 is 16% as opposed to what I think you thought of as one-third of colorectal surgical cases are eligible patients for this protocol?

Response from Ravi Kiran

We perform a high volume of reoperative surgery including fistulae, pouches, redo pouches, continent ileostomies as shown in one of the first tables, so those patients are obviously not eligible for same-day discharge. So removing those patients, taking patients who underwent colorectal resection, not only segmental colectomy but also subtotal colectomy or, you know, anything that's not a complex reoperative surgery, there were a total of 89 patients, so 29/89 is one-third. We would not expect to be discharging patients who have surgery for continent ileostomy or enterocutaneous fistula the same day, leave alone after three or four days.

With regard to the patient navigator, I personally have these discussions with the patient and the family at the preoperative visit. I set expectations for them that the surgery is expected to take a certain amount of time, that the Foley catheters will be removed at the end of the surgery, that they will be assessed at the eight-hour mark, and if they feel well and if they meet the discharge criteria and they want to go home, they could potentially go home, but if they had any hesitation whatsoever or if I felt they should stay, then they would stay overnight, so the expectation is set right from the beginning, and I think as a surgeon, it's important that I, rather than a navigator, do it.