A Comparison of Re-admission and Emergency Department Visits in a Colorectal Surgical Home versus Traditional Perioperative Care

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Abstract

Purpose: A perioperative surgical home is a program that combines enhanced recovery protocols (ERP) with pre-operative optimization and intra-op protocols to improve outcomes post-operatively. There is no significant research on them in colorectal surgery. Our objective was to study the effect of a surgical home on re-admissions and ED visits of colorectal patients compared to traditional management.

Methods: This was a retrospective study in a single system with multiple hospitals. The study group had elective colorectal surgery resection after the implementation of a colorectal surgical home that provided perioperative optimization. Patients were compared to those who underwent colorectal surgery resection with ERP but before the surgical home was established. Hospital re-admissions and ED visits within 30 days were then compared between the groups.

Results: A total of 167 colorectal surgical home patient charts were compared to colorectal ERP patients only. The surgical home patients were younger than the ERP (61.6 vs 65.4). However, ASA scores and pre-operative comorbidities were very similar between the groups. The 30-day re-admissions and ED visits were improved but not statistically significant between the matched groups (10.2% vs 15.0% and 15.6% vs 19.8%) ($p = 0.124$ and $p = 0.195$). Secondary outcomes noted the surgical home group did have a lower length of stay and fewer conversions to open.

Conclusions: Although there was no statistical significance between the 30-day re-admissions or ED visits, this trended towards improvement in patient treated under a surgical home when compared to those treated under ERP. ED visits decreased by 1/4 and re-admissions decreased by 1/3.

Introduction

Optimization of colorectal surgical patients has been a topic of ongoing research for decades, with several studies being published about programs to reduce the length of stay (LOS) and complications after colorectal surgery. One such study demonstrated a reduction of the LOS after open sigmoidectomy from 5–10 days down to 2 days by employing different pain medications, giving immediate oral nutrition and ambulating early. [1] Such interventions became the hallmark of other attempts to “fast track” and improve recovery after not only colorectal surgery, but many other major surgeries. The goal of these protocols was to maintain physiological function post-operatively to improve overall recovery. Enhanced Recovery Protocols (ERP) began to be implemented at hospitals and the Enhanced Recovery After Surgery (ERAS ®) Society was created in 2001 as an international group that offered recommendations and research in support of such programs. [2]

Over the years, ERP and ERAS have been able to show improvements in LOS [3–7] as well as post-operative complications for colorectal patients. Specifically, decreased mortality, morbidity, LOS and re-admissions were confirmed in a Cochrane review [8]. And this latest iteration of ERAS was found to shorten stay by 30–50% and reduce complications, re-admissions and cost. [9]

Meanwhile the American Society of Anesthesiologists (ASA) has made an effort to organize fragmented peri-operative care with the use of the Perioperative Surgical Home (PSH). This model includes intra-op protocols as well as pre-op optimization of comorbidities and follows the patient for the immediate post-operative period while engaging all providers in the care process [10]. The PSH organizational entity has also been shown to facilitate adherence to ERP [11]. It has also been found to improve patient satisfaction and cost [12–15]. This optimization has been studied in total joint patients [16] and other specialties. Individual preoperative interventions such as albumin testing [17] and anemia treatments [18] have also been shown to improve outcomes for colorectal surgery patients.

There has been no significant research to assess the role of the PSH in colorectal resection patients. Published ERP studies do not include protocols to reduce pre-operative comorbidities.

The objective of this study was to investigate the effect of PSH on 30-day post-operative outcomes in colorectal resection patients. We hypothesized that PSH would reduce 30-day re-admissions and emergency department visits compared to the traditional ERP care.

Materials & Methods

This was a retrospective review of data using the electronic medical record of multiple hospitals and surgeons within a medium-sized healthcare system. IRB approval was attained in 2018 with a project number of IRB Study#: 18–035. Inclusion criteria included being 18 years or older and undergoing colorectal surgical resection. Exclusion criteria included emergency procedures. A total of 250 patient charts were collected from a database of patients enrolled in the colorectal PSH from 2016–2018. 83 patients were excluded due to incomplete follow up. Complete data was able to be collected on 167 patients. We compared these patients to 167 patients who underwent elective colorectal resection patients the two years before establishment of the PSH. The primary endpoints were re-admission and Emergency Department (ED) visits within 30 days. Secondary outcomes were LOS, conversions to open procedure, major complications complication such as intra-abdominal abscess, anastomotic leak, reoperation within 30 days, bleeding requiring transfusion, myocardial infarction (MI), stroke and pneumonia and minor complications such as wound infection, urinary tract infection (UTI), ileus requiring a nasogastric tube placement, and new onset of atrial fibrillation (a-fib).

The data collected on each patient included demographics, date of surgery, comorbidities, the procedure completed, indication for surgery, conversions, 30-day ED visits and re-admissions, as well as major and minor complications. Patients' charts were reviewed out to a total of 30 days post-operatively. Comorbidities examined included chronic obstructive pulmonary disease (COPD), coronary artery disease (CAD) or congestive heart failure (CHF), smoking, pre-operative anemia (hemoglobin < 12 g/dL in women & <13 g/dL in men), malnutrition (with a pre-albumin < 15 or albumin < 3), obstructive sleep apnea (OSA) and diabetes (DM). This included a subcategory for poorly controlled diabetics with an A1C > 8 or any perioperative glucose > 200 mg/dL. All participants underwent colorectal surgery either through an open, laparoscopic, or robotic approach.

Means and standard deviations (SD) were calculated for all normally distributed continuous variables. Differences between groups were analyzed using Student's *t*-test. Frequencies and percentages were calculated for all categorical variables. Relationships among categorical variables were calculated using Fisher's Exact test. Alpha was set at $p < 0.05$ to determine statistical significance.

PSH Protocol

Those who went through the PSH were screened pre-operatively for anemia, smoking, OSA, diabetes, protein malnutrition, frailty and poorly controlled nutrition. Screening tools for these protocols as well as the indicated interventions can be found in the attached addendums. Smokers were referred to smoking cessation counseling. All PSH patients were encouraged to supplement meals with protein drinks and drank electrolyte containing beverages in the 12 hours pre-operatively to reduce dehydration. Those at higher nutritional risk were able to be referred to dietetics. All patients were screened for hyperglycemia and if no prior diagnosis of diabetes was present they were set up with the diabetic advisory team. Patients with a known diagnosis of diabetes were asked to improve glucose control with their primary care provider or the diabetic team. All individuals were also screened for undiagnosed OSA pre-operatively so that the OSA precautions order set with end tidal CO2 monitoring, non-invasive positive pressure ventilation and aspiration precautions could be ordered inpatient. Anemic patients underwent intravenous iron infusions before surgery. Frail individuals were referred outpatient physical and occupational therapy and some were able to start therapy pre-operatively. All patients also met with the anesthesia team pre-operatively and ostomy nurses as needed.

Intra-operatively the anesthesia team had protocols for PSH patients to prevent volume overload. Surgeons employed clean closure techniques for PSH patients as well as other intra-op protocols such as wound protectors and wound irrigation to decrease surgical site infection risk.

Both the PSH and pre-PSH patients received pre-operative bowel preparations with oral antibiotics and had IV antibiotics before the start of the operation. In the PSH these IV antibiotics were continued for no more than the 24 hours after surgery. The PSH protocol recommended against placement of a nasogastric tube for the immediate post-operative period, allowed clear liquids post-op day 0, and recommended urinary catheter removal on post-op day one unless the patient had a low resection. Chewing gum was provided to PSH patients to stimulate bowel activity and incentive spirometry and early ambulation were encouraged. These protocols were not mandated and could be changed at the discretion of clinical team. Alternatively, these care methods were sometimes utilized by the pre-PSH clinical teams but were not protocolized or universal.

Results

A total of 250 patients were initially identified and 83 were excluded due to incomplete data. The remaining 167 patients were compared to 167 elective colorectal surgery patients from before the PSH period, for a total patient population of 334 patients.

The average age was higher in the control group than that of the PSH (65.4 vs 61.6 years, p < 0.001). The distribution of patients in various BMI categories was similar (p = 0.68) and there were equal numbers of males and females in each group (49.7% female, 50.3% male, p = 0.544) (Table 1).

Table 1
Baseline Demographic Data

	Surgical Home	**Control**	**P Value**
Age (Years)	61.55	65.37	< 0.001
BMI	**N (%)**	**N (%)**	0.676
<18.5	2 (1.2%)	1 (0.6%)	
18.5–24.9	43 (25.7%)	42 (25.1%)	
25-29.9	54 (32.3%)	64 (38.3%)	
30-34.9	39 (23.4%)	34 (20.4%)	
35-39.9	17 (10.2%)	11 (6.6%)	
>40	12 (7.2%)	15 (9%)	
Gender (%)			0.544
F	49.7	49.7	
M	50.3	50.3	

Although there were similar numbers of diabetics in the two groups (24.5% vs 24.5%, p = 0.551) there was a higher proportion of those with poor gylcemic control pre-operatively in the control group than the PSH group (21.8% vs 8.4%, p = 0.001). There was also a trend towards more active smokers in the PSH although this did not reach statistical significance (21.0% vs 13.8%, p = 0.056). The rates of other comorbidities were all similar between the two groups. Most notable, the pre-operative rates of anemia (33.7% PSH vs 36.4% control, p = 0.350) and malnutrition (25.3% PSH vs 23.0% control, p = 0.360) were comparable. (Table 2). There was also no significant differences in the distribution of patients along ASA categories. (Table 3)

Table 2
Comorbidities

	Surgical Home N (%)	Control N (%)	P Value
COPD	14 (8.38%)	17 (10.18%)	0.353
DM	41 (24.55%)	41 (24.55%)	0.551
Poorly . Controlled	14 (8.4%)	36 (21.8%)	0.001
CAD or CHF	39 (23.35%)	31 (18.56%)	0.173
Anemia	56 (33.7%)	60 (36.4%)	0.350
Malnutrition	41 (25.31%)	37 (22.98%)	0.360
OSA	18 (10.7%)	16 (9.58%)	0.428
Smoking	35 (20.96)%	23 (13.77)%	0.056

Table 3
ASA Class

	Surgical Home N (%)	Control N (%)
1	1 (0.6%)	4 (2.4%)
2	67 (40.12%)	74 (44.31%)
3	95 (56.88%)	82 (49.1%)
4	4 (2.4%)	7 (4.19%)
p = 0.270		

The distribution of patients undergoing open, laparoscopic or robotic surgery was different between the two groups (p = 0.001). The rates of open surgery were comparable between the groups (24% PSH vs 27.5% control), but there were more robotic cases in the PSH group than the pre-PSH group (42.5% vs 24%) and fewer laparoscopic (33.5% vs 48.5%). (Table 4)

Table 4
Mode of Surgery

	Surgical Home N (%)	Control N (%)
Open	40 (24.0%)	46 (27.5%)
Laparoscopic	56 (33.5%)	81 (48.5%)
Robotic	71 (42.5%)	40 (24.0%)
P = 0.001		

A higher proportion of patients underwent partial colectomies in the PSH group (29.3% vs 14.4%). However, the type of resection was similar between the PSH and control groups (Table 5). In addition, the rate of ostomy formation was similar (18.7% PSH vs 17.4% control, p = 0.433).

Table 5
Type of Procedure

	Surgical Home N (%)	Control N (%)
Right Colectomy	51 (30.5%)	61 (36.5%)
Abdominal Perineal Resection	10 (6%)	7 (4.2%)
Low Anterior Resection	40 (24%)	53 (31.7%)
Partial Colectomy	49 (29.3%)	24 (14.4%)
Subtotal or Proctocolectomy	3 (1.8%)	4 (2.4%)
Ostomy Reversal	14 (8.4%)	18 (10.8%)
P = 0.029		

There was no difference in indication for operation (p = 0.12). These included malignant neoplasm (47.3% vs 59.9%), large benign polyps (20% vs 12%), inflammatory bowel disease (1.8% vs 1.2%), diverticulitis (25.5% vs 24%) and other diagnoses (5.5% vs 3.0%). (Table 6)

Table 6
Indication for Surgery

	Surgical Home N (%)	Control N (%)
Neoplasm	78 (47.3%)	100 (59.9%)
Benign Polyp	33 (20.0%)	20 (12.0%)
Inflammatory Bowel Disease	3 (1.8%)	2 (1.2%)
Diverticulitis	42 (25.5%)	40 (24.0%)
Other	9 (5.5%)	5 (3.0%)
p = 0.121		

Evaluation of compliance with interventions when available noted that 100% of PSH patients who had OSA were ordered to have CPAP available for the patient. In the pre-PSH only 68% of the patients with OSA had an order stating that the patient should use their home CPAP or be offered one by the hospital. Similarly, 82% of smokers were formally referred for smoking cessation counseling in the PSH group, compared to 61% of the pre-PSH.

Of our primary outcomes, the re-admissions in 30 days decreased from 15.0–10.2% after the implementation of the PSH ($p = 0.12$) and the ED visits in 30 days decreased from 19.8–15.6% ($p = 0.20$). Of our secondary outcomes there was no statistical difference between the PSH and the control group in the rate of transfusions, pneumonias, myocardial infarctions, urinary tract infections, ileus, wound infections, abscesses, leaks, returns to the OR or death. New onset a-fib trended towards a significant difference ($p = 0.061$) with 2.4% in the control group and 0% in the PSH group. (Table 7) There were no strokes within 30 days in either group.

Table 7
30 Day Outcomes

	Surgical Home N (%)	Control N (%)	P Value
Primary Endpoints			
ED Visit	26 (15.6%)	33 (19.8%)	0.195
Readmission	17 (10.2%)	25 (15.0%)	0.124
Secondary Endpoints			
Conversion to Open	8 (4.8%)	23 (13.8%)	0.004
Transfusion	11 (6.59%)	9 (5.39%)	0.409
PNA	3 (1.8%)	5 (3.0%)	0.362
MI	0 (0%)	2 (1.2%)	0.249
New a-fib	0 (0%)	4 (2.4%)	0.061
UTI	5 (3.0%)	3 (1.8%)	0.362
Ileus	25 (15.0%)	24 (14.4%)	0.500
Wound Infection	12 (7.2%)	13 (7.8%)	0.500
Abscess	7 (4.2%)	5 (3.0%)	0.385
Leak	5 (3.0%)	5 (3.0%)	0.621
RTOR	8 (4.8%)	8 (4.8%)	0.601
Death	1 (0.6%)	2 (1.2%)	0.988

The LOS in the PSH patients had a median of 3 days with the 25th percentile staying 2 days and the 75th percentile staying 5 days. The control group also stayed for a median of 3 days but the 25th percentile also had a 3 day stay and the 75th percentile had a 6 day stay. This distribution showed a longer LOS overall in the control group that was statistically significant with p = 0.004. (Table 8)

Table 8
Length of Stay

	Surgical Home	Control
Median (days)	3	3
25th Percentile (days)	2	3
75th Percentile (days)	5	6
P = 0.004		

The total number of conversions to open from minimally invasive procedures was 8 (4.8%) in the PSH group and 23 (13.8%) in the control group (p = 0.004). Of these conversions in the PSH 5 of the 56 laparoscopic surgeries converted to open and 3 of the 71 robotic surgeries converted to open. In the control group 17 of the 81 laparoscopic surgeries converted to open and 6 of the 40 robotic surgeries converted. (Table 9)

Table 9
Conversions to Open

	Surgical Home	Control	P Value
Total conversions	8 (4.8%)	23 (13.8%)	**0.0004**
Laparoscopic Converted	5/56	17/81	
Robotic Converted	3/71	6/40	

Discussion And Conclusions

After PSH was established at our institution we sought to compare outcomes of those patients undergoing elective colorectal resection under the PSH vs a partially established ERP. Although our study did not demonstrate statistical significance between the 30-day re-admissions or ED visits, this trended towards improvement in patients treated under a PSH when compared to those prior to the PSH. ED visits decreased by 1/4 (19.8–15.6%) and re-admissions decreased by 1/3 (15.0–10.2%). (Table 7)

While this was not statistically significant the numbers trended towards improvement demonstrating clinical significance for management of patients. This data is very consistent with previous studies in evaluation of patients from both PSH [14] and ERP/ERAS protocols [19] that decrease the re-admissions and ED visits. Improvement of perioperative care has also been shown to decrease re-admissions in patients after ileostomy creation as well [20]. Our sample size was small likely limiting the power of the study to be able to find a statistical difference.

In our secondary outcomes there was a significant difference in the distribution of LOS between the two groups with a shorter stay in the PSH group. This correlates well with the overall decreased complication profile of the PSH group and is likely linked to their optimization in the pre, post and intra-op time periods. The ERP portion of the PSH may have contributed to decreased LOS based on existing literature. [3–7, 19] But PSH has also been shown to decreased LOS in other subspecialties. [12]

With a lower LOS, and lower frequency of ED visits and re-admissions in the PSH than the ERP group we can say that our study found a significant improvement in overall care using a PSH rather than ERP alone. Thus the ERP components are expected to help but PSH confers an even greater benefit in colorectal patients. This was not statistically evident in individual complication outcomes but in the more long-term and overarching data points of LOS, ED visits and readmissions. This suggests that the combination of the multiple small changes in patient preparation may not reduce any one complication substantially but may improve the patient’s ability to compensate when complications occur. PSH got them out of the hospital faster and prevented them from having to come back for late events implying that if there were late events, they were better able to be managed outpatient.

In comparing the two populations interestingly, we found a higher percentage of poorly controlled diabetics in the control group and a higher number of smokers in the PSH that approached significance (Table 2). We suspect this may be secondary to more careful screenings for comorbidities in the PSH group. Indications for surgery were also similar between the groups (Table 5).

There were differences in the surgery performed both in the mode of surgery and procedure performed. While the percentage of open surgery is similar between the two groups there were more laparoscopic surgeries in the control and more robotic surgeries in the PSH group. (Table 4) This is likely because the two groups were divided by time with the control group surgeries being performed in the two years preceding the establishment of the PSH. At this time there was a rapid increase in the use of the robotic platform for colorectal surgery. This may have created some bias against the control group as there is some data to suggest robotic surgery has lower rates of conversion but appears to be equivalent in other peri-operative outcomes aside from cost. [21] This may have then contributed to our significant decrease in conversion to open in the PSH group.

There was a slight difference in type of surgical procedure performed with higher number of partial colectomies in the PSH group, however the other types of operations were similar. Careful evaluation of the procedures beyond the CPT code noted ambiguity in what was defined as a partial colectomy by CPT. Therefore, some discrepancy may have been introduced in the way we collected cases for the study. However, when combining all colectomies in (right colectomies, LAR and partial colectomies) numbers are similar between groups (83.8% vs 82.6%). The more complex cases (APR and subtotal or total colectomies) were similar between the two groups. As such this should not have influenced our overall outcomes.

One limitation of the PSH may be compliance to the established protocols. This was difficult to determine in a retrospective study. However, two measures that could be evaluated showed that smoking cessation referral was documented in 82% of PSH patients compared to only 61% of pre-PSH. And a CPAP order was placed in 100% of patients with OSA in the PSH group compared to only 68% in the pre-PSH group.

Standardization of ERAS and ERP has also been studied and found to be of benefit to recovery. [22, 23] In our pre-PSH group there was no established protocols for peri-operative care in the colorectal patient group between surgeons. Thus, establishing the PSH also standardized and encouraged use of the ERP protocols that were used but not consistent prior to PSH.

It is also possible that the significant outcomes seen in this study might be primarily conferred by the ERP portion of the PSH. We know that PSH facilitates ERP [11]. There is also a notable similarity between the goals of ERAS and PSH but with different methods that are thought to be complementary when evaluated in anesthesia literature. [24]

Based on these findings we can conclude that the PSH can provided a significant clinical benefit in terms of re-admissions, post-operative ED visits and length of stay compared to ERP alone. This should therefore be disseminated to additional health systems to improve care.

Declarations

STATEMENTS AND DECLARATIONS

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CONFLICTS OF INTEREST

None of the authors have any conflicts of interest to disclose.

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