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General Surgery Residency and Emergency General Surgery Service Reduces Readmission Rates and Length of Stay in Nonoperative Small Bowel Obstruction

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Abstract

Background: Nonoperative management of adhesive small bowel obstruction (ASBO) results in resolution for the majority of patients. Previous studies have demonstrated that outcomes for patients with ASBO are improved when patients are admitted to a surgical service, but the effect of general surgery resident coverage is unclear. This study measures quality outcomes for patients with ASBO after the establishment of a new general surgery residency program.

Methods: An institutional review board-approved retrospective chart review of admissions for ASBO was conducted following the implementation of a protocol for ASBO nested within a newly developed resident-run emergency general surgery (EGS) service. Patients successfully treated without operative intervention were analyzed.

Results: During the study period, 612 patients were admitted for ASBO. After initiation of the residency, 74% of ASBO were admitted to a surgical service compared with 35% prior to residency ($P < .01$). Length of stay was reduced by 0.77 days ($P = .016$), average direct total cost per patient was reduced by 24% ($P = .002$), and 30-day readmissions were reduced by 35.7% ($P = .046$). There was no significant difference in mortality (1.4% vs 1.0%).

Discussion: Admission to a resident-run surgical service was associated with statistically significant improvement in outcomes for patients with ASBO. These data corroborate prior studies demonstrating the positive impact of residency programs on patient outcomes and provide additional evidence that general surgery residency programs improve outcomes for patients with surgical disease.

Introduction

Adhesions from previous surgery are the leading cause of small bowel obstructions in the United States and represent up to 16% of surgical admissions and over 300 000 operations annually at a cost of 2.3 billion dollars.[1] The management of adhesive small bowel obstructions (ASBO) has undergone a significant shift over the past 2 decades toward initial nonoperative management for most patients.[2] The approach to nonoperative management, however, has been variably implemented. Over the past decade, the American College of Surgeons as well as international governing bodies have attempted to identify which patients can be successfully managed with the nonoperative approach, the appropriate timeframe for nonoperative management, and strategies for monitoring the evolution of ASBO.

Initial nonoperative management is expected to result in resolution of obstruction in 70% to 80% of patients but is only appropriate for patients without evidence of ischemia or strangulation on admission.[1] Evaluation for ischemia and strangulation includes objective findings such as abdominal radiographs, computed tomography (CT)

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scans, and laboratory results and subjective findings including the abdominal examination. Thus, in the absence of signs of ischemia or strangulation, most patients are appropriate for nonoperative management with nasogastric decompression, bowel rest, and serial examinations.

Provided there is no shift in the clinical picture to suggest bowel ischemia, nonoperative management can be undertaken for up to 72 hours.[1,3] Close monitoring includes daily imaging, abdominal examinations, and laboratory evaluation. In addition, water-soluble radiographic studies have a dual benefit of illustrating the point of obstruction as well as a potentially cathartic effect and can be used either on admission or at 48 hours for re-evaluation.

In addition to a shift in management approach, there has been a concurrent shift in admission patterns for patients with ASBO. Historically, obstructions were admitted to a surgical service. With the advent of nonoperative management, however, medical hospitalist services increasingly admit a larger proportion of obstructions. Multiple recent publications, however, have found that care is more efficient and cost-effective when patients with acute ASBO are admitted to a surgical service.[4,5]

Over a parallel time course, the concept of emergency general surgery (EGS) has generated a paradigm shift within general surgery. Defined as "any patient (inpatient or emergency department) requiring an emergency surgical evaluation (operative or nonoperative) for diseases within the realm of general surgery as defined by the American Board of Surgery". EGS services have proliferated across the United States as an effective mechanism to provide emergency surgical care.[6] ASBO comprises a significant component of the disease processes inherent to EGS. In a review of the top 20 procedures performed on an emergency basis, 7 were directly related to small bowel obstructions and comprised almost 17% of EGS cases in a 1-year period.[7]

The evolution of EGS, however, has a concomitant significant increase in workload burden. EGS admissions have been estimated at 7.1% of all hospitalizations, and of those, over 28% require an urgent operation. General Surgery Residents can provide a qualified workforce to offload this burden while garnering extensive operative experience that addresses the concern over decreasing surgical resident autonomy.

In 2012, the American College of Surgeons developed an Advisory Council for Rural Surgery in recognition of the growing shortage of rural surgeons with data from the last decade that found that one-third of rural hospitals were searching for a surgeon, while 7% of US counties lost general surgery coverage entirely between 2006 and 2011.[8,9] Western North Carolina has a void of rural general surgery access that mimics national trends. In light of this, a rural General Surgery Residency was established in 2017 at our large southeastern tertiary care center with a goal of training well-rounded General Surgeons while simultaneously meeting the surgical needs of the 23 counties served by our hospital. Eight residents at the PGY-1 and PGY-2 level formed the inaugural cohort.

To date, a comprehensive evaluation of the impact of a resident-run EGS service on a common surgical problem has not been undertaken. The establishment of a general surgical residency at a large, southeastern tertiary care center offered a unique opportunity to investigate the role of surgical residents in the provision of emergency surgical care.

Methods

This project was reviewed and approved for a retrospective chart review by the Mission Hospital Institutional Review Board.

Development of EGS Service

Prior to the development of an EGS service, the hospital had a traditional call rotation where surgeons covered emergency calls in addition to normal clinical duties. In recognition of the undue burden placed both on individual surgeons and the system, an EGS service was established in January of 2018. Resident-run with attending surgeon supervision, the EGS service is a dedicated service for patients with emergent surgical needs. The surgeons on service each week cover only the EGS service with no additional clinical duties. The residents on the service are responsible for both the emergency department and inpatient consultations as well as the management of existing inpatients.

Adoption of Evidence-Based Protocol for ASBO

The advent of the new EGS service offered an opportunity to develop evidence-based protocols for emergent surgical conditions, and ASBO was earmarked as an area particularly conducive to protocol-driven management. A multidisciplinary team including physicians from General Surgery, Internal Medicine, Emergency Medicine, Radiology, as well as representatives from Nursing, Pharmacy, Information Technology, and Quality and Safety was assembled and met biweekly throughout the fall of 2017 in advance of the January 2018 simultaneous launch of the EGS service and ASBO protocol. A comprehensive literature review was conducted. The protocol went through an iterative process until all members of the team were in agreement that the

protocol represented an evidence-based approach that did not place an undue burden on any of the involved departments (Figure 1). As part of this process, the decision to admit the majority of patients with ASBO to the EGS service was made. Some service lines including nephrology and gynecology opted to continue to admit existing patients with evidence of ASBO to their service and consult EGS if necessary. These patients are excluded from analysis and make up the majority of patients not admitted to EGS after protocol implementation. The protocol was then hardwired into the electronic medical record as an order set. The resident and faculty were educated on the protocol as well as the new order set. The attending surgeon responsible for each patient with ASBO was encouraged to use the protocol but ultimately retained the autonomy to manage each patient as they chose. Finally, a physical copy of the protocol was utilized at AM and PM signout for all patients on the ASBO protocol.

Chart Review and Data Analysis

Patients were identified by diagnosis-related group (DRG) code for the year prior to and the year following the implementation of the ASBO protocol and establishment of the EGS service. Data were exported from the Mission Health System Care Process Analytic Application. Data are sourced from the Cerner EMR (Cerner Corporation, North Kansas City, MO, USA) and stored in the Mission Health System Enterprise Data Warehouse repository. Inclusion criteria included patients (1) over the age of 18 and (2) admitted under DRG Code 388, 389, or 390 to the EGS service in the aforementioned time period. To allow for a full evaluation of the nonoperative component of the protocol, patients who underwent operations for their ASBO were excluded from the analysis. Demographic information collected included age, gender, race, and ethnicity. The primary outcome measure was 30-day readmission rates. Secondary outcomes included 90-day readmission rates, length of stay, direct total cost, ICU admissions, and mortality.

MiniTab 18.1 (Minitab, State College, PA, USA) was used for statistical software. Mean and SD were calculated for age, and *F*-test was used to determine the *P* value. Percentage of the cohort was used to report the remainder of the data. With the exception of age (*F*-test) and percent female (Fisher's exact test) was used for the demographic information including race and ethnicity. For clinical outcomes including admission rates, length of stay, direct total cost, readmissions, ICU admissions, and mortality, Fisher's exact test was used to determine *P* values.

Results

A total of 612 patients met enrollment criteria and underwent a chart review. All demographic indices were statistically the same before and after the development of the ASBO protocol with the exception of patients who identified as Hispanic (3.71% [13/350] before, 0.76% [2/262] after $P = .03$). The average age of the patients enrolled was 67 years (±16.2 years). The before group was 53.43% female, and the after group was 49.62% female ($P = .37$). The group predominantly identified as white (91.43% before, 90.84% after; Table 1).

Table 2 illustrates the clinical outcomes associated with the development of the resident-run EGS service. Prior to the development of the resident-run EGS service, 35% of patients with ASBO were admitted to a surgical service. This increased significantly to 74% after the implementation of the resident-run EGS service ($P < .0001$). Over the same time period, the average length of stay decreased significantly by 0.77 days ($P = .016$), and the average direct total cost decreased by 24%. The 30-day readmissions decreased from 15.4% to 9.9% ($P = .04$). There was no statistical change in in-hospital mortality (1.4%-1.0%, $P = .66$). There was a statistically significant increase in ICU utilization (0.57%-2.67%, $P = .04$).

Discussion

In this study, we found that shifting the admission of patients with ASBO to a resident-run EGS service was associated with significant improvement in clinical outcomes including a reduced length of stay, reduced direct total costs, and reduced 30-day readmissions. The development of a resident-run EGS service allowed for the successful adoption of an evidence-based protocol for patients with ASBO and expanded the resources necessary to shift the bulk of admissions for ASBO toward a surgical service.

A protocolized approach to ASBO has been previously demonstrated to improve outcomes for all patients with ASBO, including those in need of operative intervention. VandeWater et al developed and implemented an evidence-based protocol for ASBO that was similar to ours and also found a statistically significant reduction in length of stay.[10] In their study, the number of patients requiring surgery was significantly reduced from 37% to 25%. Furthermore, for those patients who did require operative intervention, the time to surgery, rate of small bowel resection, and rate of complications were also reduced, suggesting that the development of a protocol facilitates earlier identification of patients in need of surgery. The successful execution of a protocol for ASBO requires frequent reevaluation of patients including serial abdominal examinations. The 24-hour availability of a

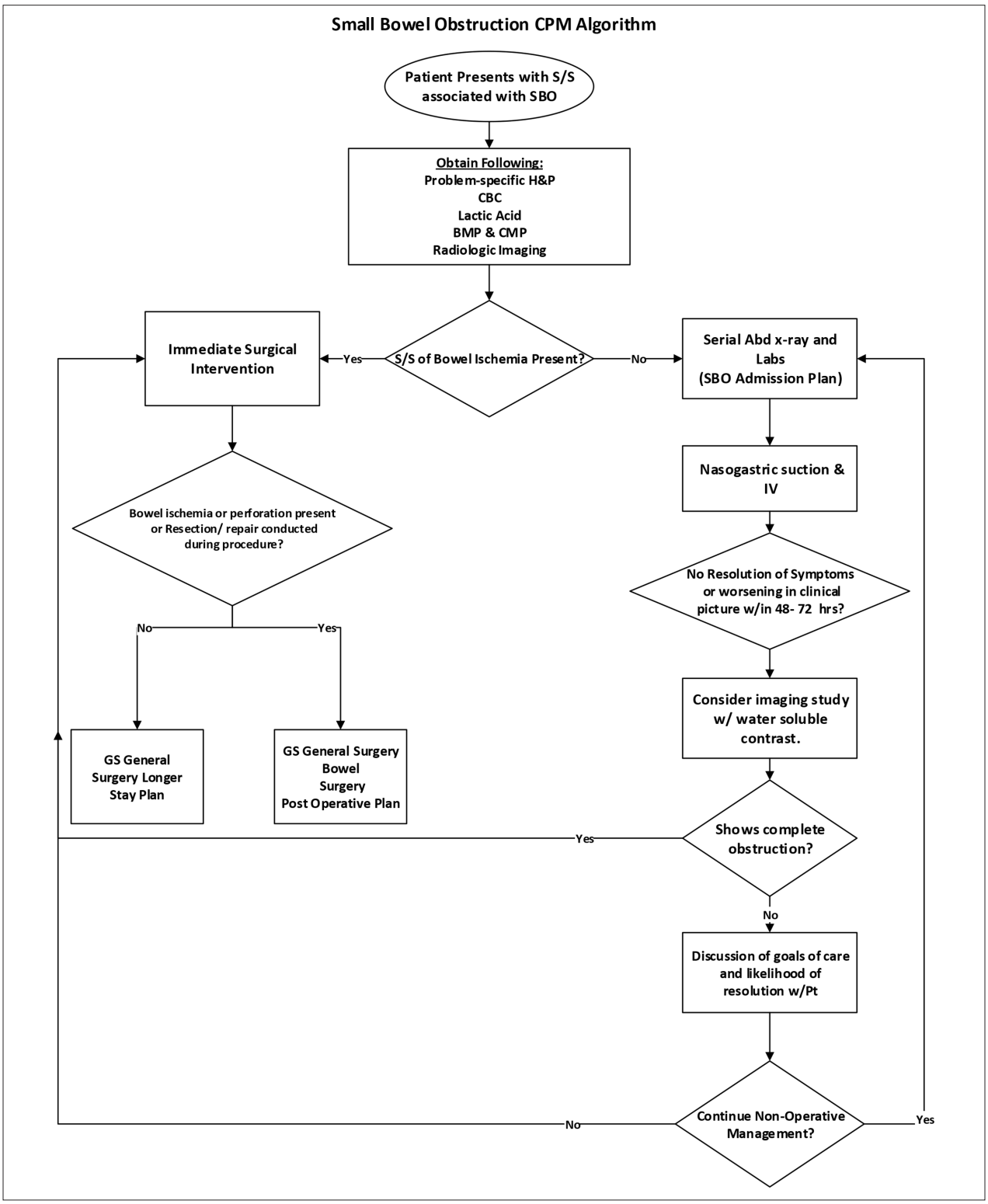

Figure 1. Small bowel obstruction CPM algorithm. Abd, abdominal; BMP, basic metabolic panel; CBC, complete blood count; CMP, comprehensive metabolic panel; CPM, care process model; H&P, history and physical; S/S, signs and symptoms; SBO, small bowel obstruction.

Table 1. Baseline Demographics of Study Population.

Characteristic	Before resident-run EGS service (n = 350)	After resident-run EGS Service (n = 262)	*P* value
Age (y, average ± SD)[a]	67 ± 16.2	67 ± 16.4	.83
Female,[b] n (%)	187 (53.43)	130 (49.62)	.37
Race[c]			
No answer, n (%)	3 (0.86)	5 (1.91)	.87
American Indian, n (%)	6 (1.71)	4 (1.53)	
Asian, n (%)	3 (0.86)	0 (0)	
Black or African American, n (%)	18 (5.14)	12 (4.58)	
Pacific Islander, n (%)	0 (0)	3 (1.15)	
White, n (%)	320 (91.43)	238 (90.84)	
Ethnicity[c]			
No answer, n (%)	6 (1.71)	8 (3.05)	.03
Non-Hispanic or Latino, n (%)	331 (94.57)	252 (96.18)	
Hispanic, n (%)	13 (3.71)	2 (0.76)	

Abbreviations: EGS, emergency general surgery; y, years.
[a]F-test used to determine *P* value.
[b]Fisher's exact test used to determine *P* value.
[c]Mann-Whitney test used to determine z value, *P* value.

Table 2. Clinical Outcomes Before and After Implementation of Resident-Run EGS Service.

	Before resident-run EGS service (n = 350)	After resident-run EGS service (n = 262)	*P* value[a]
Admitted to surgical service (%)	35	74	<.0001
Average length of stay (days)	4.10	3.33	.016
Average direct total cost		Decreased 24%	.002
30-Day readmissions (%)	15.4	9.9	.046
ICU admission (%)	0.57	2.67	.04
In-hospital mortality (%)	1.4	1.0	.66

Abbreviations: EGS, emergency general surgery; ICU, intensive care unit.
*Fisher's exact test used to determine *P* value.

dedicated EGS resident was core to our successful implementation of the ASBO protocol. Our current study excluded patients who ultimately went on to require operative intervention but is an area for future evaluation. In addition, although our protocol was hardwired into the electronic medical record as an order set and available for all to use, utilization of the protocol was at the discretion of the attending surgeon. The improvement in outcomes for all patients admitted to the EGS service is suggestive of an independent positive effect of the surgical resident on patients with ASBO.

Outcomes for patients with ASBO admitted to surgical services have repeatedly been demonstrated to be superior to those admitted to medical services. A study by Aquina et al in New York State found that patients managed nonoperatively for ASBO had better outcomes including decreased length of stay, decreased costs, and lower 30-day readmissions when admitted to a surgical service than a medicine service.[5] They also found that patients admitted to a medicine service who ultimately required an operation for their bowel obstruction had a greater delay in time to surgical intervention, greater inpatient costs, and higher 30-day mortality than those admitted to a surgical service. Bilderback et al reached a similar conclusion with their retrospective study, finding that patients admitted to a medicine service who required operative intervention had a delay of operative therapy of 11.5 hours over those admitted to a surgical service.[4] Successful and safe nonoperative management for ASBO requires careful screening for any evolving signs of bowel ischemia. Admission to a surgical service ensures patients are examined by physicians who are more experienced in examining for signs of peritonitis.

Autonomy for surgical trainees remains a contentious issue as institutions attempt to balance productivity, patient safety, and a litigious climate with the need for residents to experience incremental autonomy toward independent practice. Ownership over the EGS service and small bowel protocol is one example of how to facilitate this incremental

evolution. Residents admitted and followed patients throughout their stay, responsible for the clinical evolution of each patient. This serial monitoring likely explains the statistically significant increase in ICU utilization in the postimplementation group; residents were able to recognize and escalate the level of care more rapidly because of their 24-hour availability. Other studies on the impact of resident care on patient outcomes have been similarly positive. A 2017 study by Burke et al found that teaching hospitals had lower 30-day mortality rates than nonteaching hospitals.[11] In a study of pediatric patients undergoing a complex repair of pectus excavatum, Yong et al found that although resident participation was associated with increased operative time, there were no other negative effects on hospital stay or long-term outcomes.[12] Ferraris et al found mixed results in their study of 266 411 patients in the National Surgical Quality Improvement Program database who underwent surgery with resident involvement.[13] They found a small increase in composite morbidity but was mitigated by senior level resident involvement. Furthermore, they found a significant improvement in failure to rescue, similar to our finding of increased ICU utilization. As expected, the involvement of learners seems to increase operative time across the board but, importantly, not be negatively associated with patient outcomes and may in fact improve outcomes for the sickest patients.

There are 3 significant limitations of this trial. First, its retrospective nature introduces selection and information bias. Furthermore, retrospective studies make assessment of temporal relationships difficult. Second, although the majority of patients were admitted to the resident-run service after its establishment, approximately a quarter of all patients with an ASBO were admitted to a nonsurgical service and therefore excluded from this analysis. The cohort also intentionally excludes patients who presented and ultimately needed operative intervention and eliminates the opportunity to evaluate characteristics of that group and their outcomes under the new system. Finally, the study was performed at a large southeastern referral center on a predominantly white population, which limits generalizability. Many of these limitations suggest areas of possible future research, including a larger analysis including all patients with ASBO admitted after the initiation of the new service regardless of the service line providing care or need for eventual operative intervention. This initial proof of concept of the benefit of surgical residents can also be extended to analyze outcomes for patients with other surgical diseases.

The establishment of a new general surgery residency allowed for the development of a resident-run 24-hour EGS service at our large tertiary care center. Within this EGS service, an evidence-based protocol for ASBO was developed, implemented, and resulted in significant improvements in patient outcomes, including decreased length of stay, decreased total direct costs, and decreased 30-day readmissions.

Declaration of Conflicting Interests

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