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Publication Date

2024

DOI

10.1016/j.jss.2023.08.017

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

Feasibility of Gastrografin Use for Adhesive Small Bowel Obstruction in Low-Income Countries

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ARTICLE INFO

Article history:
Received 30 December 2022
Received in revised form
15 July 2023
Accepted 23 August 2023
Available online xxx

Keywords:
Ethiopia
Gastrografin
Global surgery
Low-income and middle-income countries
Small bowel obstruction

ABSTRACT

Introduction: Small bowel obstruction (SBO) is one of the most common causes for hospital admission in Ethiopia. The use of water-soluble contrast agents (WSCAs) such as Gastrografin to manage adhesive SBO can predict nonoperative resolution of SBO and reduce decision time to surgery and length of hospital stay. However, nothing is known about practice patterns and Gastrografin use in low-income settings. We sought to characterize current management practices, including use of WSCAs, as well as outcomes for patients with SBO in Addis Ababa, Ethiopia.

Methods: We conducted a mixed-methods study consisting of a survey of surgeons throughout Ethiopia and a retrospective record review at five public, tertiary care–level teaching hospitals in Addis Ababa.

Results: Of the 76 surgeons who completed the survey, 63% had heard of the use of WSCAs for SBO and only 11% used oral agents for its management. Chart review of 149 patients admitted with SBO showed the most common etiology was adhesion (39.6% of admissions), followed by small bowel volvulus (20.8%). Most patients (83.2%) underwent surgery during their admission. The most common diagnosis in patients who did not require surgery was also adhesion (68.0%), as well as for those who had surgery (33.9%), followed by small bowel volvulus (24.2%).

Conclusions: The etiology of SBO in Ethiopia may be changing, with postoperative adhesions becoming more common than other historically more prevalent causes. Although a Gastrografin protocol as a diagnostic and potentially therapeutic aid for SBO is feasible in this population and setting, challenges can be anticipated, and future studies of protocol implementation and effectiveness are needed to further inform its utility in Ethiopia and other low-income and middle-income countries.

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0022-4804/$ – see front matter
https://doi.org/10.1016/j.jss.2023.08.017

Introduction

Small bowel obstruction (SBO) due to intra-abdominal adhesions affects up to 30% of patients who undergo abdominal surgery[1] and is associated with significant morbidity and need for reoperation.[2] In high-income countries, where surgical volumes are large, postoperative adhesion is the most common cause of SBO[3], whereas in low-income and middle-income countries, small bowel volvulus, incarcerated abdominal wall hernia, and intussusception have been the most common causes.[3,4] In Ethiopia, adhesion was the third most common cause of SBO in a recent systematic review,[5] but greater access to emergency and essential surgical care and the expansion of surgical services throughout Ethiopia has led to more patients undergoing abdominal surgery for various reasons, including appendicitis, cholecystitis, and cancer. Consequently, postoperative adhesion may begin to overtake other primary causes of SBO. As the workup and management of adhesive SBO differs significantly from other causes of bowel obstruction, adjustments in the approach to undifferentiated patients with SBO in Ethiopia may be necessary as well.

The use of water-soluble contrast agents (WSCAs) such as Gastrografin (diatrizoate meglumine-diatrizoate) with serial abdominal radiographs—a 'Gastrografin protocol'—is effective for stratifying patients with adhesive SBO into those requiring surgery and those whose symptoms will resolve with conservative management, thereby shortening decision time to surgery.[6-13] Diagnostically, WSCA is well documented to successfully assess the need for surgical interventions.[14-17] The diagnostic criterion for complete bowel obstruction likely to require surgical intervention is failure of WSCA to reach the colon on abdominal radiograph within 24 h of admission.[18,19] Use of a Gastrografin protocol also has potentially therapeutic value by promoting earlier resolution in patients who would not have required surgery, resulting in shorter length of stay in the hospital.[19-21] Furthermore, a 'Gastrografin protocol' can maximize its benefits on operative decision-making and length of stay.[22,23] However, the use of WSCA or a Gastrografin protocol for SBO in resource-limited settings has not been well studied.[24,25]

To address this gap, we sought to characterize current management practices, including use of WSCA, as well as causes and outcomes for patients with SBO in Addis Ababa, Ethiopia. An additional focus was on the feasibility of implementing a Gastrografin protocol for the subset of SBO patients appropriate for a trial of nonoperative management.

Methods

Study design

We conducted a mixed-methods study consisting of a survey of surgeons throughout Ethiopia and a retrospective chart review at five public, tertiary care–level teaching hospitals in the capital city of Addis Ababa. Ethical approval for the study was obtained from both Institutional Review Boards at Addis Ababa University at St. Paul's Millennium Medical College. Informed consent was obtained from all survey participants after they received an information sheet about the study.

All practicing general surgeons registered as members with the Surgical Society of Ethiopia were contacted and had the opportunity to participate in the survey by e-mail, by Telegram (a messaging application commonly used in Ethiopia), and at the annual academic surgical conference in November 2019. The survey instrument had been piloted with a small subset of participants. After feedback was obtained, any necessary clarifications were made and the instrument was finalized (Appendix A). The survey included information on common practices for the management of SBO, as well as knowledge and beliefs about Gastrografin use in SBO management. The survey also assessed relevant material resources available at the healthcare facilities of participating surgeons and cost of certain admission-related items.

For the retrospective portion of the study, hospital charts, operating room, and admission logbooks from five public, tertiary care–level teaching hospitals in Addis Ababa were reviewed to obtain a list of all patients admitted with SBO at each hospital during the study period (July 2018 to July 2019). A data collection tool was piloted with a small number of patient charts retrieved from the records room; after we clarified any questions or inconsistencies with data collectors, the tool was finalized (Appendix B). Charts were retrieved from the medical records room after a letter of study approval was obtained from each hospital administration. Data were collected by manual review of the paper chart including laboratory slips, history and physical documents, progress and operative notes, and discharge summaries. The following information was recorded using the data collection tool: demographics, medical history, and operative/inpatient hospital course, as well as length of stay, inpatient complications, reoperations, and disposition on discharge.

Data analysis

Data were stored and cleaned in Microsoft Excel v16.56. Descriptive statistics (percentages, mean and standard deviation, or median and interquartile range [IQR]) were used to summarize the responses from the provider survey and stratified by location of practice. Descriptive statistics were also used to summarize patient data from chart review including patient comorbidities, surgical history, reoperation, and length of hospital stay. To analyze differences between groups, chi-squared, or Fisher's exact test for proportions, *t*-test for normally distributed data, or the Wilcoxon rank-sum or Kruskal–Wallis test for nonparametric data were used as appropriate. The alpha level was set at 0.05. All analyses were done using Stata v15.1 (StataCorp, College Station, Texas).

Results

Survey responses

A total of 76 surgeons completed the provider survey from a total of 192 general surgeons registered with the Surgical Society of Ethiopia, representing roughly 40% of all general surgeons in Ethiopia. Most (48, 64%) surgeons who responded were practicing in referral hospitals, and this was not

significantly different when stratified by those working in or outside Addis Ababa (Table 1). Respondents had been practicing for a median of 6 y (IQR 3, 11) with those in Addis Ababa having more experience (9.5 y, IQR 4, 12) than those outside (4 y, IQR 2, 8, $P = 0.005$). Overall, surgeons admitted a median of 10 (IQR 4, 20) patients with SBO each month. Those outside the capital had a higher volume of SBO admissions (12 *versus* 6 per month, $P = 0.002$).

When asked to recall the most common causes of SBO seen in their practice, surgeons ranked postoperative adhesions as the most common, small bowel volvulus as second, and incarcerated hernia as third; however, when stratified by practice location, postoperative adhesions were ranked second most common after volvulus outside of the capital city ($P = 0.025$) (Table 2).

Only 63% of surgeons had heard of the use of WSCA for SBO and only 11% used oral agents for its management, including rare examples of prune juice (5%). Just 9% had a protocol for the management of SBO. Surgeons reported they would allow approximately 2 d of conservative management before deciding to operate for SBO and 43% stated they would prescribe antibiotics; there were no significant differences between practice locations (Table 1).

Surgeons rated the likelihood of imaging-related services being available in their town or facility using a five-point Likert scale (0 = Never, 4 = Always). As shown in Table 2, Gastrografin was estimated to be "rarely" available in town, although this was slightly higher in Addis Ababa than outside. Portable abdominal radiographs were rarely available, but inpatient abdominal radiographs were nearly always available. Computed tomography (CT) scan was sometimes available in a facility, and more often in town. There was usually a radiologist available in a facility and surgeons also usually felt comfortable interpreting abdominal radiographs themselves.

Surgeons were also asked to estimate the cost of common items required for hospital admission for SBO; median prices were converted from Ethiopian Birr to USD for international contextualization. The most expensive items were CT scans ($54, IQR $29, $71) and consumable materials purchased for surgery ($21, IQR $14, $36) (Table 2). Gastrografin was estimated to cost slightly less at $15 (IQR $9, $18), and other hospital-related costs such as nasogastric tubes (NGTs), intravenous

Table 1 – Surgeon location and management practices.

Surgeon/Hospital characteristics	Overall	In Addis Ababa	Outside Addis Ababa	*P* value
	N = 76	N = 34	N = 41	
Practice location and duration				
Hospital type				0.11
Primary or general hospital	28 (37%)	16 (47%)	12 (29%)	
Referral hospital	48 (64%)	18 (53%)	29 (71%)	
Region				
Addis Ababa	34 (45%)	34 (45%)	-	
Amhara	8 (11%)	-	8 (11%)	
Dire Dawa	2 (3%)	-	2 (3%)	
Harrar	1 (1%)	-	1 (1%)	
Oromia	10 (13%)	-	10 (13%)	
SNNP	12 (16%)	-	12 (16%)	
Somali	2 (3%)	-	2 (3%)	
Tigray	6 (8%)	-	6 (8%)	
Not specified	1 (1%)	-	1 (1%)	
Number of years in practice, median (IQR)	6 (3, 11)	9.5 (4, 12)	4 (2, 8)	0.005
Volume of SBO and management practices				
Estimated number of SBO admitted per week, median (IQR)	2.5 (1, 5)	2 (1, 3)	3 (2, 6)	<0.001
Estimated number of SBO admitted per month, median (IQR)	10 (4, 20)	6 (2, 12)	12 (8, 20)	0.002
Heard of water-soluble contrast use for SBO	48 (63%)	20 (59%)	28 (68%)	0.26
Use any oral agent for SBO management	8 (11%)	4 (12%)	4 (10%)	0.78
Oral contrast	3 (4%)	1 (3%)	2 (5%)	
Prune juice	4 (5%)	2 (6%)	2 (5%)	
Magnesium citrate	1 (1%)	0 (0%)	1 (2%)	
Hospital has SBO management protocol	7 (9%)	4 (12%)	3 (7%)	0.78
# days conservative management for benign SBO, median (IQR)	2 (1, 2)	2 (2, 2)	2 (1, 2)	0.43
Use antibiotics for preoperative benign SBO management	33 (43%)	17 (50%)	16 (39%)	0.45

IQR = interquartile range; SBO = Small bowel obstruction.

Table 2 – Surgeon-reported causes of bowel obstruction, hospital resources, and cost.

Variable	Overall	In Addis Ababa	Outside Addis Ababa	P value
	N = 76	N = 34	N = 41	
Most common causes of bowel obstruction (ranked in order from 1 = most common, median [IQR])				
Postoperative adhesions	1 (1, 2)	1 (1, 1)	2 (1, 2)	0.025
Volvulus	2 (1, 2)	2 (1, 3)	1 (1, 2)	0.066
Incarcerated hernia	3 (3, 3)	3 (2, 3)	3 (3, 3)	0.25
Obstructing mass	4 (4, 4)	4 (4, 4)	4 (4, 4)	0.94
Inflammatory stricture	5 (4, 5)	5 (4, 5)	5 (5, 6)	0.100
Foreign body	6 (6, 6)	6 (5, 6)	6 (6, 6)	0.11
Other cause of obstruction	7 (6, 7)	7 (6, 7)	7 (5, 7)	0.41
Availability of resources for Gastrografin protocol (Likert scale, 0 = Never, 4 = Always), (median [IQR])				
Gastrograffin in facility	0 (0, 2)	0 (0, 1)	0 (0, 2)	0.98
Gastrograffin in town	2 (0, 3)	2 (1, 3)	1.5 (0, 2)	0.007
Portable abdominal radiograph	0 (0, 2)	1.5 (0, 2)	0 (0, 2)	0.29
Inpatient abdominal radiograph	4 (3, 4)	4 (3, 4)	4 (3, 4)	0.39
CT in facility	2 (0, 3)	2 (0, 3)	2 (0, 3)	0.76
CT in town	4 (2, 4)	4 (4, 4)	3 (0, 3)	<0.001
Radiologist in facility	4 (3, 4)	4 (4, 4)	4 (3, 4)	0.055
Surgeon can interpret abdominal XR	3 (3, 4)	3 (3, 4)	3 (2.5, 4)	0.63
Cost (in USD) of common items required for SBO admission (median, IQR)				
Gastrograffin	$15 ($9, $18)	$11 ($7, $14)	$17 ($16, $18)	0.21
Abdominal XR	$3 ($2, $7)	$2 ($2, $13)	$3 ($2, $5)	0.92
CT scan	$54 ($29, $71)	$53 ($23, $71)	$54 ($36, $71)	0.88
Inpatient stay (per day)	$1 ($1, $4)	$2 ($1, $39)	$1 ($1, $2)	0.11
ICU stay (per day)	$4 ($2, $25)	$10 ($2, $116)	$3 ($2, $9)	0.17
Nursing services (per day)	$4 ($1, $11)	$11 ($1, $11)	$4 ($1, $5)	0.64
Inpatient food services (per day)	$2 ($1, $2)	$27 ($1, $36)	$2 ($1, $2)	0.30
1 L IV fluid	$2 ($1, $2)	$2 ($1, $4)	$1 ($1, $2)	0.16
Nasogastric tube supplies	$1 ($0, $1)	$1 ($1, $2)	$1 ($0, $1)	0.01
Exploratory laparotomy supplies	$21 ($14, $36)	$25 ($11, $71)	$21 ($14, $36)	0.88

Likert scale: 0 = Never; 1 = Rarely; 2 = Sometimes; 3 = Usually; 4 = Always.
CT = computed tomography; XR = X-Ray; SBO = small bowel obstruction; ICU = intensive care unit; IV = intravenous.

fluids, nursing, and food services were much cheaper (median $1-4 per item or day). None of the estimated costs differed meaningfully between location in and outside of Addis Ababa.

Retrospective review of patients with small bowel obstruction

A total of 254 potential admissions for SBO were identified for the study period of July 2018 to July 2019. Of these, 213 charts were retrievable from the hospital records department and reviewed. Sixty four charts were then excluded for primary diagnoses other than SBO (large bowel obstruction, appendicitis, and other causes of acute abdomen), leaving 149 patient charts for analysis.

Patients with SBO had a median age of 35 y (IQR 26, 50) and 65.1% were male (Table 3). Most patients were from Addis Ababa (61.7%) or the surrounding Oromia region (29.5%) and were relatively healthy with low prevalence of hypertension (6.0%), diabetes (2.0%), or heart disease (1.3%). The most common etiology of SBO was adhesive, accounting for 39.6% of admissions, followed by small bowel volvulus/ileo-sigmoid knotting (20.8%), incarcerated hernia (10.7%), malignant obstruction (8.7%), and other intra-abdominal infections such as peritoneal tuberculosis or perforated appendicitis with associated SBO (4.7%).

All patients reported abdominal pain on presentation; other common presenting symptoms were vomiting (97.3%), bloating (91.9%), and constipation (81.9%) for a median of 3 d before admission. Forty percent of patients had prior abdomino-pelvic surgery and 10.7% previously had an SBO. These presenting symptoms did not differ significantly between hospitals, except for the largest referral hospital having a higher proportion of patients with prior surgery (78% *versus* 30%-55%, $P = 0.041$).

Most patients (85.2%) had an abdominal radiograph, but only 8.7% had a CT scan, 61.5% of which were performed with oral contrast. Two-thirds of patients had an NGT placed and 46.3% were started on antibiotics—either ceftriaxone alone or in combination with metronidazole. Most patients (83.2%) underwent surgery during their admission, but reliable day of

Table 3 – Patient demographics, hospital management, and outcomes ($N = 149$).

Demographics		Initial management	
Age, median (IQR)	35 (26, 50)	NGT placed	98 (65.8%)
Sex		Days with NGT, median (IQR)	3 (2, 4)
Male	97 (65.1%)	Days NPO, median (IQR)	3 (2, 4)
Female	52 (34.9%)	Antibiotics administered	69 (46.3%)
		Antibiotic type	
Region		Ceftriaxone	43 (28.9%)
Addis Ababa	92 (61.7%)	Ceftriaxone + metronidazole	26 (17.4%)
Amhara	4 (2.7%)		
Harrar	1 (0.7%)	Final diagnosis	
Oromia	44 (29.5%)	Adhesion or congenital band	59 (39.6%)
SNNP	8 (5.4%)	Small bowel volvulus/ileo-sigmoid knotting	31 (20.8%)
		Malignant obstruction	13 (8.7%)
Comorbidities		Internal hernia	4 (2.7%)
Hypertension	9 (6.0%)	Incarcerated/strangulated abdominal wall hernia	16 (10.7%)
Diabetes	3 (2.0%)	Ileus	6 (4.0%)
Heart disease	2 (1.3%)	Mesenteric ischemia	3 (2.0%)
Active cancer	3 (2.0%)	Other intra-abdominal infection	7 (4.7%)
Asthma	2 (1.3%)	Obstructing foreign body	1 (0.7%)
HIV	4 (2.7%)	Inflammatory stricture	4 (2.7%)
Other comorbidities	12 (8.1%)	Unknown	5 (3.4%)
Presenting features			
Abdominal pain	149 (100.0%)	Operative intervention	124 (83.2%)
Vomiting	145 (97.3%)	Lysis of adhesions	28 (18.8%)
Bloating	137 (91.9%)	Hernia repair	12 (8.1%)
Constipation	122 (81.9%)	Derotation	24 (16.1%)
Nausea	118 (79.2%)	Small bowel resection and anastomosis	21 (14.1%)
Obstipation	91 (61.1%)	Lavage only	9 (6.0%)
		Hemicolectomy w/primary anastomosis	13 (8.7%)
Duration of symptoms (days), median (IQR)	3 (2, 4)	Appendectomy	5 (3.4%)
Prior abdominal/pelvic surgery	60 (40.3%)	Bowel resection with diverting ostomy	4 (2.7%)
Prior SBO	16 (10.7%)	Foreign body removal	2 (1.3%)
		Graham patch and lysis of adhesions	2 (1.3%)
Initial physiologic parameters		Other operation	4 (2.7%)
Temperature, median (IQR)	36.5 (36.3, 37.0)		
Heart rate, mean (SD)	100 (15)	Patient outcomes and complications	
Systolic blood pressure (mean, SD)	113 (17)	Hospital length of stay, median (IQR)	7 (5, 11)
WBC, median (IQR)	9 (7, 12)	Reoperation	9 (6.0%)
Creatinine, median (IQR)	0.9 (0.6, 1.1)	Sepsis	14 (9.4%)
		Pneumonia	10 (6.7%)
Initial imaging		Surgical site infection	17 (11.4%)
Abdominal radiograph performed	127 (85.2%)	Pulmonary embolism	5 (3.4%)
CT scan performed	13 (8.7%)	Enterocutaneous fistula	2 (1.3%)
Oral contrast administered	8 (5.4%)	Death	7 (4.7%)

IQR = interquartile range; SD = standard deviation; NGT = nasogastric tube; WBC = white blood cell; NPO = nil per os; CT = computed tomography.

surgery relative to admission date could not be determined from the records. The most common surgical procedure was lysis of adhesions (18.8%), followed by detorsion of volvulus (16.1%). Median length of stay in the hospital was 7 d (IQR 5, 11). Complications were relatively common and included surgical site infection (11.4%), sepsis (9.4%), pneumonia (6.7%), reoperation (6.0%), and death (4.7%) (Table 3).

When stratified by operative *versus* conservative management, patients undergoing surgery were older (average age 38 *versus* 30 y, $P = 0.022$) (Table 4), but did not differ significantly by

Table 4 – Patient characteristics by operative *versus* conservative management.

Patient characteristics	Surgical intervention	Conservative management	P value
	124 (83.2%)	25 (16.8%)	
Patient location and demographics			
Age, median (IQR)	38 (27, 50)	30 (25, 35)	0.022
Sex			0.74
Male	80 (64.5%)	17 (68.0%)	
Female	44 (35.5%)	8 (32.0%)	
Comorbidities			
Hypertension	8 (6.5%)	1 (4.0%)	0.64
Diabetes	2 (1.6%)	1 (4.0%)	0.44
Heart disease	1 (0.8%)	1 (4.0%)	0.21
Active cancer	3 (2.4%)	-	
Asthma	2 (1.6%)	-	
HIV	2 (1.6%)	2 (8.0%)	0.071
Other comorbidities	10 (8.1%)	2 (8.0%)	0.90
Presenting features			
Duration of symptoms, median (IQR)	3 (2, 4)	2 (1, 3)	0.025
Prior abdominal/pelvic surgery	43 (34.7%)	17 (68.0%)	0.002
Prior SBO	11 (8.9%)	5 (20.0%)	0.10
Initial physiologic parameters			
Temperature, median (IQR)	36.6 (36.2, 37.0)	36.5 (36.3, 36.7)	0.52
Heart rate, mean (SD)	101 (15)	95 (15)	0.083
Systolic blood pressure, mean (SD)	113 (17)	114 (17)	0.78
WBC, median (IQR)	9 (7, 12)	9 (7, 11)	0.77
Creatinine, median (IQR)	0.8 (0.6, 1.1)	1.0 (0.8, 1.0)	0.74
Initial imaging			
Abdominal radiograph	104 (83.9%)	23 (92.0%)	0.30
CT scan	11 (8.9%)	2 (8.0%)	0.89
Oral contrast administered	7 (5.6%)	1 (4.0%)	0.74
Initial management			
NGT placed	75 (60.5%)	23 (92.0%)	0.002
Days with NGT, median (IQR)	4 (3, 5)	2.5 (1, 4)	0.020
Days NPO, median (IQR)	3 (2, 5)	3 (2, 4)	0.099
Antibiotics administered	68 (54.8%)	2 (8.0%)	<0.001
Final diagnosis			<0.001
Adhesion or congenital band	42 (33.9%)	17 (68.0%)	
Small bowel volvulus/ileo-sigmoid knotting	30 (24.2%)	1 (4.0%)	
Malignant obstruction	13 (10.5%)	-	
Internal hernia	4 (3.2%)	-	
Incarcerated/strangulated abdominal wall hernia	15 (12.1%)	1 (4.0%)	
Ileus	5 (4.0%)	1 (4.0%)	
Mesenteric ischemia	2 (1.6%)	1 (4.0%)	
Intraabdominal infection (TB, appendicitis)	7 (5.6%)	-	
Foreign body obstruction	1 (0.8%)	-	
IBD/Inflammatory stricture	4 (3.2%)	-	
Unknown	1 (0.8%)	4 (16.0%)	
Patient outcomes and complications			
Hospital length of stay, median (IQR)	7.5 (6, 13)	4 (2, 7)	<0.001
Sepsis	14 (11.3%)	-	
Pneumonia	10 (8.1%)	-	

(*continued*)

Table 4 – (*continued*)

Patient characteristics	Surgical intervention	Conservative management	*P* value
	124 (83.2%)	25 (16.8%)	
Surgical site infection	17 (13.7%)	-	
Pulmonary embolism	5 (4.0%)	-	
Enterocutaneous fistula	2 (1.6%)	-	
Death	7 (5.6%)	-	

WBC = white blood cell; CT = computed tomography; NGT = nasogastric tube; NPO = nil per os.

sex, comorbidities, initial physiologic variables, laboratory values, or imaging studies done (Table 4). The most common diagnosis in patients who did not require surgery was adhesion (68.0% *versus* 33.9%, $P < 0.001$). This was also the most common cause in the surgical intervention group (33.9%) followed by small bowel volvulus (24.2%) and incarcerated hernia (12.1%). Those managed conservatively had a significantly shorter duration of symptoms (2 *versus* 3 d, $P = 0.025$) than those who had surgery and were more likely to have undergone prior abdominal surgery (68.0% *versus* 34.7%, $P = 0.002$). Significantly more patients undergoing conservative management had an NGT placed (92.0% *versus* 60.5%, $P = 0.002$) but the duration of NGT was shorter than for patients who had surgery (median 2.5 d *versus* 4 d, $P = 0.02$). Significantly fewer patients treated conservatively received antibiotics (8.0% *versus* 54.8%, $P < 0.001$). No complications were reported in the conservative management group, and they had a shorter length of hospital stay than the surgery group (4 *versus* 7.5 d, $P < 0.001$).

Discussion

In this mixed-methods study, we sought to characterize current management practices, including use of Gastrografin and other WSCA, as well as outcomes for patients with SBO in Addis Ababa, Ethiopia. Our survey findings indicate that only two-thirds of surgeons reported knowledge of a Gastrografin protocol and related interventions for management of SBO. Our retrospective data analysis shows that nonoperative management was relatively uncommon for patients with SBO, with 83% undergoing surgery during their admission. However, most of these patients presented without severe physiologic or laboratory derangements, which suggest that more patients may be able to undergo a trial of conservative management, particularly those who have a prior surgical history in whom adhesive SBO is suspected.

Our retrospective data analysis of five referral hospitals indicated that 39.6% of patients had adhesions as the cause of their SBO, ahead of small bowel volvulus (20.8%), which corroborates previous work in suggesting that the underlying epidemiology of SBO in Ethiopia may be shifting. Specifically, a recent study in Nekempt, a city in Western Ethiopia, found the most common cause to be postoperative adhesion (35.1%), ahead of small bowel volvulus (24.2%) and intussusception (23.7%).[3] Furthermore, in our survey, surgeons within Addis Ababa reported the most common cause of SBO in their patient populations as being due to postoperative adhesions and the second most common cause outside of Addis Ababa. Although other causes of SBO traditionally encountered in Ethiopia are less amenable to conservative management and put the patient at risk of intestinal ischemia and necrosis if surgical intervention is delayed, many adhesive SBOs can be successfully managed conservatively, avoiding the cost and pain of surgery, longer recovery, and risk of postoperative complications. Therefore, given the changing landscape for SBO, incorporation of the Gastrografin protocol into resident teaching and continuing medical education may be appropriate.

The feasibility of implementing a Gastrografin protocol for the subset of SBO patients appropriate for a trial of nonoperative management was one focus of this study. Although the Gastrografin protocol may introduce an additional diagnostic step, the results of our study indicate that nonoperative management is a successful strategy with favorable outcomes in the Ethiopian setting. Some patients who presented with likely benign adhesive SBO may have been able to be managed conservatively, and implementation of a Gastrografin protocol could aid in determining which patients will ultimately require surgery and shorten length of stay for those who will recover with conservative management.

Our survey findings indicate that the availability of abdominal radiographs and radiology interpretation is nearly ubiquitous and affordable, but the lack of portable machines may limit the ease of implementing a Gastrografin protocol. In those instances, hospitals pursuing more widespread use of the Gastrografin protocol may want to invest in the requisite materials including portable radiograph machines ensuring water-soluble contrast material is stocked in the hospital formulary or nearby pharmacies. The contrast material is available within Ethiopia and the cost ($15 per patient) is within the range of similar hospital materials such as surgical supplies ($21) or 1 d of services in the hospital ($9).

In our study, patients managed conservatively had significantly shorter durations of symptoms and NGT placement than those who had surgery, received significantly less antibiotics, and had no reported complications. In patients who had surgery, complications were relatively common and included surgical site infection, sepsis, pneumonia, reoperation, and death. It is possible that other factors not measured by our study, such as malnutrition, lack of intensive care services, and higher than recognized disease severity, may impact patient recovery. Furthermore, total parenteral nutrition was virtually unavailable in Ethiopia during the study period and malnutrition is common in Ethiopian surgical patients,[26] with up to 50% being malnourished according to preoperative body mass index and serum albumin levels.[27] The resource challenges in caring for patients with SBO

highlight the need for a way to more rapidly identify those patients who will require surgical intervention for SBO. Although speculative, the possible therapeutic effect of Gastrografin protocol could result in shortened nil per os time for this malnourished patient population.

Our study had several limitations. The primary limitation was the use of paper charts in records departments. This made it difficult to identify all charts that may have been included per the admission logbook review. We did review additional sources such as operating room logbooks and morning report documents to ensure as many patients as possible were captured. Furthermore, the data in identified charts were typically handwritten and sometimes incomplete. For example, the date of surgery was sometimes missing or illegible, dates of complications or indications for antibiotics were not clearly indicated, and specific elements of the hospital course, including operative events, were sometimes difficult to identify. This made the chart review process tedious, time consuming, and imperfect. However, given the commonalities among record keeping in Ethiopian hospitals, we estimate our data completeness and accuracy is on par with other studies on the topic. A second limitation is that the cost of services and materials is an estimation made by surgeons and may not reflect the actual cost to patients. However, given the frequency of utilization, the cost of these supplies is likely to be known by the surgeons. We did attempt to review exact billing information from patient charts to determine the real cost to patients, but this information is kept in a department separate from patient charts and could not be obtained due to the retrospective nature of the records review aspect of our study.

Conclusions

SBO remains a common indication for hospital admission and surgery, both in Ethiopia and globally. As essential and emergency surgical services rapidly expand in Ethiopia, the epidemiology of SBO may be changing, with postoperative adhesions becoming more common than other historically more prevalent causes. The implementation of a Gastrografin protocol as a diagnostic and potentially therapeutic aid is increasingly more appropriate and affordable in this population. Although feasible, challenges can be anticipated in more widespread utilization of this protocol. Furthermore, additional study on nutritional support and intensive care services may add important context to other inpatient services needed given the frequency of postoperative complications seen in this patient cohort. Future studies of the implementation and effectiveness of a Gastrografin protocol will further inform its utility in Ethiopia and other low-income and middle-income countries.

Supplementary Materials

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jss.2023.08.017.

Author Contributions

N.S., M.T., C.I., H.H., and D.Z. performed the study design and literature search. K.S., A.G., Y.A., E.Z., D.T., B.G., and M.D. performed data collection, data cleaning, and merging. N.S. performed data analysis. N.S., M.T., C.I., K.S., A.G., H.H., and D.Z. performed writing and review. N.S., M.T., M.I., K.S., A.G., Y.A., E.Z., D.T., B.G., M.D., H.H., and D.Z. performed data interpretation and critical revision.

Disclosure

None declared.

Funding

N.S. received grant funding from NIH T32 training grant DK007573 and NIH Fogarty International Center (Global Health Equity Scholars NIH FIC D43TW010540). C.I. received grant funding from NIH F30 grant DK117612-01A1.

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