The predictive role of computed tomography with oral contrast in the successful management of adhesive small bowel obstruction

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Background
Adhesive small bowel obstruction (SBO) stands out as one of the most frequent and clinically significant complications following abdominal surgery. The present study aimed to investigate the role of computed tomography (CT) with oral contrast media in guiding treatment and predicting the success of conservative treatment in patients presenting with adhesive SBO.

Patients and methods
This is a prospective study that was conducted on adult patients who were clinically and radiologically proven to have SBO and had a history of at least one previous abdominal surgical intervention. The included patients underwent CT examination of the abdomen and pelvis with oral contrast. Patients who had the oral contrast seen reaching the right colon were admitted and completed conservative management. Surgical intervention was indicated in patients who showed failure of treatment with oral contrast.

Results
This study included 70 patients, of whom 29 (41.4%) had contrast in the right colon during CT examination after the first oral contrast administration. The remaining patients (n=41, 58.6%) indicated a second oral contrast CT study after 24 h. Sixteen (22.9%) patients had nonresolving obstructions and underwent surgical intervention. Overall, 52 (74.3%) patients were successfully treated with oral contrast studies, with no subsequent morbidity. Significant predictors for surgical intervention were a history of more than one previous surgical intervention (OR=6.08, CI: 1.75–21.14, P=0.005) and nonpassage of contrast to the right colon in the CT study (OR=0.099, CI: 0.029–0.341, $P<0.001$).

Conclusion
This study highlights the clinical relevance of CT with oral contrast studies in guiding management. A history of multiple previous surgeries and nonpassage of the oral contrast to the right colon emerged as a significant predictor for surgical intervention.

Keywords:
adhesions, adhesive small bowel obstruction, computed tomography with oral contrast, previous abdominal surgery

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Introduction

Following abdominal surgery, it is estimated that ~93% of patients will develop postoperative adhesions [1], which are abnormal fibrous bands that form between organs and tissues as part of the peritoneal healing process following surgery [2]. Despite advancements such as the use of antiadhesive barriers and the increasing adoption of laparoscopic techniques, adhesion-associated complications persist, with recent epidemiological studies reporting that about 25% of patients undergoing open or laparoscopic abdominal surgery are readmitted due to adhesion-related complications [3].

Adhesive small bowel obstruction (SBO) stands out as one of the most frequent and clinically significant complications following abdominal surgery [4,5]. Adhesive SBO is a common issue seen in the field of general surgery, making up ~20% of all surgical emergencies [6]. Despite advancements in healthcare, it continues to pose substantial difficulties in terms of prevention, diagnosis, and treatment, leading to notable impacts on patient morbidity and socioeconomic burden [7].

Since surgical treatment would confer the risk of forming more adhesions with subsequent complications, finding effective conservative treatment modalities that minimize morbidity risk,

reduce workload, and lower costs is highly warranted. In cases of partial adhesive SBO without signs of strangulation or peritonitis, it is generally feasible to initiate a non-surgical treatment approach. This approach has been successful in ~60–85% of patients [8]. Moreover, in the absence of signs indicating strangulation or peritonitis, non-operative management can be extended for a duration of up to 72 h [9].

The effective management of patients with adhesive SBO hinges on the timely diagnosis of the obstruction and the precise identification of those patients who necessitate surgical intervention from those who can benefit from nonoperative treatment. Computed tomography (CT) is currently the preferred diagnostic method for assessing bowel obstruction. CT scans can clearly delineate a well-defined transition point where the bowel is dilated above this point and decompressed below it. Additionally, CT can reveal that intraluminal contrast does not progress beyond this transitional zone, and there is typically limited gas or fluid in the colon. These findings on CT are indicative features of small bowel obstruction [10]. Moreover, water-soluble contrast agents have been shown to add considerably to the nonoperative treatment of adhesive SBO. Numerous studies have investigated the therapeutic benefits of employing water-soluble contrast agents in cases of adhesive SBO [11–14]. The hyperosmolarity of water-soluble contrast agents has been suggested to confer therapeutic advantages by inducing water transfer into the small bowel lumen, with a resultant reduction of wall edema and enhancement of smooth muscle contractility [15].

However, CT scans are not routinely performed in cases of adhesive SBO, and they are usually done when clinical history, physical examination, and plain film are not conclusive. In addition, consensus remains elusive regarding the benefit of routine use of oral contrast-enhanced CT for guiding the treatment choice in adhesive SBO [16–18].

The present study aimed to investigate the role of CT with oral contrast media in guiding treatment and predicting the success of conservative treatment in patients presenting with adhesive SBO.

Patients and methods

This is a prospective study that was conducted on patients consecutively admitted to the Emergency Department of Cairo University Hospitals (Kasr Al Ainy) from March 2021 to October 2021 with clinical and radiological features of adhesive SBO. The study was performed after being approved by the Research Ethics Committee and following the Helsinki Declaration.

Patients who presented with clinical features suggestive of SBO underwent complete history-taking, clinical assessment, and abdominal plain radiography examination in the supine and erect positions. Adult patients who were clinically and radiologically proven to have SBO and had a history of at least one previous abdominal surgical intervention were eligible for the study. Patients with peritonitis, clinical or radiological evidence of intestinal strangulation, sepsis, or those who were hemodynamically unstable were excluded from the study. Patients with a history of malignancy and pregnant women were also excluded. An informed written consent was obtained from each included patient.

Sample size

The sample size of the current study was calculated using STATA 14.2 software. A calculation based on a previously described disease prevalence rate of 12%, precision±15%, sensitivity 95%, and specificity 95% [19] yielded the required sample size of 68 patients.

The included patients underwent conservative treatment that encompassed nasogastric intubation, administration of intravenous fluid, clinical observation, urine output monitoring through urinary catheterization, and serial assessment of the electrolyte concentrations and leukocytic count. The included patients underwent a CT examination of the abdomen and pelvis with oral contrast. Patients who had the oral contrast seen reaching the right colon were admitted and completed conservative management. The remaining patients underwent a second CT study with oral contrast after 24 h. Surgical intervention was indicated in patients who showed failure of oral contrast to reach the right colon at the 24 h follow-up CT. Patients who had clinically or radiologically suspected closed-loop obstruction, strangulated obstruction, or perforation at any point during the study underwent urgent laparotomies. A radiological consultant was available to interpret the CT examination of the patients.

Study outcomes

The primary outcomes of this study were the number of cases that were managed conservatively without the need for surgery based on CT findings with oral contrast. The secondary outcomes were the length of

hospital stay (LOS) and treatment-related morbidity and mortality.

Statistical analysis

The obtained data were analyzed using SPSS statistical software (IBM Corp., Armonk, NY, USA), version 28. The numerical data were checked for normality and expressed as mean±standard deviation (SD), median, and range accordingly, whereas categorical data were presented as a number and percentage. Binary logistic regression analyses were performed to identify the predictors of surgical intervention. A *P* value less than 0.05 was considered statistically significant.

Results

This study included 70 patients with SBO and a history of previous abdominal surgery. The patients' ages ranged from 18 to 77 years, with a mean of 46 ±16.91. Females constituted slightly more than half of the cases (*n*=38, 54.3%). The most prevalent comorbidities were hypertension (*n*=10, 14.3%) and diabetes mellitus (*n*=8, 11.8%).

Thirty-three (47.1%) patients had undergone one previous abdominal surgery, while the rest (52.9%) had more than one previous abdominal surgery. The most common types of previous surgeries were exploration (*n*=20, 28.6%) for intestinal obstruction, abdominal trauma with suspected organ injury, suspected perforated bowel, or suspected missed gauzes after a cesarean section. Other surgeries were appendectomy (*n*=18, 25.7%), other bowel resection surgeries (*n*=18, 25.7%), cesarean section (*n*=16, 22.9%), and herniorrhaphy/hernioplasty (*n*=14, 20%). The duration from the previous abdominal surgery to the current condition ranged from 0.2 to 360 months, with a median of 24 months (Table 1).

The study patients clinically presented with abdominal pain and tenderness (*n*=70, 100%), anorexia and nausea (*n*=53, 74.7%), abdominal distention (*n*=23, 32.9%), nonpassing flatus (*n*=14, 20%), and vomiting (*n*=7, 10%). The duration of symptoms ranged from 1 to 14 days, with a median of 3 days. An abdominal radiography showed bowel air fluid levels in all the patients. Abdominal ultrasound examination revealed

Table 1 Baseline demographic data previous surgery history of the study patients

	Study patients (*n*=70)	
	Mean±SD/Median	Range
Age (y)	46±16.91	18-77
Duration from previous surgery (months)	24	0.2-360
	Count	**%**
Sex		
Male	32	45.7%
Female	38	54.3%
Comorbidities		
Hypertension	10	14.3%
Diabetes mellitus	8	11.4%
Ischemic heart disease	2	2.9%
Asthma	1	1.4%
Hepatitis C virus	1	1.4%
Rheumatoid arthritis	1	1.4%
History of previous surgery		
One Surgery (n)	33	47.1%
More than One Surgery (n)	37	52.9%
Type of previous surgery		
Exploration	20	28.6%
Appendectomy	18	25.7%
Meckel's diverticulum surgery	1	1.4%
Other Bowel Resection Surgeries	18	25.7%
Cesarean Section	16	22.9%
Herniorrhaphy/Hernioplasty	14	20.0%
Hysterectomy/fibroidectomy	7	10.0%
Tubal/ovarian surgery	6	8.6%
Cholecystectomy	5	7.1%
Splenectomy	3	4.3%
Renal surgery	2	2.9%

Table 2 Clinical and ultrasound data of the study patients

	Study patients (*n*=70)
Clinical presentation	
Abdominal Pain and Tenderness	70 (100%)
Anorexia and Nausea	53 (74.7%)
Abdominal Distention	23 (32.9%)
Non-Passing Flatus	14 (20%)
Vomiting	7 (10%)
Abdominal ultrasound findings	
Free Peritoneal Fluid	32 (45.7%)
Bowel Gaseous Distention	27 (38.6%)
Sluggish Peristalsis	8 (11.4%)
Inflamed Peritoneal Fat	2 (2.8%)
Obstructed Hernia	4 (5.7%)
Gallbladder Stone	1 (1.4%)
Pelvic Kidney	1 (1.4%)
Adnexal Cyst	1 (1.4%)

free peritoneal fluid (*n*=32, 45.7%), bowel gaseous distention (*n*=27, 38.6%), sluggish peristalsis (*n*=8, 11.4%), gallbladder (GB) stone (*n*=1, 1.4%), pelvic kidney (*n*=1, 1.4%), and adnexal cyst (*n*=1, 1.4%) (Table 2).

Of the 70 patients included, 29 (41.4%) had contrast in the right colon during CT examination after the first oral contrast administration. These patients continued with conservative management until complete improvement and discharge from the hospital. The remaining patients (*n*=41, 58.6%) indicated a second oral contrast CT study after 24 h. Two (2.9%) patients had clinical signs of closed-loop obstruction and strangulation that were confirmed by an unplanned CT scan and underwent laparotomies. The remaining 39 (55.7%) patients underwent the second oral contrast CT study within 24 h, with contrast seen reaching the right colon in 23 (32.9%) patients who completed their treatment conservatively. The rest of the patients (*n*=16, 22.9%) had non-resolving obstructions and underwent surgical intervention. Overall, a total of 52 (74.3%) patients were successfully treated with oral contrast studies, with no subsequent morbidity.

Two of the patients who required surgical intervention developed postoperative complications and were admitted to the ICU. One case had leakage from the small bowel anastomosis on day 2 postoperatively, and the other patient had peritonitis after heterolysis. The hospital LOS ranged from 1 to 20 days, with a median of 3 days.

Assessment of the potential predictors of surgical intervention revealed that significant predictors for surgical intervention were a history of more than one previous surgical intervention (OR=6.08, CI: 1.75–21.14, *P*=0.005) and nonpassage of contrast to the right colon in the CT study (OR=0.099, CI: 0.029–0.341, *P*<0.001).

Discussion

Adhesive SBO presents a complex and recurrent challenge for surgeons. This condition arises because of previous abdominal surgeries, transforming the peritoneal cavity into a battleground of adhesions and complications. This is a real-world medical dilemma that demands systematic understanding and evidence-based strategies for effective management.

This study provides valuable insights into the clinical characteristics, management strategies, and outcomes of 70 patients with adhesive SBO in such a context. The study population consisted of a diverse group of patients, with ages ranging from 18 to 77 years and a mean age of 46. This broad age range highlights the fact that adhesive SBO can affect individuals across different age groups. Furthermore, the gender distribution indicated a slight predominance of females, comprising 54.3% of the cases. This sex distribution reflects the influence of gynecological and obstetric procedures, which involve surgical interventions in the abdominal or pelvic regions, including cesarean sections, hysterectomies, fibroidectomies, and ovarian and tubal surgeries.

In this study, a close clinical observation approach allowed for the identification of patients who needed surgical intervention promptly, as evidenced by the two patients with clinical signs of closed-loop obstruction and strangulation. Overall, a significant proportion (74.3%) of patients were successfully treated without the need for surgical intervention. The low subsequent morbidity rate further supports the effectiveness of this approach in selected cases.

This study showed that CT with oral contrast could be used to guide the management of adhesive SBO, avoid unnecessary surgery, or aid in surgical decision-making. Similar data were previously reported, with the administration of water-soluble contrast medium in adhesive SBO showing both diagnostic and therapeutic benefits [20–23]. One of the key findings of this study is the identification of significant predictors for surgical intervention in patients with adhesive SBO. Specifically, the study revealed that a history of more than one previous surgical intervention and nonpassage of contrast to the right colon, as visualized in the CT study, significantly predicted the need for surgical intervention.

In line with our findings, the study of Cho *et al.* [21] reported the number of previous abdominal surgeries as a predictor for surgical intervention in adhesive small bowel obstruction after conservative treatment. Also, Khorshidi *et al.* [22] highlighted that a smaller number of previous abdominal surgeries could be a predictor of successful conservative treatment in patients. This finding underscores the clinical relevance of prior surgical history. Each abdominal surgery leaves behind adhesions, a natural part of the healing process but potentially problematic when they lead to SBO. Patients who have undergone multiple surgeries are more likely to have a higher burden of adhesions, increasing the risk of noneasily relieved bowel obstruction.

As for the CT findings, like our study, the recent study of Ng and coworkers [23] reported that the presence of contrast in the colon on CT scans of patients with adhesive SBO was found to be predictive of successful nonoperative management. The passage of contrast to the colon indicates that there is no complete obstruction in the small bowel, suggesting that the obstruction may be partial or resolving.

Overall, these findings can help clinicians decide whether surgical intervention is necessary or if non-operative management can be successful. The recognition that patients with a history of multiple surgeries are at greater risk for surgical intervention highlights the need for tailored treatment approaches. These patients may benefit from more vigilant monitoring, closer follow-up, or earlier consideration of surgical consultation. Additionally, surgical techniques may need to be adapted to address the specific challenges posed by the presence of extensive adhesions, which was beyond the scope of the current study. In contrast, the presence of contrast in the colon on CT scans can assist in preventing unnecessary surgical interventions, which can lead to associated morbidity and mortality in patients with adhesive SBO.

Conclusion

This study highlights the therapeutic role of oral contrast studies in the treatment of adhesive SBO. A total of 74.3% of patients were successfully treated conservatively, supported by low morbidity. This study highlights the clinical relevance of CT with oral contrast studies in guiding management. A history of multiple previous surgeries and nonpassage of the oral contrast to the right colon emerged as a significant predictor for surgical intervention.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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