

Original Research Article

ROLE OF ORAL CONTRAST IN THE MANAGEMENT OF ADHESIVE INTESTINAL OBSTRUCTION (SMALL INTESTINE)

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Received : 03/09/2026
 Received in revised form : 01/10/2026
 Accepted : 12/10/2026

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DOI: 10.70034/ijmedph.2026.4.110

Source of Support: Nil,
 Conflict of Interest: None declared

Int J Med Pub Health
 2026; 16 (4); 732-739

ABSTRACT

Background: Adhesive small bowel obstruction is a common cause of intestinal obstruction following abdominal or pelvic surgery. Although many patients respond to conservative management, early identification of those likely to require surgery remains challenging. Water-soluble oral contrast can provide useful prognostic information by demonstrating bowel transit and may assist in treatment decisions. The aim is to evaluate the role of oral water-soluble contrast in the management of adhesive small bowel obstruction and assess its ability to predict successful conservative treatment and the need for operative intervention.

Materials and Methods: This prospective observational study was conducted from 2022 to 2025 at Pt. Jawahar Lal Nehru Government Medical College and Hospital (Pt. JLNMGCH), Chamba, and included 40 adult patients with clinically and radiologically diagnosed adhesive small bowel obstruction. All eligible patients initially underwent standardized conservative management followed by administration of water-soluble oral contrast. Follow-up abdominal radiographs were assessed for passage of contrast into the colon within 24 hours. Clinical, laboratory, radiological, and outcome parameters were recorded. Data were analyzed using IBM SPSS Statistics version 27.0, with $p < 0.05$ considered statistically significant.

Results: The mean age was 46.82 ± 13.64 years, and 60.00% of patients were males. Conservative management was successful in 30 patients (75.00%), while 10 patients (25.00%) required operative management. Contrast reached the colon within 24 hours in 30 patients (75.00%); among them, 28 (93.33%) were successfully managed conservatively and 2 (6.67%) required surgery. In contrast, 8 of 10 patients (80.00%) without colonic contrast passage required operative intervention ($p < 0.001$). Contrast progression into the colon within 24 hours predicted successful conservative management with 93.33% sensitivity, 80.00% specificity, 93.33% positive predictive value, 80.00% negative predictive value, and 90.00% overall diagnostic accuracy. Patients with colonic contrast passage had significantly earlier passage of flatus (1.74 ± 0.64 vs. 3.18 ± 1.08 days; $p = 0.002$), earlier initiation of oral feeding (2.38 ± 0.74 vs. 4.64 ± 1.43 days; $p < 0.001$), fewer in-hospital complications (3.33% vs. 40.00%; $p = 0.010$), and a shorter hospital stay (4.21 ± 1.20 vs. 8.73 ± 2.24 days; $p < 0.001$).

Conclusion: Oral water-soluble contrast is a valuable adjunct in adhesive small bowel obstruction. Colonic contrast passage within 24 hours strongly predicts successful conservative management, while failure of progression identifies patients with a higher likelihood of surgery and prolonged hospitalization.

Keywords: Adhesive small bowel obstruction; Water-soluble contrast; Gastrografin; Conservative management; Intestinal obstruction.

INTRODUCTION

Small bowel obstruction is an important surgical emergency encountered in routine clinical practice and remains a frequent cause of acute hospital admission. Among the various etiologies of mechanical small bowel obstruction, postoperative intra-abdominal adhesions constitute a major cause, particularly in patients with a history of abdominal or pelvic surgery. Adhesions develop as part of an abnormal peritoneal healing response following surgical manipulation, inflammation, ischemia, infection, or tissue injury. These fibrous bands may restrict the normal mobility of the small bowel, create an angulation or transition point, or entrap a bowel segment, resulting in partial or complete obstruction. Adhesive small bowel obstruction may occur shortly after an operation or several years later and can recur repeatedly, creating a substantial clinical and healthcare burden.^[1] The clinical presentation of adhesive small bowel obstruction commonly includes colicky abdominal pain, vomiting, abdominal distension, constipation, and failure to pass flatus. The severity and progression of these manifestations depend on the site, degree, and duration of obstruction. Initial evaluation is directed not only toward confirming mechanical obstruction but also toward identifying bowel compromise, particularly strangulation, ischemia, closed-loop obstruction, or perforation. These complications require prompt operative intervention because inappropriate prolongation of conservative treatment may increase morbidity. Computed tomography has therefore assumed an important role in evaluating suspected adhesive obstruction by defining the level and degree of obstruction, demonstrating a transition point, assessing bowel-wall and mesenteric changes, and identifying radiological features that may indicate ischemia or the need for surgical intervention.^[2] In the absence of peritonitis, bowel ischemia, perforation, strangulation, or hemodynamic instability, an initial trial of non-operative management is generally appropriate. Conventional conservative treatment includes bowel rest, nil per oral status, nasogastric decompression when required, intravenous fluid resuscitation, correction of electrolyte abnormalities, analgesia, and repeated clinical assessment. One of the major challenges during conservative treatment is determining which patients are likely to improve without surgery and which patients are unlikely to resolve spontaneously. Delayed identification of treatment failure may expose patients to prolonged obstruction and its associated complications, whereas unnecessary early surgery can result in additional bowel manipulation, new adhesion formation, inadvertent enterotomy, and recurrent adhesive disease. Standardized clinical pathways are therefore increasingly employed to facilitate timely decision-making.^[3] Water-soluble oral contrast has emerged as an important adjunct in this decision-making process.

The contrast agent may be administered orally or through a nasogastric tube after adequate gastric decompression, followed by serial abdominal radiographs to document its progression through the small intestine. The basic principle of the water-soluble contrast challenge is straightforward: progression of contrast beyond the obstructed segment and its appearance within the colon indicates preserved luminal continuity and favors resolution with conservative treatment. Conversely, failure of contrast to progress into the colon within the defined observation period raises concern regarding persistent or high-grade obstruction and may support earlier consideration of operative management.^[4] Apart from its diagnostic and prognostic role, hyperosmolar water-soluble contrast has also been proposed to possess a therapeutic effect. Agents such as diatrizoate-based contrast are hyperosmolar and may promote movement of fluid into the intestinal lumen, alter bowel-wall edema, stimulate intestinal motility, and facilitate transit of intestinal contents through a partially obstructed segment. Nevertheless, the extent to which these physiological properties translate into a true therapeutic benefit remains debated. Consequently, contemporary use of water-soluble contrast is often considered valuable principally because it provides objective information regarding bowel transit and assists clinicians in determining whether continued conservative treatment remains appropriate.^[5] The water-soluble contrast challenge is particularly attractive because it integrates easily into routine conservative management and provides a relatively simple radiological end point. However, its clinical usefulness depends on appropriate patient selection, adequate nasogastric decompression, standardized contrast administration, suitable timing of follow-up imaging, and careful interpretation alongside the patient's clinical condition. Contrast findings should never supersede evidence of deterioration, peritoneal irritation, ischemia, or strangulation. Furthermore, published protocols vary in the type and quantity of contrast administered and in the timing of subsequent radiographs. This heterogeneity has contributed to continuing uncertainty regarding the optimal protocol and the precise therapeutic contribution of water-soluble contrast.^[6]

MATERIALS AND METHODS

This hospital-based prospective observational study was conducted from 2022 to 2025 at Pt. JLNMGCH, Chamba, to evaluate the role of oral water-soluble contrast in the management of adhesive small bowel obstruction. A total of 40 consecutive patients presenting with clinical and radiological features suggestive of adhesive small intestinal obstruction were enrolled. Patients were managed according to a standardized institutional protocol, with particular emphasis on the diagnostic and therapeutic utility of oral contrast in predicting successful conservative

management and identifying patients requiring operative intervention. The study included adult patients presenting with symptoms suggestive of small bowel obstruction, including colicky abdominal pain, abdominal distension, vomiting, and failure to pass flatus or stools, with a previous history of abdominal or pelvic surgery and radiological findings consistent with adhesive small bowel obstruction. The diagnosis was established by clinical examination together with abdominal radiography and/or contrast-enhanced computed tomography, wherever indicated. Relevant demographic characteristics, previous surgical history, number and type of previous abdominal operations, interval since the last surgery, and previous episodes of intestinal obstruction were recorded.

Inclusion Criteria

Patients aged 18 years or older with clinical and radiological evidence of partial or complete small bowel obstruction presumed to be secondary to postoperative adhesions were included. Patients were required to be hemodynamically stable at presentation and considered suitable for an initial trial of non-operative management. A previous history of abdominal or pelvic surgery supporting an adhesive etiology was considered an important eligibility criterion.

Exclusion Criteria

Patients with clinical evidence of generalized peritonitis, bowel perforation, strangulation, bowel ischemia, uncontrolled sepsis, persistent hemodynamic instability, or an obvious indication for immediate emergency surgery were excluded. Patients with obstruction due to incarcerated hernia, malignancy, inflammatory bowel disease, intussusception, volvulus, gallstone ileus, or other clearly identifiable non-adhesive causes were also excluded. Patients with known hypersensitivity to the selected water-soluble contrast agent, severe aspiration risk, pregnancy, or inability to undergo the contrast protocol were not included.

Methodology: At admission, a detailed history and clinical examination were performed. Recorded parameters included age, sex, duration of symptoms, number of vomiting episodes, abdominal pain, abdominal distension, obstipation, passage of flatus, previous abdominal surgery, previous episodes of obstruction, pulse rate, blood pressure, respiratory rate, temperature, hydration status, abdominal tenderness, guarding, rigidity, bowel sounds, and presence or absence of peritoneal signs. Nasogastric tube output during initial management was also documented.

Laboratory and Radiological Evaluation: Baseline investigations included complete blood count, hemoglobin concentration, total leukocyte count, serum sodium, potassium, urea, creatinine, and other biochemical investigations considered clinically necessary. Plain abdominal radiographs were assessed for dilated small bowel loops, multiple air-fluid levels, and paucity of colonic gas. Computed tomography findings, when available, were evaluated

for the site and grade of obstruction, transition point, maximum small bowel diameter, bowel wall thickening, mesenteric edema, free intraperitoneal fluid, small bowel feces sign, and radiological features suspicious for ischemia or closed-loop obstruction.

Initial Conservative Management: All eligible patients initially underwent standardized conservative treatment consisting of nil per oral status, nasogastric decompression, intravenous fluid resuscitation, correction of electrolyte abnormalities, analgesia, antiemetics, and close clinical monitoring. Urine output, nasogastric aspirate, abdominal findings, vomiting, passage of flatus or stools, and changes in vital parameters were monitored. Patients developing clinical or radiological evidence of bowel ischemia, strangulation, perforation, worsening peritonitis, or hemodynamic deterioration were considered for immediate operative intervention irrespective of the contrast findings.

Oral Water-Soluble Contrast Protocol: After initial stabilization and adequate gastric decompression, eligible patients received water-soluble iodinated contrast through the oral or nasogastric route according to the institutional protocol. The nasogastric tube was temporarily clamped following administration to facilitate progression of contrast through the gastrointestinal tract, provided that the patient tolerated the procedure. Follow-up abdominal radiographs were obtained to assess progression of contrast through the small bowel and its appearance in the colon. The principal radiological parameter was passage of contrast into the colon within 24 hours of administration. Time to colonic opacification and changes in small bowel dilatation were also recorded wherever assessable.

Assessment of Response and Outcome Measures: Successful conservative management was defined by clinical improvement with reduction in abdominal pain and distension, decrease in nasogastric output, cessation of vomiting, passage of flatus or stools, tolerance of oral feeding, and absence of need for surgery. Failure of conservative treatment was defined as persistence or worsening of obstruction, failure of satisfactory clinical improvement, deterioration in clinical condition, or requirement for operative intervention. The primary parameters assessed were passage of oral contrast into the colon within 24 hours and successful non-operative resolution of obstruction. Secondary parameters included time to passage of flatus, time to first stool, time to nasogastric tube removal, time to initiation of oral feeding, requirement for surgery, operative findings, need for bowel resection, complications, and total length of hospital stay. The predictive value of colonic contrast passage for successful conservative management was also evaluated.

Operative Management: Patients requiring surgery underwent exploratory laparotomy or laparoscopy according to the surgeon's clinical judgment and patient condition. Intraoperative findings including

single-band adhesion, multiple adhesions, site of obstruction, bowel viability, closed-loop obstruction, ischemia, gangrene, perforation, adhesiolysis, and requirement for bowel resection and anastomosis were recorded. Postoperative complications were documented during hospitalization.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 27.0. Continuous variables were expressed as mean $\pm$ standard deviation or median with interquartile range depending on data distribution, while categorical variables were presented as frequencies and percentages. The Chi-square test or Fisher's exact test was used to compare categorical variables, and the independent-samples t-test or Mann-Whitney U test was applied for continuous variables, as appropriate. The association between contrast passage into the colon and successful conservative management was assessed. Sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy of contrast progression for predicting non-operative resolution were calculated where applicable. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 40 patients with adhesive small bowel obstruction were included in the study. The demographic characteristics, previous abdominal surgeries, clinical and radiological findings, oral contrast progression, diagnostic performance, and subsequent clinical outcomes were analyzed.

[Table 1] Baseline Demographic and Previous Surgical Characteristics

The mean age of the study population was 46.82 ± 13.64 years. Among the 40 patients, 6 (15.00%) were aged between 18 and 30 years, 12 (30.00%) were in the 31–45-year age group, 14 (35.00%) were aged between 46 and 60 years, and 8 (20.00%) were older than 60 years. The largest proportion of patients belonged to the 46–60-year age group. With respect to sex distribution, 24 patients (60.00%) were males and 16 patients (40.00%) were females.

Regarding previous surgical history, 28 patients (70.00%) had undergone one previous abdominal surgery, whereas 12 patients (30.00%) had undergone two or more abdominal surgical procedures. A previous episode of intestinal obstruction was reported in 14 patients (35.00%), while 26 patients (65.00%) had no previous history of intestinal obstruction.

The most common previous surgical procedure was appendectomy, reported in 10 patients (25.00%). Gynecological or pelvic surgery had been performed in 9 patients (22.50%), while 7 patients (17.50%) had a history of colorectal surgery. Six patients (15.00%) had previously undergone upper gastrointestinal or hepatobiliary surgery, 4 patients (10.00%) had undergone hernia or other lower abdominal surgery,

and another 4 patients (10.00%) had undergone other types of abdominal surgery.

[Table 2] Comparison of Clinical, Laboratory and Radiological Parameters According to Final Management

Of the 40 patients, 30 patients were successfully managed conservatively, whereas 10 patients required operative management. The mean age was 45.94 ± 13.12 years in the conservative management group and 49.55 ± 14.89 years in the operative management group. The difference in mean age between the two groups was not statistically significant ($p=0.506$). Males constituted 18 of 30 patients (60.00%) in the conservative group and 6 of 10 patients (60.00%) in the operative group, with no statistically significant difference between the groups ($p=1.000$).

The mean duration of symptoms before presentation was 2.18 ± 0.92 days among patients managed conservatively compared with 3.45 ± 1.21 days among those requiring operative management. This difference was statistically significant ($p=0.010$). Vomiting was present in 26 patients (86.67%) in the conservative group and all 10 patients (100.00%) in the operative group; however, the difference was not statistically significant ($p=0.556$). Obstipation was observed in 22 patients (73.33%) treated conservatively and 9 patients (90.00%) undergoing operative management, with no statistically significant difference ($p=0.404$).

Abdominal tenderness was present in 16 patients (53.33%) in the conservative group compared with 8 patients (80.00%) in the operative group. The difference was not statistically significant ($p=0.263$). A history of two or more previous abdominal surgeries was noted in 7 patients (23.33%) in the conservative group and 5 patients (50.00%) in the operative group, with a p-value of 0.133. Similarly, previous episodes of intestinal obstruction were reported in 9 patients (30.00%) successfully managed conservatively and 5 patients (50.00%) requiring surgery; this difference was not statistically significant ($p=0.278$).

The mean total leukocyte count was $9.84 \pm 2.31 \times 10^3/\mu\text{L}$ in the conservative management group and $12.76 \pm 3.08 \times 10^3/\mu\text{L}$ in the operative management group. The difference was statistically significant ($p=0.017$). The mean maximum small bowel diameter was 3.42 ± 0.51 cm among conservatively managed patients compared with 4.11 ± 0.62 cm among patients requiring operative management, and this difference was statistically significant ($p=0.007$). Complete intestinal obstruction was observed in 4 patients (13.33%) in the conservative group and 5 patients (50.00%) in the operative group, showing a statistically significant difference ($p=0.029$). Mesenteric edema was present in 6 patients (20.00%) managed conservatively compared with 6 patients (60.00%) who required surgery, and the difference was statistically significant ($p=0.041$). Free intraperitoneal fluid was detected in 5 patients (16.67%) in the conservative group and 5 patients

(50.00%) in the operative group. The difference did not reach statistical significance ($p=0.085$).

[Table 3] Relationship Between Oral Contrast Progression and Final Management

Oral water-soluble contrast reached the colon within 24 hours in 30 of the 40 patients (75.00%). Among these 30 patients, 28 (93.33%) were successfully managed conservatively, while only 2 patients (6.67%) required operative intervention. In contrast, oral contrast failed to reach the colon within 24 hours in 10 patients (25.00%). Among these patients, 2 (20.00%) were successfully managed conservatively, whereas 8 patients (80.00%) ultimately required operative management. The association between passage of contrast into the colon within 24 hours and final management was statistically significant ($p<0.001$).

When patients were further categorized according to the time taken for contrast to reach the colon, 16 patients (40.00%) demonstrated colonic contrast progression within 8 hours. All 16 of these patients (100.00%) were successfully managed conservatively, and none required operative intervention. In another 14 patients (35.00%), contrast reached the colon between more than 8 hours and 24 hours. Among these patients, 12 (85.71%) were successfully managed conservatively, whereas 2 patients (14.29%) required operative intervention. Among the 10 patients (25.00%) in whom no colonic contrast was observed within 24 hours, 2 patients (20.00%) were managed conservatively and 8 patients (80.00%) required operative treatment. The distribution of final management according to the time of contrast progression showed a statistically significant difference ($p<0.001$).

[Table 4] Diagnostic Performance of Colonic Contrast Passage Within 24 Hours

The diagnostic performance of oral contrast progression into the colon within 24 hours was evaluated for predicting successful conservative management. The sensitivity was 93.33%, indicating that 93.33% of patients who were successfully managed conservatively demonstrated contrast passage into the colon within 24 hours. The specificity was 80.00%, indicating that 80.00% of patients requiring operative management were correctly identified by the absence of colonic contrast progression within 24 hours.

The positive predictive value was 93.33%, indicating that among patients in whom contrast reached the

colon within 24 hours, 93.33% were successfully managed conservatively. The negative predictive value was 80.00%, indicating that among patients in whom contrast failed to reach the colon within 24 hours, 80.00% required operative intervention. The overall diagnostic accuracy of contrast passage into the colon within 24 hours for predicting successful conservative management was 90.00%.

[Table 5] Clinical Outcomes According to Passage of Contrast Into the Colon Within 24 Hours

Clinical outcomes were compared between the 30 patients in whom contrast reached the colon within 24 hours and the 10 patients in whom contrast did not reach the colon. The mean time to passage of flatus was 1.74 ± 0.64 days in patients with colonic contrast passage compared with 3.18 ± 1.08 days among those without colonic contrast passage. This difference was statistically significant ($p=0.002$).

The mean time to first stool was 2.16 ± 0.73 days in the group with colonic contrast progression compared with 3.73 ± 1.10 days in the group without contrast progression. The difference was statistically significant ($p=0.001$). Similarly, the mean time to nasogastric tube removal was 1.91 ± 0.68 days when contrast reached the colon compared with 3.36 ± 1.12 days when contrast did not reach the colon. This difference was statistically significant ($p=0.003$).

The mean time to initiation of oral feeding was 2.38 ± 0.74 days among patients with colonic progression of contrast compared with 4.64 ± 1.43 days among patients without colonic contrast progression. The difference was statistically significant ($p<0.001$).

Operative intervention was required in 2 of the 30 patients (6.67%) in whom contrast reached the colon within 24 hours compared with 8 of the 10 patients (80.00%) in whom contrast did not reach the colon. This difference was statistically significant ($p<0.001$). In-hospital complications occurred in 1 patient (3.33%) with colonic contrast passage and in 4 patients (40.00%) without colonic contrast passage, with a statistically significant difference between the groups ($p=0.010$).

The mean length of hospital stay was 4.21 ± 1.20 days among patients in whom contrast reached the colon within 24 hours, whereas it was 8.73 ± 2.24 days among patients in whom contrast failed to reach the colon. The difference in hospital stay between the two groups was statistically significant ($p<0.001$).

Table 1: Baseline demographic and previous surgical characteristics of the study population (n = 40)

Parameter	Number (n)	Percentage (%)
Age group (years)		
18–30	6	15.00
31–45	12	30.00
46–60	14	35.00
>60	8	20.00
Mean age (years)	46.82 ± 13.64	—
Sex		
Male	24	60.00
Female	16	40.00
Number of previous abdominal surgeries		

One	28	70.00
Two or more	12	30.00
Previous episode of intestinal obstruction		
Yes	14	35.00
No	26	65.00
Type of previous surgery		
Appendectomy	10	25.00
Gynecological/pelvic surgery	9	22.50
Colorectal surgery	7	17.50
Upper gastrointestinal/hepatobiliary surgery	6	15.00
Hernia/other lower abdominal surgery	4	10.00
Other abdominal surgery	4	10.00

Table 2: Comparison of clinical, laboratory and radiological parameters according to final management (n = 40)

Parameter	Conservative management (n = 30)	Operative management (n = 10)	p-value
Age (years), Mean $\pm$ SD	45.94 $\pm$ 13.12	49.55 $\pm$ 14.89	0.506
Male sex, n (%)	18 (60.00)	6 (60.00)	1.000
Duration of symptoms (days), Mean $\pm$ SD	2.18 $\pm$ 0.92	3.45 $\pm$ 1.21	0.010
Vomiting, n (%)	26 (86.67)	10 (100.00)	0.556
Obstipation, n (%)	22 (73.33)	9 (90.00)	0.404
Abdominal tenderness, n (%)	16 (53.33)	8 (80.00)	0.263
≥ 2 previous abdominal surgeries, n (%)	7 (23.33)	5 (50.00)	0.133
Previous episode of obstruction, n (%)	9 (30.00)	5 (50.00)	0.278
Total leukocyte count ($\times 10^3/\mu\text{L}$), Mean $\pm$ SD	9.84 $\pm$ 2.31	12.76 $\pm$ 3.08	0.017
Maximum small bowel diameter (cm), Mean $\pm$ SD	3.42 $\pm$ 0.51	4.11 $\pm$ 0.62	0.007
Complete obstruction, n (%)	4 (13.33)	5 (50.00)	0.029
Mesenteric edema, n (%)	6 (20.00)	6 (60.00)	0.041
Free intraperitoneal fluid, n (%)	5 (16.67)	5 (50.00)	0.085

Table 3: Relationship between oral contrast progression and final management (n = 40)

Contrast progression	Total n (%)	Conservative management n (%)	Operative management n (%)	p-value
Contrast reached colon within 24 hours	30 (75.00)	28 (93.33)	2 (6.67)	<0.001
Contrast did not reach colon within 24 hours	10 (25.00)	2 (20.00)	8 (80.00)	
According to time of progression				
≤ 8 hours	16 (40.00)	16 (100.00)	0 (0.00)	<0.001
>8–24 hours	14 (35.00)	12 (85.71)	2 (14.29)	
No colonic contrast within 24 hours	10 (25.00)	2 (20.00)	8 (80.00)	

Table 4: Diagnostic performance of contrast reaching the colon within 24 hours for predicting successful conservative management (n = 40)

Diagnostic parameter	Value (%)
Sensitivity	93.33
Specificity	80.00
Positive predictive value (PPV)	93.33
Negative predictive value (NPV)	80.00
Overall diagnostic accuracy	90.00

Table 5: Clinical outcomes according to passage of contrast into the colon within 24 hours (n = 40)

Outcome parameter	Contrast reached colon (n = 30)	Contrast did not reach colon (n = 10)	p-value
Time to passage of flatus (days), Mean $\pm$ SD	1.74 $\pm$ 0.64	3.18 $\pm$ 1.08	0.002
Time to first stool (days), Mean $\pm$ SD	2.16 $\pm$ 0.73	3.73 $\pm$ 1.10	0.001
Time to nasogastric tube removal (days), Mean $\pm$ SD	1.91 $\pm$ 0.68	3.36 $\pm$ 1.12	0.003
Time to initiation of oral feeding (days), Mean $\pm$ SD	2.38 $\pm$ 0.74	4.64 $\pm$ 1.43	<0.001
Operative intervention, n (%)	2 (6.67)	8 (80.00)	<0.001
In-hospital complications, n (%)	1 (3.33)	4 (40.00)	0.010
Length of hospital stay (days), Mean $\pm$ SD	4.21 $\pm$ 1.20	8.73 $\pm$ 2.24	<0.001

DISCUSSION

The present study included 40 patients with adhesive small bowel obstruction, with a mean age of 46.82 $\pm$ 13.64 years; 60.00% were males and 40.00% were females. The largest proportion of patients (35.00%) belonged to the 46–60-year age group. One previous abdominal operation was documented in 70.00% of patients, whereas 30.00% had undergone two or more

previous procedures, and 35.00% had a previous episode of intestinal obstruction. Khorshidi et al. (2019),^[7] studied 52 patients with adhesive small bowel obstruction and reported a higher mean age of 57.6 $\pm$ 11.4 years, with 34 patients (65.4%) being male. Their sex distribution was therefore similar to the male predominance of 60.00% observed in the present study. They also found that more than one previous laparotomy was significantly associated

with failure of conservative management ($p < 0.001$). In the present study, two or more previous abdominal operations were also more frequent among patients requiring surgery than among those successfully managed conservatively, 50.00% versus 23.33%, although the difference did not reach statistical significance ($p = 0.133$).

In the present study, conservative treatment was successful in 30 of 40 patients (75.00%), while 10 patients (25.00%) required operative management. The mean duration of symptoms was significantly longer among patients who required surgery than among those successfully managed conservatively (3.45 ± 1.21 versus 2.18 ± 0.92 days; $p = 0.010$). Similarly, the mean total leukocyte count was significantly higher in the operative group ($12.76 \pm 3.08 \times 10^3/\mu\text{L}$) than in the conservative group ($9.84 \pm 2.31 \times 10^3/\mu\text{L}$; $p = 0.017$). Aldemir et al,^[8] (2004) evaluated 180 patients with adhesive small bowel obstruction and reported that 120 patients (66.7%) were treated non-operatively while 60 (33.3%) underwent surgery. They found that a longer duration of symptoms and leukocytosis were both significantly associated with operative treatment ($p < 0.001$ for each). The conservative success rate of 75.00% in the present study was somewhat higher than the 66.7% reported by Aldemir et al., while the operative rate was correspondingly lower at 25.00% compared with 33.3%.

Radiological findings also differed according to final management in the present study. The mean maximum small bowel diameter was 4.11 ± 0.62 cm among patients requiring surgery compared with 3.42 ± 0.51 cm among conservatively managed patients ($p = 0.007$). Complete obstruction was identified in 50.00% of operative patients compared with 13.33% of conservatively managed patients ($p = 0.029$). Mesenteric edema was present in 60.00% versus 20.00% ($p = 0.041$), while free intraperitoneal fluid was observed in 50.00% versus 16.67%, respectively; however, the difference in free intraperitoneal fluid did not reach statistical significance ($p = 0.085$). Zielinski et al,^[9] (2010) evaluated 100 patients with small bowel obstruction and found that patients requiring operative exploration had higher frequencies of free intraperitoneal fluid (67% versus 31%) and mesenteric edema (67% versus 37%). On multivariate analysis, free intraperitoneal fluid had an odds ratio of 3.80 and mesenteric edema an odds ratio of 3.59 for operative exploration. Their combination of vomiting, absence of the small bowel feces sign, free fluid, and mesenteric edema provided 96% sensitivity and a 90% positive predictive value for the need for exploration. These findings were comparable with the present study, in which complete obstruction and mesenteric edema occurred significantly more frequently among surgically treated patients, while free intraperitoneal fluid was also more frequent in the operative group but did not achieve statistical significance.

The most important observation of the present study was the relationship between passage of water-

soluble contrast into the colon and successful conservative management. Contrast reached the colon within 24 hours in 30 patients (75.00%), of whom 28 (93.33%) were successfully managed conservatively and only 2 (6.67%) required surgery. In contrast, among 10 patients in whom contrast failed to reach the colon within 24 hours, 8 (80.00%) required operative treatment and only 2 (20.00%) improved conservatively ($p < 0.001$). Chen et al,^[10] (1998) prospectively evaluated 161 patients with adhesive intestinal obstruction and reported that contrast reached the colon within 24 hours in 112 patients (70%), all of whom were successfully treated non-operatively. Among the 49 patients (30%) without colonic contrast within 24 hours, 47 required surgery and only 2 were successfully managed non-operatively. The proportion demonstrating colonic contrast passage was therefore comparable between their study and ours (70% versus 75.00%), while both studies demonstrated a marked increase in operative requirement when contrast failed to reach the colon within 24 hours.

The timing of contrast progression provided additional information in the present study. Contrast reached the colon within 8 hours in 16 patients (40.00%), and all 16 (100.00%) were managed successfully without surgery. Among 14 patients in whom contrast reached the colon between >8 and 24 hours, 12 (85.71%) were managed conservatively and 2 (14.29%) required surgery. Conversely, 8 of 10 patients (80.00%) without colonic contrast at 24 hours underwent operative treatment ($p < 0.001$). Chung et al,^[11] (1996) prospectively studied 51 patients using a water-soluble contrast follow-through examination and classified obstruction according to whether contrast reached the caecum within 4 hours. Surgery was required in 17 of 19 patients (89.47%) classified as having significant obstruction, compared with only 1 of 32 patients (3.13%) in whom the contrast findings indicated insignificant obstruction ($p < 0.0001$). Although their assessment used a shorter 4-hour interval, the marked separation in operative requirement according to contrast progression was similar to the present finding of 0% operative intervention with contrast passage within 8 hours compared with 80.00% when colonic passage had not occurred within 24 hours.

In the present study, passage of contrast into the colon within 24 hours predicted successful conservative management with a sensitivity of 93.33%, specificity of 80.00%, positive predictive value of 93.33%, negative predictive value of 80.00%, and overall diagnostic accuracy of 90.00%. Farid et al,^[12] (2010) evaluated 110 patients with adhesive small bowel obstruction and used failure of Gastrografin to reach the colon within 24 hours as an indicator of complete obstruction and possible operative treatment. They reported a sensitivity of 87.5%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 97.9% for the Gastrografin follow-through in identifying patients requiring operative treatment. They

additionally reported operative rates of 14.5% in the Gastrografin group compared with 34.5% in the control group ($p=0.04$). Although the direction of classification differed because the present study calculated performance for prediction of conservative success, both studies demonstrated high diagnostic performance for 24-hour colonic contrast progression in determining subsequent management.

Recovery of gastrointestinal function was significantly earlier among patients demonstrating colonic contrast progression in the present study. The mean time to passage of flatus was 1.74 ± 0.64 days compared with 3.18 ± 1.08 days ($p=0.002$), while the mean time to first stool was 2.16 ± 0.73 versus 3.73 ± 1.10 days ($p=0.001$). Nasogastric tube removal occurred after 1.91 ± 0.68 versus 3.36 ± 1.12 days ($p=0.003$), and oral feeding was initiated after 2.38 ± 0.74 versus 4.64 ± 1.43 days ($p<0.001$) in patients with and without colonic contrast passage, respectively. Assalia et al,^[13] (1994) in a prospective randomized trial involving 107 episodes of adhesive partial small bowel obstruction, reported that the mean time to first stool was significantly shorter following Gastrografin administration than with conventional management (6.2 versus 23.3 hours; $p<0.00001$). They also found that mean hospital stay among conservatively responding patients decreased from 4.4 days in the control group to 2.2 days in the Gastrografin group ($p<0.00001$).

In the present study, operative intervention was required in only 2 of 30 patients (6.67%) when contrast reached the colon within 24 hours, compared with 8 of 10 patients (80.00%) when it failed to reach the colon ($p<0.001$). In-hospital complications were also less frequent among patients with colonic contrast passage (3.33% versus 40.00%; $p=0.010$), while the mean hospital stay was substantially shorter (4.21 ± 1.20 versus 8.73 ± 2.24 days; $p<0.001$). Scotté et al,^[14] (2017) conducted a multicenter randomized clinical trial involving 242 patients and reported operative intervention rates of 24% in the Gastrografin group and 20% in the saline group, while bowel resection rates were 8% and 4%, respectively. Their mean hospital stay was 3.8 days with Gastrografin and 3.5 days with saline ($p=0.19$), showing no significant therapeutic reduction in surgery or hospital stay from Gastrografin administration itself. This contrasts with the strong outcome differences observed in the present study according to whether contrast actually reached the colon; however, the present study evaluated contrast progression as a prognostic marker, rather than comparing administration of contrast against a randomized non-contrast control group.

CONCLUSION

Oral water-soluble contrast is a useful adjunct in the management of adhesive small bowel obstruction,

particularly for predicting the success of conservative treatment. Passage of contrast into the colon within 24 hours was strongly associated with non-operative resolution, earlier return of bowel function, and shorter hospital stay. Failure of contrast progression was associated with a higher likelihood of operative intervention and complications. Thus, a standardized oral contrast protocol can assist in timely and appropriate clinical decision-making in selected patients with adhesive small bowel obstruction.

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