



Use of oral iohexol in patients with adhesive small intestinal obstruction

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ABSTRACT

Objective: To evaluate the clinical impact of orally administered iohexol on the restoration of bowel passage and surgical outcomes in patients with adhesive small bowel obstruction.

Material and Methods: This retrospective study included 120 adult patients diagnosed with adhesive small bowel obstruction between August 2021 and January 2024. Patients were categorized according to the treatment strategy used in routine clinical practice: Conservative management with oral iohexol or standard conservative management alone. Demographic data, laboratory parameters, time to restoration of bowel passage, length of hospital stay, need for surgery, readmission, recurrence, morbidity, and mortality were analyzed and compared between groups. Restoration of bowel passage was defined by both radiological and clinical criteria and was assessed using abdominal radiographs obtained at 24-hour intervals and clinical improvement.

Results: Bowel passage was successfully restored with conservative treatment in 109 patients (90.8%), while 11 patients (9.2%) required surgical intervention. No statistically significant difference was observed between the groups regarding surgical requirement ($p=0.755$). However, patients who received oral iohexol achieved bowel passage significantly earlier than those managed without contrast [median 1 day [interquartile range (IQR) 1-2] vs. 4 days (IQR 3-5); $p<0.001$]. The corresponding mean times to bowel passage were 1.35 and 4.10 days, respectively. Mortality occurred only in surgically treated patients.

Conclusion: Oral iohexol appears to be a safe adjunct to conservative management in patients with adhesive small bowel obstruction and is associated with earlier restoration of bowel passage. Failure of bowel passage to resolve in the early period remains an important indicator for operative management. Although no statistically significant difference in surgical requirement was observed in this cohort, larger prospective randomized controlled studies are needed to further clarify the impact of oral iohexol on clinical outcomes in adhesive small bowel obstruction.

Keywords: Intestinal obstruction, iohexol, conservative treatment

INTRODUCTION

Adhesive small bowel obstruction (ASBO) is a common surgical emergency associated with substantial morbidity and significant mortality, particularly when surgical intervention is delayed (1). The adhesions causing such bowel obstructions are typically the footprints of previous abdominal surgical procedures (2,3). After surgery, the balance between fibrin formation and disintegration in the peritoneal cavity is effective in adhesion formation (4). ASBO is a condition in which mechanical intestinal obstruction occurs due to adhesions following abdominal surgery. Treatment is surgical or conservative (5). However, water-soluble contrast media has become a popular non-surgical approach to treatment.

The Bologna guidelines revised in 2018 recommend that conservative management of ASBO be proposed first in the absence of bowel pain or hemodynamic intolerance. It is stated that in cases of obstruction without signs of strangulation and persistent vomiting or combined computed tomography findings (free fluid, mesenteric oedema, small bowel faecal sign, de-vascularized bowel), patients can be safely treated with conservative treatment and NG tube decompression. It has been suggested that conservative treatment can be continued for up to 72 hours if there are no signs of strangulation or peritonitis. Still, if no improvement is observed, surgical treatment should be applied (3).

Iohexol, a water-soluble non-ionic radiopaque contrast agent, is widely used for diagnostic purposes and can be administered orally. In this study, we retrospectively

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evaluated outcomes of patients with ASBO who received oral iohexol compared with those who underwent standard conservative management.

MATERIAL and METHODS

Between August 2021 and January 2024, a total of 120 patients admitted with ASBO were retrospectively evaluated. Ethical permission was obtained from the Mersin University Medical Faculty Clinical Research Ethics Committee for this study with date 03/04/2024 and number 2024/349. Informed consent was waived due to the retrospective nature of the study and the use of anonymized data, as described in the appropriate section of the manuscript. The study was conducted in accordance with the Declaration of Helsinki.

Inclusion and Exclusion Criteria

Patients were included if they were over 18 years of age, had a history of previous abdominal surgery, and had a radiologically confirmed diagnosis of ASBO. Exclusion criteria comprised patients with clinical peritonitis, bowel ischemia, closed-loop obstruction on computed tomography, hemodynamic instability, or other obstructive pathologies requiring urgent surgery. Patients who did not attend follow-up or had incomplete data were also excluded.

Data Collection

Patient data were obtained from hospital records and telephone follow-up. The collected variables included age, sex, number of previous operations, indication (benign vs. malignant), and baseline leukocyte and C-reactive protein (CRP) values, treatment modality, treatment outcomes, recurrence, length of hospital stay (days), time to first oral intake, 30-day readmission, morbidity, and mortality were recorded.

Treatment Allocation and Intervention

Patients were divided into two groups according to whether oral iohexol was used in the management of ASBO. Given the retrospective design of the study, patients were not prospectively assigned to treatment groups for research purposes. During the study period, there was no institutional protocol regarding the routine use of oral iohexol in ASBO. The decision to administer oral iohexol was made by the treating surgeon according to clinical assessment and established practice patterns. Accordingly, treatment allocation was not based on predefined patient characteristics, disease severity, or other systematic clinical criteria. Rather, some surgeons routinely incorporated oral iohexol into conservative management based on their clinical experience, whereas others routinely preferred standard conservative treatment alone. Consequently, the study groups were defined retrospectively according to existing variations in clinical practice rather than being created specifically for the study.

In the iohexol group, 200 mL of water mixed with 100 mL of iohexol (300 mg/mL) was administered orally over 2-3 hours. Patients with gastric distension underwent nasogastric (NG) decompression prior to iohexol administration, and the NG tube was clamped. Bowel transit was evaluated using a plain abdominal radiograph obtained approximately 24 hours after oral contrast administration (Figure 1). Restoration of bowel passage was defined by both radiological and clinical criteria. Radiological improvement was defined as the presence of contrast material in the colon and regression of air-fluid levels (Figure 2). Clinical improvement was defined as the passage of flatus and stool, absence of vomiting and abdominal distension, and tolerance of oral intake without the need for NG decompression. Oral feeding was initiated only after both radiological and clinical criteria had been met, and NG tubes were subsequently removed. In patients without evidence of restored bowel passage at the initial assessment, follow-up was continued with plain abdominal radiographs obtained at 24-hour intervals.

Patients in the non-contrast group were also followed with plain abdominal radiographs obtained at 24-hour intervals. In this group, restoration of bowel passage was considered when regression of air-fluid levels was accompanied by the passage of flatus and stool, absence of vomiting and abdominal distension, and tolerance of oral intake. Patients who failed to tolerate oral intake or showed no evidence of clinical and radiological improvement were considered to have persistent obstruction.

Surgical intervention was performed in patients who developed acute abdominal symptoms, persistent vomiting, or in whom intestinal passage could not be established during follow-up (Figure 3).



Figure 1. Abdominal X-ray.

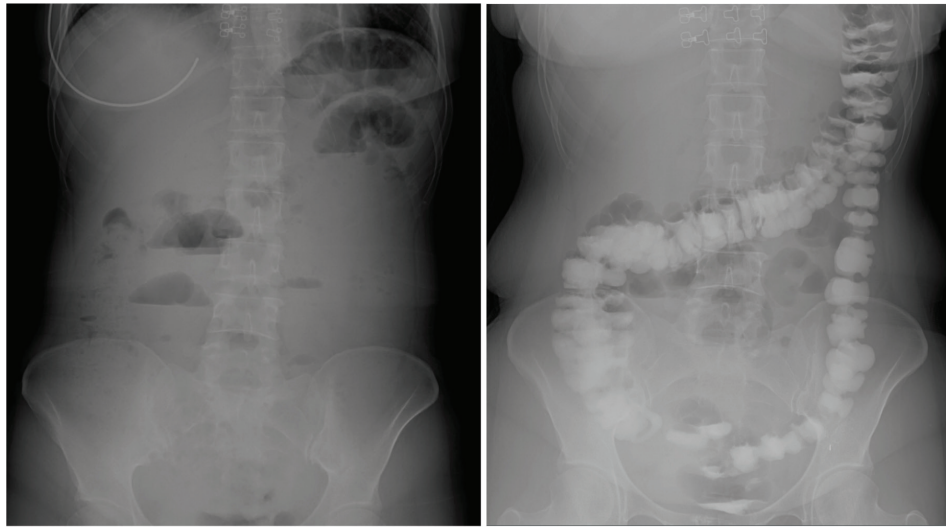


Figure 2. Abdominal X-ray before and after oral contrast, showing initial ileus and restoration of bowel passage following administration of oral contrast.

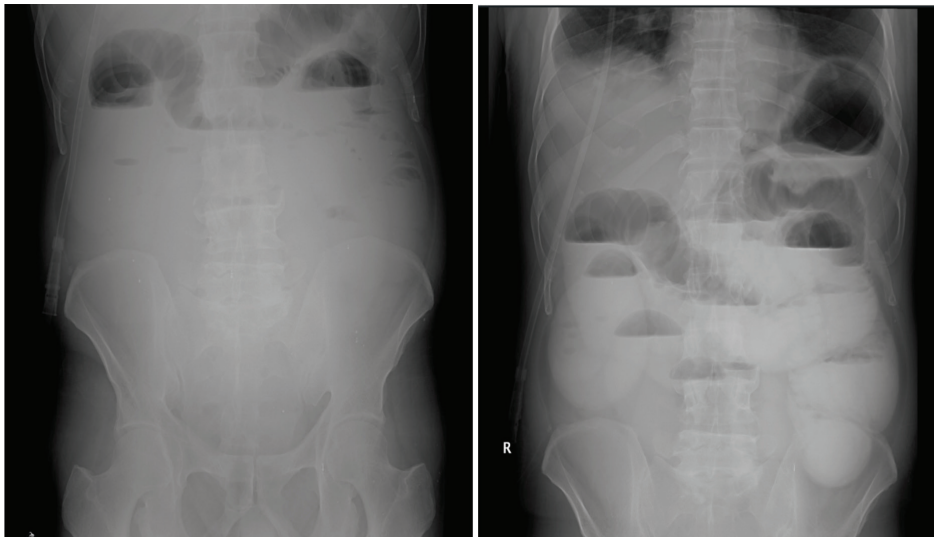


Figure 3. Oral contrast was administered, but bowel passage did not progress.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 21.0. Continuous variables with a normal distribution were expressed as mean $\pm$ standard deviation, whereas non-normally distributed variables were presented as median and interquartile range (IQR). The Independent Samples t-test was used for normally distributed continuous variables, while the Mann-Whitney U test was used for non-normally distributed data. Categorical variables were compared using the chi-square test or Fisher's exact test when expected counts were low. A p-value less than 0.05 is considered statistically significant.

RESULTS

A total of 120 patients were included in this retrospective analysis. Among them, 57 patients received oral iohexol, while 63 did not. Bowel passage was restored with conservative management in 109 patients (90.8%), whereas 11 patients (9.2%) required surgical intervention due to failure of non-operative treatment. No mortality occurred among patients managed conservatively.

Baseline characteristics, including age, sex, indication for previous surgery (benign vs. malignant), number of prior laparotomies, and admission laboratory values (white blood cell and CRP), were compared between groups (Tables 1, 2).

Table 1. Baseline characteristics of patients with ASBO (iohexol vs. control)

Variable	iohexol (+) (n=57)	iohexol (-) (n=63)	p-value
Age (years, mean ± SD)	63.26±16.21	59.97±17.07	0.282
Sex (male/female)	39/18	43/20	0.984
Number of prior laparotomies (IQR)	1 (1-3)	1 (1-4)	0.075
Malignancy/benign indication	15/42	23/40	0.231
Baseline WBC ($\times 10^3/\mu\text{L}$, mean ± SD)	10.63±2.93	11.24±3.35	0.291
Baseline CRP (mg/dL, mean ± SD)	3.73±4.65	4.29±6.93	0.925
Surgical requirement, n (%)	6 (10.5%)	5 (7.9%)	0.755

WBC: White blood cell, CRP: C-reactive protein, SD: Standard deviation, ASBO: Adhesive small bowel obstruction, IQR: Interquartile range.

Table 2. Logistic regression analysis for surgical requirement

Variable	OR [exp(B)]	95% CI	p-value
Age	1.014	0.973-1.057	0.532
WBC	0.869	0.7-1.079	0.203
CRP	1.048	0.964-1.140	0.272
Number of prior laparotomies	0.448	0.069-2.901	0.4
Oral contrast (yes/no)	1.172	0.314-4.374	0.814

OR: Odds ratio, CI: Confidence interval, WBC: White blood cell, CRP: C-reactive protein.

Among the 11 patients who underwent surgery, 6 were in the iohexol group and 5 were in the control group. There was no statistically significant difference in the need for surgery between patients who received oral contrast and those who did not ($p=0.755$).

Postoperative mortality occurred in three patients (2.5% of the total cohort and 27.3% of surgically treated patients). One patient in the iohexol group died due to intestinal ischemia and subsequent sepsis with multiorgan failure. The remaining two deaths occurred in the control group and were associated with advanced age and severe postoperative complications, including cardiopulmonary failure and septic shock secondary to delayed strangulation and bowel perforation.

In the subgroup of 109 patients successfully managed conservatively, 51 had received iohexol and 58 had not. Among the 109 patients successfully managed conservatively, the median time to restoration of bowel passage was significantly shorter in the iohexol group than in the control group [1 day (IQR, 1-2) vs. 4 days (IQR, 3-5), $p<0.001$]. The corresponding mean times to restoration of bowel passage were 1.35 ± 0.48 days and 4.10 ± 1.30 days, respectively.

Post-discharge outcomes were further analyzed among patients who did not undergo surgery. Early readmission within 30 days, recurrence, and follow-up duration were evaluated and are summarized in Table 3.

DISCUSSION

Adhesions that develop after surgery are the most common cause of mechanical intestinal obstruction (6,7). ASBO is a common cause of hospital admission, and although both conservative and surgical treatment options are available, conservative management has become increasingly common (8).

Water-soluble contrast agents are used in both diagnosis and conservative treatment. Gastrografin (meglumine and sodium diatrizoate) is the water-soluble contrast agent most frequently used in ASBO according to the literature (9,10).

Water-soluble contrast agents are believed to facilitate the resolution of ASBO through several mechanisms, including the creation of an osmotic gradient that promotes intraluminal fluid influx, reduction of bowel wall edema, and stimulation of intestinal motility (8,11). Although iohexol is hyperosmolar relative to plasma (approximately 670 mOsm/kg versus 290

Table 3. Comparative post-discharge outcomes in patients with adhesive small bowel obstruction managed non-operatively

	iohexol (+) (n=51)	iohexol (-) (n=58)	p-value
Early readmission (<30 days), n (%)	10 (19.6%)	8 (13.8%)	0.415
Recurrence, n (%)	4 (7.8%)	10 (17.2%)	0.112
Follow-up duration, months (mean ± SD)	14.04±7.73	10.53±8.70	0.002

SD: Standard deviation.

mOsm/kg), it is considered a low-osmolar contrast agent and is substantially less hyperosmolar than gastrografin (approximately 1900 mOsm/kg) (12,13). Despite this lower osmotic activity, patients receiving oral iohexol in our study experienced significantly earlier restoration of bowel passage. This finding suggests that mechanisms other than osmotic fluid shifts alone may contribute to its clinical efficacy (8,14).

Previous studies evaluating water-soluble contrast agents in ASBO have demonstrated earlier restoration of bowel passage after contrast administration (9,15). Similarly, in our study, oral iohexol was associated with significantly earlier restoration of bowel passage. A total of 300 mL of fluid, consisting of 200 mL water mixed with 100 mL iohexol, was administered orally. Most patients who were successfully managed without surgery achieved bowel passage within the first two days after contrast administration.

Several studies have reported that oral contrast administration not only accelerates bowel passage but may also reduce the need for surgery (16,17). In our study, the time to restoration of bowel passage was significantly shorter in patients receiving oral iohexol; however, no reduction in surgical requirement was observed. Although previous meta-analyses, including that of Koh et al. (8), have suggested that water-soluble contrast agents may reduce the need for surgery in ASBO, we did not observe such an effect (18). Several factors may explain this discrepancy. First, our study evaluated iohexol rather than gastrografin, and differences in osmolality may influence therapeutic efficacy. Second, the number of surgical events was small, limiting statistical power. Third, treatment allocation was not randomized and local surgical decision thresholds may have influenced operative management. Finally, differences in patient selection across studies may also contribute to the observed variation.

Most studies evaluating water-soluble contrast agents in ASBO have focused on gastrografin, a highly hyperosmolar ionic contrast medium (9,10). In contrast, the present study evaluated iohexol, a non-ionic low-osmolar contrast agent. Despite its substantially lower osmolality compared with gastrografin, iohexol was associated with a significantly shorter time to restoration of bowel passage. This finding suggests that the beneficial effects of oral contrast agents in ASBO may not be solely dependent on osmotic properties and supports further investigation of non-ionic contrast agents as potential alternatives to gastrografin.

Although the difference did not reach statistical significance, the recurrence rate was numerically lower in the iohexol group than in the control group (7.8% vs. 17.2%). This finding may suggest a potential effect of iohexol on bowel wall edema and subsequent bowel function. However, it should be interpreted cautiously given the limited sample size. Further prospective studies with

larger cohorts are needed to determine whether oral iohexol has a role in reducing recurrence following conservative management of ASBO.

Studies have shown that failure of contrast to reach the colon within 24 hours and failure of conservative treatment within 72 hours are associated with an increased need for operative intervention (19). In our study, bowel passage was restored within the first two days in nearly all patients who received oral contrast and did not require surgery. Early restoration of bowel passage may facilitate earlier recovery and return to normal activities. Moreover, persistence of obstruction beyond three days despite oral contrast administration may indicate the need for surgical intervention, allowing earlier operative management and potentially preventing complications related to delayed treatment. Delayed intervention has been associated with increased mortality (3,20).

Different methods have been used to predict which patients may benefit most from nonsurgical treatment. Computed tomography and ultrasonography have been reported to be useful in detecting intestinal strangulation and monitoring conservative treatment (21,22). With oral iohexol, the need for surgery can be monitored in the early period using only abdominal radiographs. This approach is simple, inexpensive, and widely available, potentially reducing the need for additional radiological examinations.

Although the overall number of patients requiring surgery was limited, postoperative mortality in this subgroup was notable and highlights the clinical severity of complicated ASBO. The three deaths occurred exclusively in elderly male patients (78-84 years), all of whom had severe complications such as bowel ischemia, perforation, or major postoperative cardiopulmonary events. These findings emphasize that delayed identification of patients who fail conservative management may lead to progression toward irreversible ischemia and systemic complications. Therefore, earlier recognition of non-responders to conservative treatment, particularly within the first 72 hours, may be critical in reducing morbidity and improving survival outcomes.

Study Limitations

This study has several limitations. First, its retrospective and non-randomized design introduces the possibility of selection bias, as treatment allocation reflected individual surgeon practice patterns rather than a standardized protocol. Second, restoration of bowel passage was defined using both radiological and clinical criteria. Although predefined assessment criteria were applied in both groups, the retrospective and non-blinded nature of the study may have introduced some degree of assessment bias, particularly regarding the timing of oral intake initiation. In addition, differences in follow-up duration between groups may

have influenced the evaluation of long-term outcomes such as recurrence. Finally, the relatively small number of surgical events limited the statistical power to detect differences in operative outcomes. Larger prospective randomized controlled studies are needed to confirm these findings.

CONCLUSION

In addition to its diagnostic utility, water-soluble iohexol can be safely administered orally in the conservative management of ASBO. Oral iohexol facilitates earlier restoration of bowel passage and shortens the time to return to normal daily activities. Furthermore, failure of bowel passage to resolve in the early period remains an important indicator for operative management. Although no statistically significant difference in surgical requirement was observed between the study groups, this finding should be interpreted in the context of the limited number of surgical events. Larger prospective randomized controlled studies are needed to provide more robust evidence and to further clarify the impact of oral iohexol on clinical outcomes in patients with ASBO.

Ethics

Ethics Committee Approval: Ethical permission was obtained from the Mersin University Medical Faculty Clinical Research Ethics Committee for this study with date 03/04/2024 and number 2024/349.

Informed Consent: Informed consent was waived due to the retrospective nature of the study and the use of anonymized data, as described in the appropriate section of the manuscript.

Footnotes

Author Contributions

Surgical and Medical Practices - G.E., G.D., S.S.; Concept - G.E., G.D., F.Y.; Design - G.E., G.D., S.S.; Data Collection or Processing - G.E., S.S., F.Y.; Analysis or Interpretation - G.E., G.D., S.S., F.Y.; Literature Search - F.E., S.S., F.Y.; Writing - F.E., S.S., F.Y.

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