Evaluating the Role of Oral Water Soluble Contrast in Adhesive Intestinal Obstruction among Children

Original Article

Mohamed Shaban Mohamed[1], Mohammed Abdel-Latif[1], Khaled Mohamed El-Asmar[2] and Gehad Ahmed[3]

Department of Pediatric Surgery, Faculty of medicine, [1]Helwan University, [2]Ain Shams University, [3]Department of General Surgery, faculty of Medicine, Helwan University

ABSTRACT

Background: Adhesive small intestinal obstruction (ASBO) is a common pediatric surgical emergency and a major cause of postoperative morbidity, requiring prompt diagnosis and management.

Aim: To evaluate the role of non-ionic oral water-soluble contrast (Iohexol) in ASBO among children.

Methods: A prospective comparative study on children with ASBO (November 2022–January 2024). After excluding peritonitis and perforation, all underwent 24-hour conservative management. Non-responders were simply randomized into two groups: non-contrast (group I) and contrast (group II) using Iohexol. Both groups were monitored by serial examinations and radiography.

Results: Thirty cases were enrolled, with 15 in each group. Group I had 9 males and 6 females (ages 1–13 9/12 years), and Group II had 10 males and 5 females (ages 1–12 11/12 years). In Group I, 5 cases (33.3%) required surgery. Median time till initial oral intake and hospital stay were 36 hours (31.5–39.5) and 115.5 hours (106–121.5), respectively. In Group II, contrast reached the cecum in 12 cases (80%). Median time till initial oral intake and hospital stay were 9 hours (6–12) and 60 hours (54–66), respectively. While success rates showed no significant difference ($P = 0.6817$), Group II had significantly shorter time till initial oral intake and hospital stay ($P < 0.001$). Recurrence rates were 30% (Group I) and 16.7% (Group II), with no significant difference ($P = 0.6241$).

Conclusion: Non-ionic water-soluble contrast helps avoid unnecessary surgeries and shortens hospital stays in ASBO, likely due to its diagnostic role.

Key Words: Adhesive small bowel obstruction, gastrogarfin, iohexol, omnipaque, pediatrics.

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Corresponding Author: Mohamed Shaban Abdelnaby Mohamed, Pediatric Surgery Department, Faculty of Medicine, Helwan University, Cairo, Egypt., **Tel.:** +2 01033220039, **E-mail**: mohamed_shaban_93_post@med.helwan.edu.eg

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INTRODUCTION

Adhesive small intestinal obstruction is a prevalent emergency condition in pediatric surgery, contributing to significant morbidity, particularly in neonates and young children. Common surgical procedures such as appendectomy, stoma formation and closure, Ladd's procedure and Nissen fundoplication often lead to the formation of adhesions, which can cause intestinal obstructions postoperatively[1].

ASBO in children leads to a rapid onset of fluid and electrolyte derangement, nutritional problems, risk of aspiration and sepsis[2]. Due to higher chances for complications, management of adhesive intestinal obstruction is a challenging task requiring utmost attention and neat health care[3].

Conservative management of adhesive small bowel obstruction (ASBO) typically involves keeping the patient nil per os (NPO), administering intravenous fluids, and utilizing nasogastric decompression. While surgical treatment may result in additional adhesions, prompting the need for alternative strategies[4]. Recent studies have explored the use of water-soluble contrast agents for both diagnostic and therapeutic purposes. For example, Gastrografin which is a hyperosmolar contrast media and iohexol which is low osmolar[5-7].

AIM OF THE STUDY

The aim of this study is to evaluate the role of omnipaque "Iohexol" in ASBO among children.

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PATIENTS AND METHODS

A prospective comparative study conducted from November 2022 to January 2024. All patients presented with clinical picture suggestive of ASBO were subjected to: detailed demographic data, surgical and medical history taking. Complete physical examination with emphasis on signs of bowel strangulation and/or peritonitis was done. Initial investigations included both laboratory "complete blood count, serum Na, K and creatinine" and radiologically "plain erect and supine abdominal x-rays". Excluded from the study cases who were presented with peritonitis or intestinal perforation.

Conservative management was initiated for 24 hours in the form of: nothing per os (NPO), full maintenance intravenous fluids (IVF), nasogastric tube and a single antibiotic dose of 3rd generation cephalosporines (50 mg/kg IV once. Maximum dose: 1 g/dose)[8]. All patients were followed up for 24 hours clinically and radiologically and those who did not improve were randomized by closed envelop method into 2 groups: non-contrast (group I) and contrast (group II).

In group I standard conservative management was continued for another 48 hours. Routine conservative management in group I would be considered successful when abdominal distension subsided, no naso-gastric tube output, open bowel and x-rays confirmed that.

In group II iohexol (omnipaque) water-soluble contrast was used. Dosage of omnipaque was age-dependent as in (Table 1). Non surgical management in group II would be considered successful when contrast reached the cecum within 24 hours. If vomiting occurred after administering the contrast, nasogastric tube was opened for 6 hours, then another trial of contrast administration was attempted. Additionally, a bolus of intravenous fluids (20 ml/kg) would be given to protect against the risk of diarrhea[9].

Table 1: Dose of omnipaque contrast according to age.[10]

Age in years	Amount of Omnipaque (ml)
≥ 1 year	
< 2 years	30
≥ 2 years	
< 3 years	40
≥ 3 years	
< 4 years	50
≥ 4 years	
< 6 years	60
≥ 6 years	
< 10 years	70
≥ 10 years	80

Both groups were monitored with serial examinations and radiography. Time till start of oral feeding and hospital stay would be evaluated in both study groups.

Patients with successful conservative management who discharged home were followed up after 1 week, 2 weeks and 1 month. Also they were guided to return to emergency room if a recurrent attack of adhesive intestinal obstruction occurred.

RESULTS

Thirty-nine Patients (23 males and 16 females) their ages ranged from 1 year to 14 years presented to emergency room with ASBO following different surgical procedures (32 open and 7 laparoscopic). The presenting symptoms were colicky abdominal pain, abdominal distension, persistent bilious and non bilious vomiting and absolute constipation as shown in (Table 2).

On examination, 3 patients showed signs of dehydration. Abdomen of all patients showed scar of previous surgery, tympanic resonance and exaggerated intestinal sounds. On doing plain abdominal x-rays; all erect showed multiple air–fluid levels with no air under diaphragm except in three patients and all supine showed dilated small bowel loops with non-distended colon.

Table 2: Percentage of admitted cases in relation to presenting symptoms.

Presenting symptoms	Percentage of patients
Colicky abdominal pain	100%
Abdominal distension	100%
Bilious vomiting	71.8%
Non bilious vomiting	28.2%
Absolute constipation	66.6%

Three patients (1 males and 2 females) were excluded during initial assessment. Their ages were 4,7$^{3/12}$ and 11 years. They showed tachycardia, signs of peritoneal irritation and elevated total leucocytic count. Their abdominal x-rays showed fixed bowel loop. They were resuscitated and explored. On exploration, 2 needed adhesolysis and 1 needed resection anastomosis.

Thirty-six patients were subjected to conservative management for 24 hours. They were assessed clinically for early detection of peritonitis and radiologically by plain abdominal x-rays; 6 hours after admission and nasogastric tube insertion and another one after 24 hours.

After first 24 hours, 6 patients (4 males and 2 females) improved and were excluded from the study. Their ages ranged from 2 years to 14 years. Their abdominal distension subsided with no naso-gastric tube output and became open bowel. Their x-rays showed distal aeration. They started oral feeding and discharged after reaching full oral intake.

30 patients (19 males and 11 females) of ASBO following different surgical procedures (27open and 3 laparoscopic) were enrolled in this study. Their ages ranged from 1 year to $13^{9/12}$ years. They were randomised into 2 equal groups:

Group I:

It included 15 patients (9 males and 6 females) of adhesive intestinal obstruction. Their ages ranged from 1 year to $13^{9/12}$ years. Conservative measures were continued for 48hours.

Ten patients improved with success rate of 66.7%. Their abdominal distension subsided with no naso-gastric tube output and became open bowel (Fig. 1).

Four patients did not improve without appearance of distal aeration in x-rays (Fig. 2). One patient developed tachycardia with signs of peritoneal irritation and fixed bowel loops in follow up x-rays. They were resuscitated and explored. On exploration, 4 cases needed adhesiolysis and one needed resection and anastomosis respectively.

During the follow up period, 3 of the succeeded 10 patients suffered from recurrent attack of ASBO after 1,2 and 3 months with recurrence rate of 30%. They were subjected to 24 hours routine conservative management; 1 case improved and the other 2 cases were subjected to contrast study. One improved after contrast and one needed exploration and adhesiolysis.

In this group, Time till start of oral intake ranged from 28 to 45 hours. Also gap between initial oral intake and tolerance to full oral intake was found ranging from 40 to 72 hours. Concerning hospital stay, it was found ranging from 92 to 129 hours.

Group II:

It included 15 patients (10 males and 5 females) of ASBO. Their ages ranged from 1 year to $12^{11/12}$ years. Omnipaque was administered and patients were followed up both clinically and radiologically by plain abdominal x-rays. After omnipaque administration 2 patients suffered from vomiting, so they were subjected to 6 hours gastric rest and resumed our study after that. For the first 5 of the enrolled patients, they did not suffer from diarrhea so no more boluses were given to the following patients before contrast administration.

Twelve patients improved with success rate of 80% (Fig. 1). The 3 failed cases were resuscitated and explored. On exploration, they needed adhesiolysis (Fig. 2).

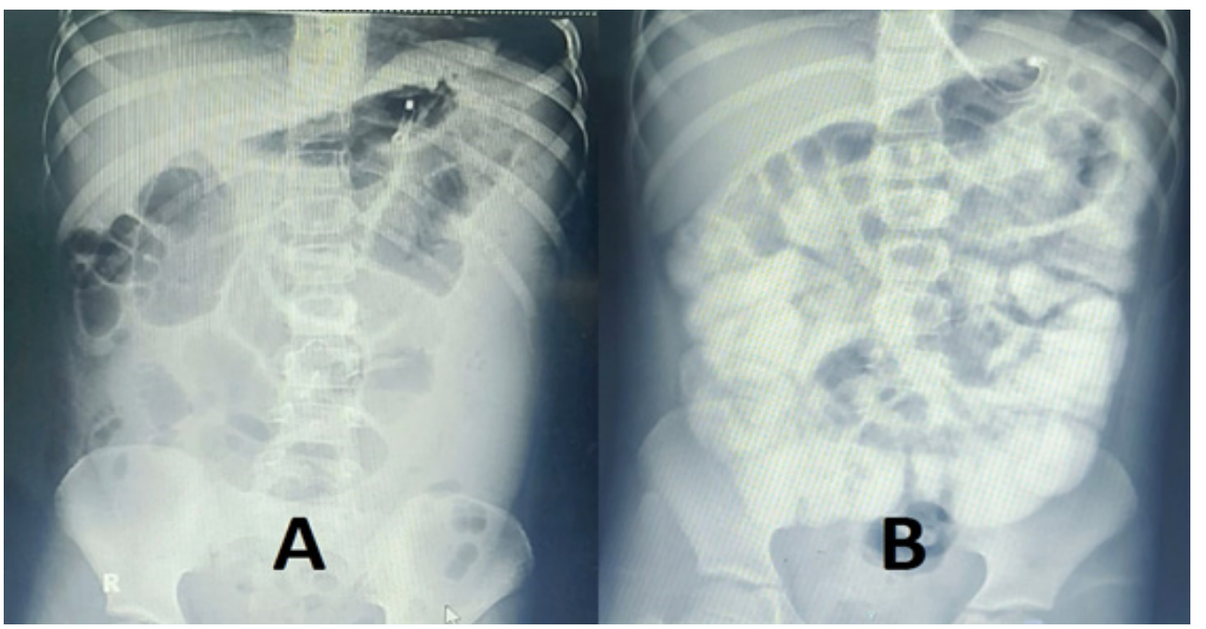

Fig. 1: Plain abdominal x-ray A) After 24 hours of routine conservative management. B) After 12 hrs of omnipaque oral contrast administration showing succeeded contrast role.

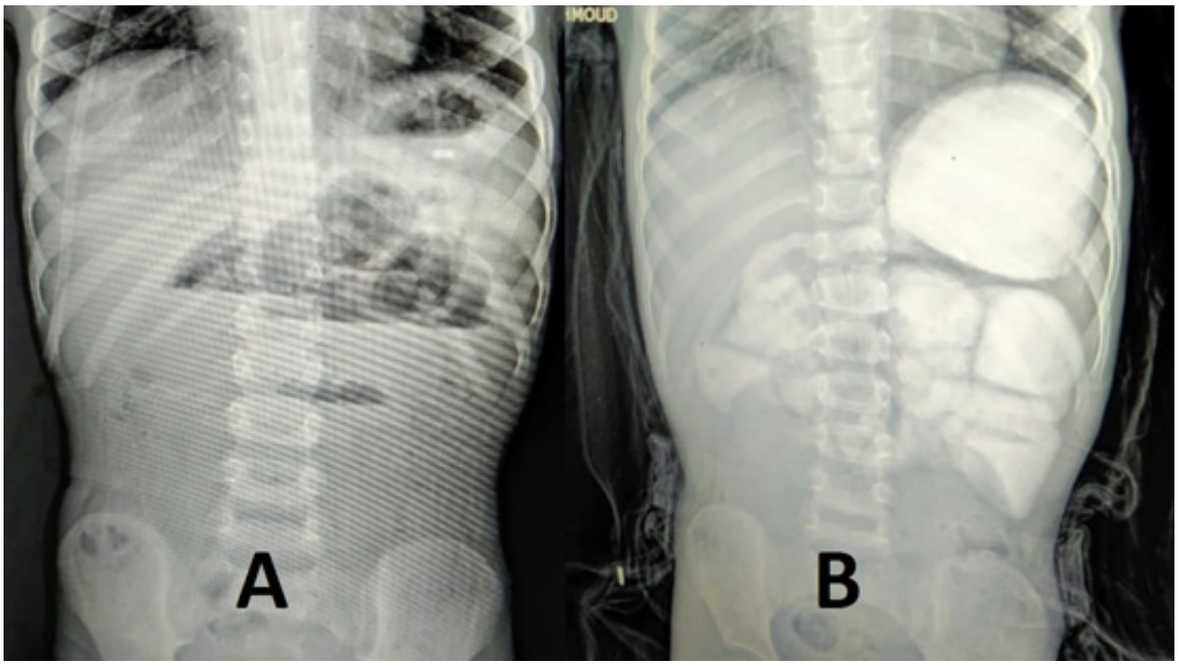

Fig. 2: Plain abdominal x-ray A) After 24 hours of routine conservative management. B) After 24 hrs of omnipaque oral contrast administration showing failed contrast role.

During the follow up period, 2 of the succeeded 12 patients in Group II suffered from recurrent attack of ASBO after 2 and 5 months with recurrence rate of 16.7%. They were improved after being subjected to 24 hours routine conservative management.

In this group, Time till start of oral intake ranged from 6 to 18 hours. Gap between initial oral intake and tolerance to full oral intake was found ranging from 20 to 54 hours. Concerning hospital stay, it was found ranging from 50 to 84 hours.

There was no statistically significant difference between group I and group II in relation to age, time since last surgery, success rate and recurrence rate with p value of 0.870, 0.148, 0.6817, 0.6241 respectively.

Time till start of oral feeding, gap between start of oral feeding and tolerance to full oral feeding and hospital stay were statistically significantly lower in group II than group I with p of $P<0.001$.

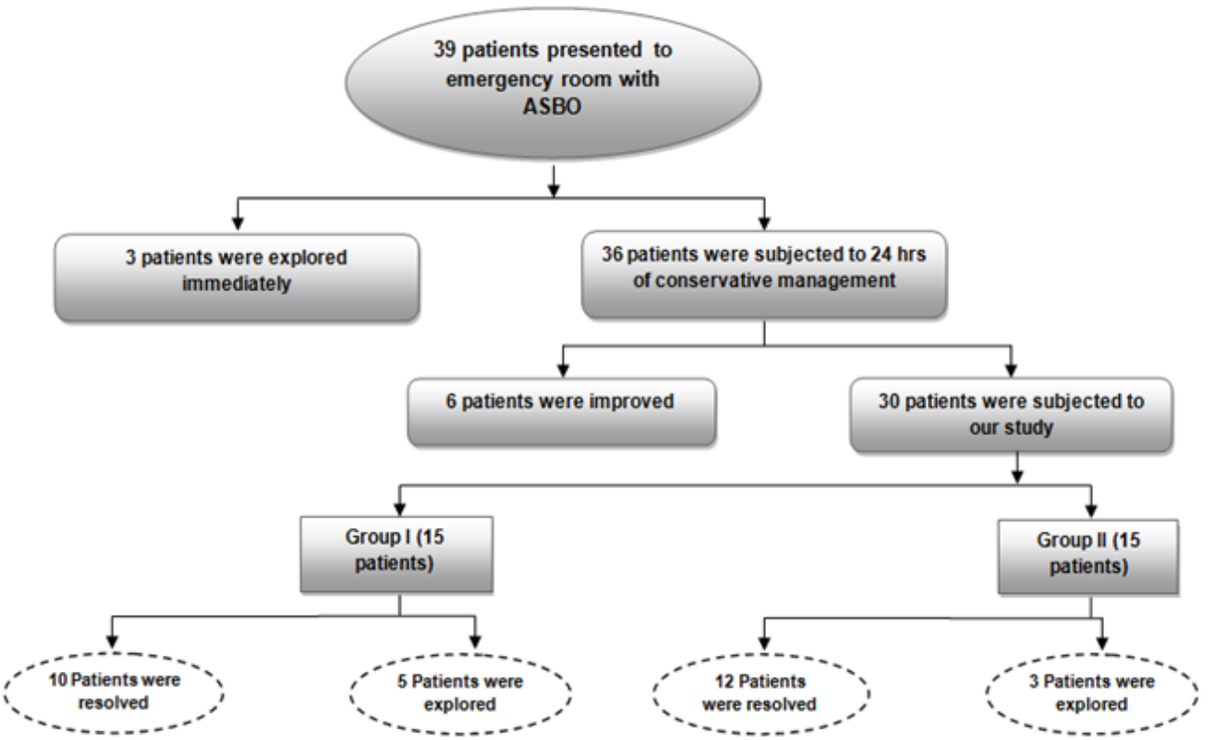

Fig. 3: A schematic presentation for management of the 39 cases of adhesive small bowel obstruction by routine and omnipaque management.

DISCUSSION

ASBO is a leading cause of surgical emergencies, particularly those requiring urgent intervention[11]. In the pediatric population, ASBO significantly contributes to postoperative morbidity. The increased risk of complications, such as intestinal injury during adhesiolysis, highlights the necessity of exploring alternative non-operative approaches that could reduce morbidity, shorten hospital stays, and ultimately lower the financial burden[12].

There is no consensus on the optimal duration of conservative management for ASBO. Most studies recommend a period of 3 to 5 days, while the Bologna guidelines suggest a 72-hour trial of non-operative treatment in the absence of complications[13]. In this study, the first 24 hours of conservative management successfully ruled out 6 patients with mild ASBO without exposing them to contrast agents or unnecessary surgical exploration. Thus, these initial 24 hours proved to be highly beneficial in managing mild cases of ASBO.

Gastrografin, a hyperosmolar oral contrast agent, is frequently used in managing adhesive intestinal obstruction. With an osmolarity approximately six times higher than that of extracellular fluid, Gastrografin draws fluid into the intestinal lumen, increasing the pressure gradient at obstruction sites. Additionally, this water-soluble contrast thins bowel contents, facilitating their passage and reducing bowel wall edema[5]. Omnipaque (Iohexol) is another water-soluble contrast agent. As a low-osmolar, non-ionic contrast medium, it minimizes water influx from the bowel mucosa, reducing dilution by enteric fluids and enhancing radiographic visualization of the bowel[7]. Due to its osmolarity, an intravenous bolus of Ringer's solution was initially administered in this study to prevent dehydration caused by Omnipaque. Notably, no patients experienced diarrhea, eliminating the need for further boluses. In contrast, hyperosmolar Gastrografin requires routine administration of intravenous Ringer's solution[14].

Linden et al. Conducted a study evaluating the role of Gastrografin in ASBO management. Their findings demonstrated that contrast administration offers both diagnostic and therapeutic benefits, reducing the need for surgery from 45% to 17%, shortening hospital stays from 6.2 to 3.6 days, and lowering costs[15]. Similarly, a study by ***Bonnard et al.*** showed that using Gastrografin increased the success rate of non-operative management from 50% to 75%[4]. ***Abdelkader H. et al.*** also reported a success rate of 66.6% with Gastrografin, alongside reduced hospital stays[16].

The use of Omnipaque contrast media in this study increased the success rate of conservative management from 66.7% to 80%, reduced the median hospital stay from 4.8 days to 2.5 days, and consequently lowered

costs. These results are comparable to those achieved with Gastrografin. Therefore, the therapeutic role of contrast media in managing ASBO, based on their physical characteristics, remains debatable, as both ionic hyperosmolar (Gastrografin) and non-ionic low-osmolar (Omnipaque) contrast media produced comparable outcomes. In this study, the role of Iohexol contrast media (Omnipaque) was particularly evident in the early detection of obstruction resolution. This early detection allowed for the timely initiation of oral feeding, reduced the interval between the start of oral feeding and achieving full oral intake, and ultimately shortened the hospital stay. These findings suggest that Iohexol serves a more pronounced diagnostic role rather than a therapeutic one in the management of ASBO.

This study was limited by the small sample size and short follow-up period. Future randomized controlled trials involving larger patient cohorts and extended follow-up durations are recommended to validate the role of Omnipaque in ASBO management.

CONCLUSION

The use of non-ionic water-soluble contrast in cases of ASBO is beneficial in avoiding unnecessary surgical interventions and reducing total hospital stay. Such benefits could be owed to its diagnostic rather than its active therapeutic role.

ETHICAL CONSIDERATIONS

Helwan University's Academic and Ethical Committee approved the study on September 6, 2022, under serial number 79-2022. Informed consent was obtained in writing from every participant. The research was carried out in accordance with the Declaration of Helsinki, the ethical code for human subject research established by the World Medical Association.

CONFLICT OF INTERESTS

There is no conflicts of interest.

AUTHOR CONTRIBUTIONS

1. M.S.A.M.: Conceptualization, Project administration, Data curation, Writing – original draft.

2. M.A.: Conceptualization, Formal Analysis, Validation, Visualization, Writing – review and editing.

3. K.M.E.: Data curation, Formal Analysis.

4. G.A.: Data curation, Formal Analysis, Writing – review and editing.

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تقييم دور الصبغه المعطاه عن طريق الفم و القابلة للذوبان في الماء في انسداد الأمعاء الناتج عن الإلتصاقات عند الأطفال

محمد شعبان عبدالنبي محمد[١]، محمد عبداللطيف[١]، خالد محمد الأسمر[٢] و جهاد أحمد[٣]

قسم جراحة الأطفال، كلية الطب، [١]جامعة حلوان، [٢]جامعة عين شمس، القاهره، مصر

[٣]قسم الجراحة العامة، كلية الطب، جامعة حلوان، القاهره، مصر

الخلفية: انسداد الأمعاء الدقيقة الناتج عن الالتصاقات هو حالة طارئة جراحية شائعة لدى الأطفال، ويُعد سببًا رئيسيًا للمراضة بعد الجراحة، مما يتطلب تشخيصًا وعلاجًا سريعًا.

الهدف: تقييم دور الصبغة الفموية القابلة للذوبان في الماء (Iohexol) في حالات انسداد الأمعاء الدقيقة الناتج عن الالتصاقات لدى الأطفال.

الطرق: أُجريت دراسة مقارنة مستقبلية على الأطفال المصابين بانسداد الأمعاء الدقيقة الناتج عن الالتصاقات من نوفمبر ٢٠٢٢ إلى يناير ٢٠٢٤. بعد استبعاد حالات التهاب الصفاق والانثقاب، خضع جميع المرضى لعلاج تحفظي لمدة ٢٤ ساعة. تم توزيع الأطفال الذين لم يستجيبوا عشوائيًا إلى مجموعتين: مجموعة بدون صبغة (المجموعة الأولى) ومجموعة باستخدام صبغة (المجموعة الثانية). تم متابعة المجموعتين عبر فحوصات متكررة وأشعه.

النتائج: تم تسجيل ٣٠ حالة، ١٥ في كل مجموعة. في المجموعة الأولى، احتاجت ٥ حالات (٣٣.٣%) إلى جراحة، وكان الوسيط الزمني لبدء التغذية الفموية والإقامة بالمستشفى ٣٦ ساعة و١١٥.٥ ساعة على التوالي. في المجموعة الثانية، وصلت الصبغة إلى الأعور في ١٢ حالة (٨٠%)، وكان الوسيط الزمني لبدء التغذية الفموية والإقامة بالمستشفى ٩ ساعات و٦٠ ساعة على التوالي. على الرغم من عدم وجود فرق إحصائي في معدلات النجاح ($P = 0.6817$)، إلا أن المجموعة الثانية أظهرت وقتًا أقصر لبدء التغذية والإقامة ($P < 0.001$). بلغت معدلات تكرار الانسداد ٣٠% في المجموعة الأولى و١٦.٧% في المجموعة الثانية، دون فرق إحصائي ($P = 0.6241$).

الاستنتاج: الصبغة الفموية غير الأيونية القابلة للذوبان في الماء تساهم في تجنب العمليات الجراحية غير الضرورية وتقليل فترة الإقامة في المستشفى في حالات انسداد الأمعاء الدقيقة اللاصق.