

Original Article

Surgical risk factors in clinical use of transnasal intestinal decompression for acute complete adhesive non-strangulated small bowel obstruction

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Abstract: Objective: To evaluate the clinical value of transnasal intestinal decompression tube placement in the treatment of acute complete adhesive non-strangulated small bowel obstruction (ACANSBO) and to identify independent risk factors associated with the need for surgical intervention. Methods: A retrospective analysis was conducted on 98 patients with ACANSBO treated at Tianjin Union Medical Center from January 2018 to December 2024. All patients underwent transnasal intestinal decompression combined with contrast imaging. Based on whether surgical treatment was required, patients were categorized into a surgical group (n = 38) and a non-surgical group (n = 60). Baseline characteristics and treatment-related variables were compared between the groups. Univariate and multivariate logistic regression analyses were performed to identify factors influencing the need for surgery, and a predictive model was subsequently developed. Results: Significant differences were observed between the surgical and non-surgical groups in the following factors: pre-treatment Acute Physiology And Chronic Health Evaluation II (APACHE II) score, age, presence of ascites during treatment, leukocyte count, duration of non-surgical treatment, time to resolution of air-fluid levels, and time to return of anal exhaust (all $P < 0.05$). Multivariate analysis identified ascites, age, APACHE II score, time to resolution of air-fluid levels, and time to return of anal exhaust as independent predictors of surgical requirement. The predictive model based on these variables demonstrated excellent discriminatory performance, with an area under the receiver operating characteristic curve (AUC) of 0.987. Conclusion: Transnasal intestinal decompression combined with contrast imaging is effective in the management of ACANSBO. Ascites, advanced age, higher APACHE II score, delayed resolution of air-fluid levels, and prolonged time to return of anal exhaust were independent risk factors for surgical intervention. These findings support individualized clinical decision-making to optimize outcome.

Keywords: Transnasal intestinal decompression tube, acute complete adhesive small bowel obstruction, influencing factors, surgical treatment, predictive performance

Introduction

Intestinal obstruction occurs in approximately 15% of all acute abdominal cases, ranking third after appendicitis and biliary tract diseases. Among these, small bowel obstruction (SBO) is the most common subtype, representing 60%-80% of cases [1, 2]. Without timely and appropriate management, SBO may progress to strangulation, bowel necrosis, severe systemic complications, and even death. The predominant etiologies of SBO include adhesions, intestinal neoplasms, inflammatory strictures, and inguinal hernias, with adhesive small bowel obstruction (ASBO) being the most prevalent.

Moreover, the incidence of ASBO has been increasing annually [3, 4].

Gastrointestinal decompression remains a cornerstone in the management of intestinal obstruction. Among various decompression methods, transnasal intestinal decompression tube placement has gained widespread acceptance as a first-line conservative treatment for SBO due to its high efficacy and broad applicability [5]. However, clinical observations have shown that some patients fail to respond adequately to transnasal decompression, and delayed surgical intervention in such cases may lead to disease progression and adverse out-

comes. Conversely, untimely surgical procedures may subject patients to unnecessary risks and complications. Thus, determining the optimal treatment approach and timing of surgery for SBO remains a topic of ongoing clinical debate [6, 7]. While previous studies have largely focused on the timing of surgical intervention, relatively few have addressed treatment recurrence [8]. Therefore, this study retrospectively analyzed the clinical outcomes of patients with SBO managed at our center. By evaluating factors associated with the efficacy of transnasal decompression and the necessity for surgical intervention, we aim to provide evidence-based insight to guide individualized treatment and optimize patient outcome.

Patients and methods

General information

A retrospective analysis was conducted on 98 patients with acute complete adhesive non-strangulated small bowel obstruction (ACAN-SBO) who were admitted to Tianjin Union Medical Center between January 2018 and December 2024. All patients underwent placement of a transnasal intestinal decompression tube combined with contrast imaging. Based on the requirement for surgical intervention, patients were divided into a surgical group ($n = 38$) and a non-surgical group ($n = 60$). Additionally, according to follow-up data regarding recurrence, patients were further categorized into recurrence and non-recurrence groups.

Inclusion criteria were as follows: Patients presenting with clinical symptoms of intestinal obstruction, including abdominal distension and abdominal pain, with or without nausea and vomiting; age between 18 and 80 years; Radiological confirmation of intestinal obstruction, excluding cases with narrow-type obstruction; first-time presentation with SBO.

Exclusion criteria included: Intestinal obstruction secondary to motility or vascular insufficiency; Incomplete or missing clinical data; Presence of medical disputes during hospitalization; Intestinal obstruction due to advanced malignancy deemed unsuitable for surgery; Patients who underwent more than one placement of a transnasal intestinal decompression tube. This study was approved by the Ethics Committee of Tianjin Union Medical Center (Ethics Approval Number: KYLL-2024-0078).

Treatment methods

Upon admission, all patients received standardized conservative management. This included complete cessation of oral intake until resolution of the obstruction and positioning in a semi-recumbent or lateral posture to alleviate abdominal distension. Anti-infective therapy was administered using second- or third-generation cephalosporins in combination with metronidazole. Antispasmodic and analgesic agents, such as anisodamine (654-2), were used to relieve intestinal spasm, while potent analgesics were used with caution to avoid masking clinical signs. To promote the recovery of intestinal motility, agents such as neostigmine or traditional Chinese medicine enemas were employed. Fluid and electrolyte balance was carefully maintained using daily infusions of 3000-4000 mL of crystalloid solution. Electrolyte levels were regularly monitored to ensure that serum sodium and potassium remained within normal ranges. Nutritional support was also provided as needed [9].

All patients underwent transnasal intestinal decompression tube placement according to the following procedure: (1) Pre-procedure preparation: Patients were fasted and underwent preliminary gastrointestinal decompression to minimize gastric volume. (2) Tube placement: Patients were positioned supine on the digital subtraction angiography (DSA) examination table. Surface anesthesia was achieved by spraying 2% lidocaine onto the mucosa of the nostrils, nasopharynx, and oropharynx. Under DSA guidance, a 260-cm stiff guidewire and a 5F catheter were introduced through one nostril. Using the guidewire-assisted technique, the catheter was advanced sequentially through the oropharynx, esophagus, stomach, duodenum, and the ligament of Treitz, ultimately reaching the proximal jejunum. The catheter was then withdrawn while maintaining the position of the guidewire within the intestinal tract. The external (proximal) end of the guidewire was threaded through the distal (head) end of the intestinal decompression tube and exited from the third to fifth lateral side holes. The matched inner guidewire of the decompression tube was retained in place to provide support. The 260-cm guidewire was secured, and the intestinal decompression tube was slowly advanced along it - together with the supporting inner guidewire - until the tube reached the jeju-

num. Both guidewires were then withdrawn, and contrast medium was injected through the decompression tube. Once the tip position was confirmed, 10-15 mL of sterile distilled water mixed with 1:10 contrast agent was injected into the anterior balloon. (3) Contrast imaging protocol: Meglumine diatrizoate contrast imaging was performed according to the following protocol: After initial decompression using the transnasal tube, 40 mL of meglumine diatrizoate (Compound Meglumine Diatrizoate Injection, approval number H43021120, Hunan Hansen Pharmaceutical Co., Ltd.) mixed with an equal volume of normal saline was administered through the tube for intestinal imaging. If the contrast medium reached the colon within 24 to 48 hours and clinical symptoms improved (e.g., passage of flatus, defecation, or diarrhea), conservative treatment was continued, with repeat imaging performed after 1 to 3 days. However, if the contrast agent failed to reach the colon within 24 to 48 hours or if symptoms worsened, surgical intervention was considered [10].

Outcome measures

Primary outcome measures: The primary outcome of this study was the short-term clinical response to conservative treatment, categorized as either successful conservative management or the need for surgical intervention. Successful conservative treatment was defined as a significant improvement in clinical symptoms following transnasal intestinal decompression, accompanied by spontaneous passage of flatus and stool. Patients who failed to respond to conservative treatment and subsequently underwent surgery were assigned to the surgical group.

Secondary outcome measures: Secondary outcomes included both short-term and long-term prognostic indicators. Short-term outcomes were based on the time required for the resolution of clinical symptoms, while long-term outcomes focused on the recurrence of SBO. Recurrence was defined as re-hospitalization due to intestinal obstruction after initial symptom resolution post-treatment. In addition, baseline clinical characteristics were analyzed to identify risk factors associated with the need for surgical intervention. Based on recurrence data, a predictive model was developed to evaluate the risk of obstruction recurrence.

Statistical analysis

All data were analyzed using SPSS version 23.0. Continuous variables with normal distribution were presented as mean $\pm$ standard deviation (Mean $\pm$ SD). For within-group comparisons for normally distributed data with homogeneous variance, paired t-tests were applied. Between-group comparisons were conducted using independent samples t-tests. Categorical data, expressed as counts and percentages [n (%)], were compared using the chi-square test. Multivariate logistic regression analysis was conducted to identify factors influencing the need for surgical intervention and the recurrence of intestinal obstruction. Based on the identified factors, predictive models were established. Model performance was evaluated using receiver operating characteristic (ROC) curve analysis. A *p*-value less than 0.05 was considered significant.

Results

Baseline characteristics of the two groups

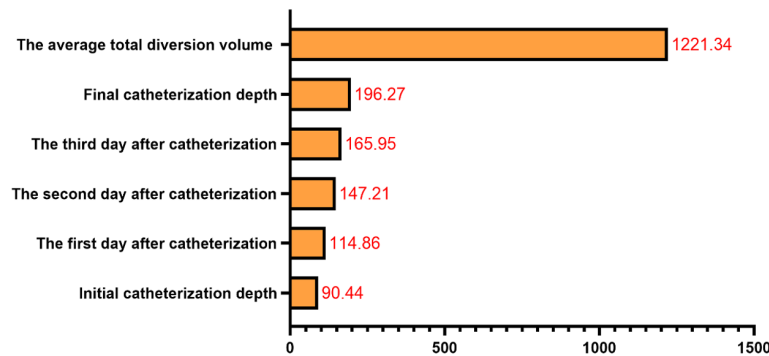
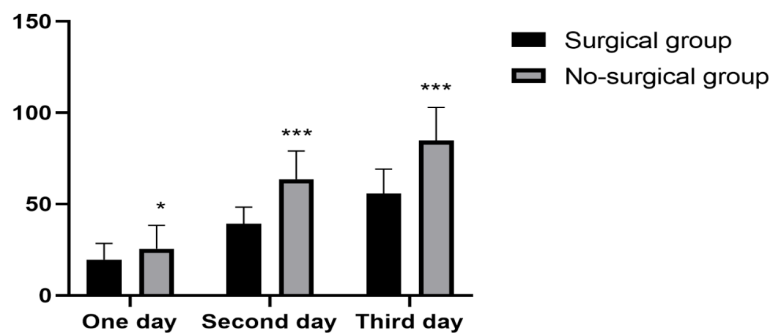
A total of 98 patients with acute adhesive small bowel obstruction were included in this study. The mean age was 67.8 ± 3.5 years (range: 34-75 years), and the average duration of disease was 78.5 days (range: 1-100 days). Among the patients, 61 were male and 37 were female. No significant differences were observed in baseline etiology between the surgical and non-surgical groups. Detailed data are presented in **Table 1**.

Comparison of intestinal decompression tube placement findings between groups

All 98 patients in this study successfully underwent transnasal intestinal decompression tube placement under gastroscopic guidance. The mean initial insertion depth was 90.04 cm. On postoperative days 1, 2, and 3, the mean tube depths were 114.86 cm, 147.21 cm, and 165.95 cm, respectively, with a final average insertion depth of 196.27 cm. The average cumulative drainage volume within the first three days was 1221.34 mL. There was no significant difference in the initial tube insertion depth between the surgical and non-surgical groups. However, the non-surgical group exhibited significantly greater tube depths on days 1, 2, and 3 compared to the surgical group (all *P* <

Table 1. Comparison of baseline data between the two groups of patients

Group	Course of the disease	Gender	Surgical site			
			Gastrointestinal tract	Appendix	Gynecological surgery	Liver and gallbladder
Non-surgical group (n = 60)	36.0±7.8	42/19	39	15	5	2
Surgical group (n = 38)	35.5±8.0	20/18	20	10	6	2
t/ χ^2	0.306	2.632			0.893	
P	0.760	0.105			0.442	

**Figure 1.** Correlation analysis of catheterization factors in the patient cohort.**Figure 2.** Comparison of catheter insertion depth between the two groups of patients during the first three days. Compared to the surgical group, *P < 0.05, ***P < 0.001.

0.05). Detailed data are shown in **Figures 1 and 2**.

Univariate analysis of transnasal intestinal decompression tube treatment in small bowel obstruction

All 98 patients completed treatment and were discharged after clinical improvement. Of these, 60 patients responded successfully to conservative treatment, while 38 required surgical intervention due to treatment failure. Univariate analysis revealed significant differences between the two groups in the following findings: Acute Physiology and Chronic Health Evaluation II (APACHE II) score, age, presence of ascites during treatment, white blood cell

count, duration of non-surgical treatment, time to resolution of air-fluid levels, and time to return of anal exhaust (all P < 0.05). Subsequent multivariate analysis identified ascites, age, APACHE II score, time to disappearance of air-fluid levels, and time to return of anal exhaust as independent predictors of the need for surgical intervention. Detailed results are shown in **Tables 2 and 3** and illustrated in **Figure 3**.

Performance evaluation of the predictive model for surgical intervention after conservative treatment of small bowel obstruction

A predictive model for determining the need for surgical intervention after conservative treatment of SBO was established based on the presence of ascites, age, APACHE II score, time to resolution of air-fluid levels, and time to

return of anal exhaust. The model demonstrated excellent performance with an area under the receiver operating characteristic (ROC) curve (AUC) of 0.964 (95% CI: 0.926-0.987). Model calibration was evaluated using the Hosmer-Lemeshow goodness-of-fit test, yielding a chi-square value of 5.926 (P = 0.656), indicating good fit and stability. Details are presented in **Figure 4**.

Establishment and evaluation of a logistic regression model for predicting surgical intervention in small bowel obstruction

Based on the multivariate analysis results presented in **Table 3**, a logistic regression model was established as follows: $P = 1/(1 + e^X)$ ($X =$

Table 2. Univariate analysis of factors associated with successful conservative treatment in small intestinal obstruction

Indicator	Non-surgical group (n = 60)	Surgical group (n = 38)	t/ χ^2	P
Age (years)	58.7±5.8	65.7±6.2	5.668	< 0.001
Admission ADL classification			0.156	0.658
Grade I/II	32	22		
Grade III/IV	28	16		
Fever	9	7	0.199	0.655
History of abdominal surgery	51	34	0.405	0.525
APACHEII score	13.8±2.0	16.4±2.8	5.357	< 0.001
Peritoneal effusion during treatment	12	16	5.571	0.183
White blood cell count ($\times 10^9$)	8.65±1.23	10.9±1.20	8.906	< 0.001
Platelet count ($\times 10^9$)	135.8±35.8	143.5±37.5	1.019	0.311
Albumin (g/L)	36.0±3.5	36.2±3.3	0.282	0.779
Duration of non-surgical treatment (d)	6.8±1.2	7.9±1.1	4.564	< 0.001
Time to disappearance of air-fluid levels (d)	2.2±0.9	3.1±1.3	4.050	< 0.001
Time to return of anal exhaust (d)	3.5±1.1	5.0±1.2	7.620	< 0.001
Blood potassium concentration (mmol/L)	4.3±0.8	4.4±0.9	0.574	0.567
Serum chloride concentration (mmol/L)	127.5±8.9	128.4±9.0	0.486	0.623
Serum amylase (U/L)	50.8±4.3	51.3±4.0	0.576	0.566

Notes: APACHE II, Acute Physiology and Chronic Health Evaluation II; ADL, Activity of Daily Living Scale.

Table 3. Multivariate analysis of factors influencing successful conservative treatment in small intestinal obstruction

Factor	β	OR	95% CI	P
Age	0.150	1.860	1.711-2.041	0.028
Presence of ascites	0.419	1.657	1.110-3.933	0.046
APACHE II score	1.833	1.680	1.436-1.812	0.01
Time to disappearance of air-fluid levels	0.866	6.250	1.893-20.833	0.003
Time to return of anal exhaust	2.006	7.407	2.500-22.220	< 0.001

Notes: OR, odds ratio; CI, confidence interval.

$3.820 - 0.052x_3 - 0.135x_4 - 0.159x_5$). Using a probability threshold of 0.5, patients with $P \geq 0.5$ were classified as requiring surgical treatment, while those with $P < 0.5$ were considered suitable for continued conservative treatment.

When applied to the study cohort, the model achieved an overall prediction accuracy of 92.85% (91/98), with a specificity of 92.1% (35/38) and sensitivity of 93.3% (56/60); see **Table 4**.

Follow-up of patients with small bowel obstruction after treatment (Figure 5)

All 98 patients showed clinical improvement and were discharged after treatment. During

the follow-up period, 20 patients experienced recurrence of SBO, while the remaining 78 patients remained recurrence-free.

Univariate analysis of recurrence in patients with small bowel obstruction after treatment (Table 5)

Univariate analysis revealed significant differences between the recurrence and the non-recurrence groups in white blood cell count, catheter insertion depth on day 1, final catheter insertion depth, and duration of catheter placement (all $P < 0.05$). No significant differences were observed for other evaluated variables.

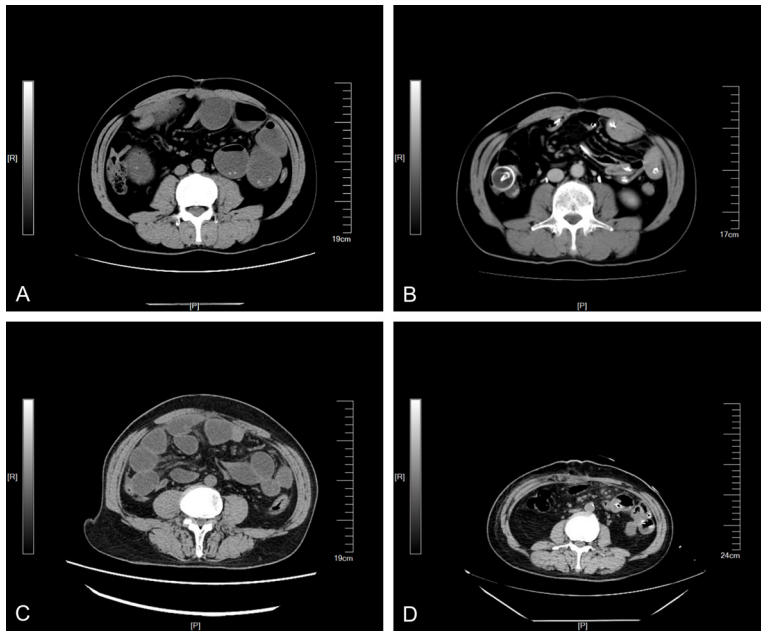


Figure 3. Abdominal CT images of patients in the surgical and non-surgical groups before and after treatment. A, C. Impact chart of patients with small intestinal obstruction. B. Successful resolution of small bowel obstruction following transnasal intestinal decompression tube placement; D. Indication for surgical intervention when conservative transnasal decompression fails to resolve the obstruction.

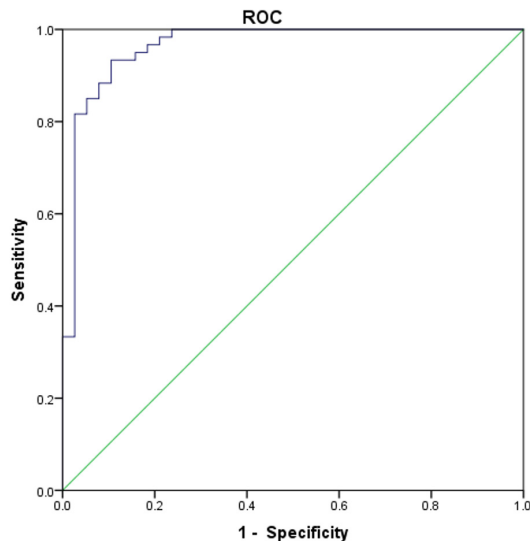


Figure 4. Predictive model for conservative treatment of small bowel obstruction. Note: AUC, Area under Curve.

Multivariate analysis of factors influencing recurrence in patients with small bowel obstruction after treatment (Table 6)

Multivariate logistic regression identified white blood cell count, catheter insertion depth on

day 1, final catheter insertion depth, and duration of catheter placement as significant factors influencing the recurrence of SBO after treatment.

Discussion

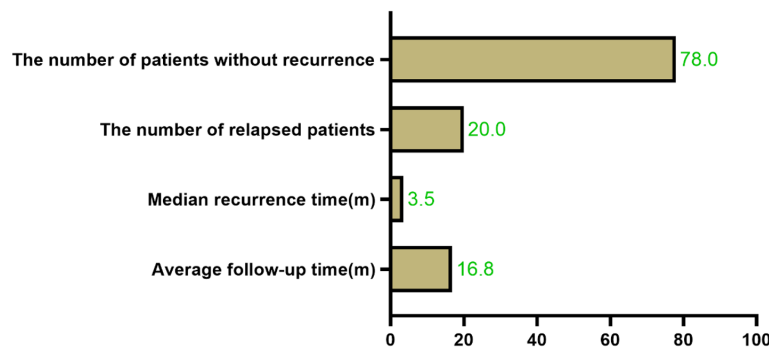
Adhesive small bowel obstruction (ASBO) is caused by fibrous adhesions forming between the peritoneum and adjacent intra-abdominal tissues. These adhesions most commonly arise as a result of postoperative healing, infections, trauma, or other pathologic processes [11, 12]. Once adhesions develop within the small intestine, normal peristalsis and intestinal function become significantly impaired, leading to obstruction of the passage of intestinal contents and triggering a series of complex clinical symptoms.

Without timely intervention, mild cases may progress to intestinal dysfunction, while severe cases can result in intestinal necrosis, infection, or even shock, posing a potentially fatal risk [13, 14].

Gastrointestinal decompression remains a cornerstone of the management of SBO. The intestinal decompression tube offers advantages due to its ability to be inserted deeper into the small intestine and advance further along with intestinal peristalsis, thus facilitating more effective drainage of intestinal contents and enhancing symptom relief [15]. Previous studies have reported clinical success rates exceeding 80% for intestinal decompression tube therapy. However, in our cohort, the effective rate was 61.5%, which is comparatively lower than those reports [16]. This discrepancy may be attributed to regional differences in indications for tube placement and variability in patient severity. Similar observations have been reported by previous studies [17]. Moreover, failure of conservative intestinal decompression may delay appropriate intervention and result in missed therapeutic windows, thereby worsening patient outcomes. Therefore, effective and proactive prediction of the success of conservative treatment is of

Table 4. Comparison between predicted and actual surgical intervention in patients with small intestinal obstruction

Actual surgery	Predicted surgery		Total
	No	Yes	
No	35	4	39
Yes	3	56	59
Total	38	60	98

**Figure 5.** Follow-up outcomes of patients.

great significance for improving patient outcome.

Previous studies have demonstrated that patients' baseline characteristics and disease severity significantly influence the success of conservative treatment. In this study, we identified ascites, age, APACHE II score, time to resolution of air-fluid levels, and time to return of anal exhaust as independent predictors of conservative treatment outcome. The presence of ascites is often associated with impaired intestinal motility and increased intraluminal pressure, exacerbating the severity of bowel obstruction. Moreover, ascites may indicate underlying intestinal ischemia, perforation, or inflammation. Patient age is another critical factor that warrants attention. Clinically, age correlates closely with overall health status, immune competence, and treatment tolerance. Elderly patients often exhibit more complex and variable presentations of SBO due to the progressive decline of physiologic functions. Their intestinal recovery tends to be slower, and they are at greater risk of developing complications, thereby complicating management. The APACHE II score, widely used in intensive care settings, provides a comprehensive assessment of disease severity and prognosis by integrating multiple physiologic variables. It enables clinicians to rapidly evaluate

disease progression and tailor treatment strategies. In the context of SBO, higher APACHE II scores often indicate more severe disease and elevated mortality risk. Additionally, since age constitutes a component of the APACHE II score, these factors may exert a synergistic influence on patient outcomes. The disappearance of air-fluid levels is a common radiologic finding in patients with SBO. The air-fluid level refers to the distinct interface between liquid and gas seen on X-ray or CT imaging. Under normal conditions, a certain amount of gas is present within the intestinal lumen. However, in cases of SBO, the air-fluid levels often diminish or disappear. This phenomenon reflects

impaired evacuation of intestinal gas and indicates severe dysfunction of intestinal motility. Consequently, changes in air-fluid levels serve as an important radiographic marker for assessing the severity of SBO. Additionally, the time to return of anal exhaust is a critical clinical indicator of recovery following treatment. The restoration of the anal gas passage is widely recognized as a key sign of recovering intestinal function, and its timing closely correlates with patient prognosis. A shorter duration of return to anal exhaust generally predicts faster recovery, according to previous research. Furthermore, the predictive model constructed using these variables demonstrated robust predictive accuracy and stability, underscoring its substantial clinical applicability. These findings align with conclusions reported in prior studies [18-22].

SBO is characterized by a high recurrence rate. Previous studies have reported recurrence rates of approximately 20%, which is consistent with the 22% observed in our patient cohort [23, 24]. Further analyses have identified hematological values and catheter-related factors as significant predictors of SBO recurrence. Consistent with these findings, our study demonstrated that white blood cell count, catheter insertion depth on day 1, final catheter insertion depth, and duration of catheter placement were influential factors for recurrence.

Table 5. Univariate analysis of factors associated with recurrence after treatment of small intestinal obstruction

Indicator	Non-recurrence group (n = 78)	Recurrence group (n = 20)	t/ χ^2	P
Age (years)	60.9±5.5	61.1±5.3	0.146	0.884
Admission ADL classification			0.490	0.484
Grade I/II	48	6		
Grade III/IV	30	14		
Fever	12	4	0.025	0.618
History of abdominal surgery	70	15	1.863	0.172
APACHE II score	14.9±2.5	15.2±2.4	0.483	0.631
Peritoneal effusion during treatment	20	8	1.608	0.205
White blood cell count ($\times 10^9$)	7.54±1.04	11.2±1.19	13.630	< 0.001
Platelet count ($\times 10^9$)	139.7±34.7	142.4±36.4	0.307	0.759
Albumin (g/L)	36.1±3.4	36.0±3.2	0.119	0.906
Duration of non-surgical treatment (d)	7.2±1.1	7.5±1.2	1.068	0.288
Time to disappearance of air-fluid levels (d)	2.9±1.0	3.0±1.1	0.391	0.697
Time to return of anal exhaust (d)	4.4±1.2	4.6±1.3	0.653	0.515
Initial catheter insertion depth (cm)	35.6±8.9	26.7±7.5	4.109	< 0.001
Final catheter insertion depth (cm)	185.7±16.8	138.5±17.0	11.180	< 0.001
Catheterization duration (d)	15.6±3.2	23.1±2.9	9.521	< 0.001
Blood potassium concentration (mmol/L)	4.5±0.9	4.6±1.0	0.433	0.666
Serum chloride concentration (mmol/L)	128.3±8.5	129.6±9.2	0.600	0.550
Serum amylase (U/L)	51.8±4.2	51.0±4.2	0.760	0.449

Notes: ADL, Activity of Daily Living; APACHE II, Acute Physiology and Chronic Health Evaluation II.

Table 6. Multivariate analysis of factors associated with recurrence after treatment of small intestinal obstruction

Factor	β	OR	95% CI	P
White blood cell count	4.476	3.873	1.602-16.044	0.016
Initial catheter insertion depth	0.474	1.921	1.001-2.049	0.035
Final catheter insertion depth	0.461	1.724	1.075-2.242	0.044
Time to disappearance of air-fluid levels	3.284	1.335	1.126-1.467	0.032

Notes: OR, Odds Ratio; CI, Confidence Interval.

The underlying mechanisms are as follows: elevated white blood cell counts generally reflect bacterial infection and intestinal inflammation. Counts exceeding normal ranges often reflect disease progression and a higher risk of recurrence. Catheter insertion depth on day 1 and final insertion depth are critical values that directly affect treatment efficacy and patient recovery. The insertion depth refers to the length of catheter advancement from the external entry point into the intestine, while the final insertion depth indicates the catheter's maintained position at the conclusion of treatment. These factors not only affect catheter functionality but also influence patient comfort and

postoperative recovery. Both excessively long and insufficient insertion depths can negatively impact recovery outcomes. Additionally, prolonged catheter indwelling increases the risk of infection, whereas insufficient indwelling duration may compromise effective symptom relief. Therefore, clinicians must carefully balance catheter placement duration to optimize timing for insertion and removal, thereby enhancing treatment success and reducing recurrence risk. These conclusions are consistent with previous studies [25, 26].

In summary, transnasal intestinal decompression tube placement demonstrates favorable

therapeutic efficacy in the management of SBO. Clinical outcomes are influenced by multiple factors, which can be integrated into predictive models with strong practical applicability. Furthermore, identifying factors related to the recurrence of SBO holds significant clinical relevance. However, this study is limited by a small sample size, single-center design, and heterogeneity in patient condition severity and nested cases. Therefore, multicenter studies with larger sample sizes are needed to further validate these findings. Moreover, the relatively short follow-up period necessitates extended longitudinal studies to further strengthen the conclusions. Finally, due to the very low incidence of catheter-related mucosal injury and aspiration pneumonia observed in this cohort, no related statistical analysis or evaluation was performed. Future research will focus on refining catheter assessment methods for nasal decompression and externally validating the predictive model to enhance its clinical applicability.

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Disclosure of conflict of interest

None.

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