

# Fluoroscopy-guided long intestinal tube placement for the treatment of malignant bowel obstruction

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**Abstract.** The aim of the present study was to investigate the safety and efficacy of long intestinal tube placement under fluoroscopic guidance for the treatment of malignant bowel obstruction (MBO). The cases of 74 patients with MBO who underwent long intestinal tube placement under fluoroscopic guidance during the period between June 2015 and October 2017 were reviewed. The clinical characteristics were retrospectively analysed with respect to efficacy, safety and outcome. Long intestinal tube placement was successfully completed in all 74 patients. The mean time required for tube placement was  $31.09 \pm 16.25$  min and the mean insertion depth of the tube was  $153 \pm 39$  cm. In 58 cases, the symptoms of abdominal pain, abdominal bloating and vomiting were greatly improved following 1-3 days of tube decompression. The symptoms of the remaining 16 patients were not effectively relieved following decompression. No serious complications were observed in any patients. Overall, for patients with severe MBO, long intestinal tube placement under fluoroscopic guidance appears to be an effective and safe treatment, and it may improve quality of life.

## Introduction

Malignant bowel obstruction (MBO) is a common complication of advanced cancer of gastrointestinal or gynaecological origin and can result in a potentially life-threatening emergency, including rupture of the intestine, sepsis and multi-organ failure, without timely and effective treatment (1,2). However, due to colonic distension with faecal loading, dehydration, electrolyte imbalance, oedema of the intestinal dissepiment, localised tumours and a poor general condition in elderly

patients, emergency colonic surgery for acute obstruction is associated with a high mortality rate of 15-34%, which is significantly higher than the mortality rates following elective surgery (3,4).

Patients with MBO are commonly at a late stage of cancer, and a number are unable to tolerate surgery (2). In addition, due to the potentially distant obstruction position and severe bowel stenosis, it is difficult to achieve crossing of the obstruction site and sufficient drainage using the traditional nasogastric tube and gastroscopy-assisted catheterization treatment method (5-7).

Long intestinal tube decompression can alleviate the symptoms of obstruction effectively by aspiration of the intestinal contents. In addition, in certain cases, the long intestinal tube can pass through the severe obstruction of the intestine and result in a correction of intestinal kinking, thus improving quality of life (2,5). The aim of the present study was to investigate the safety and efficacy of long intestinal tube decompression under fluoroscopic guidance for the treatment of MBO.

## Patients and methods

**Patients.** The cases of 74 patients with small intestinal MBO who were treated at The Sixth Affiliated Hospital of Sun Yat-Sen University (Guangzhou, China) during the period between June 2015 and October 2017 were reviewed. All the patients were diagnosed by clinical and pathological diagnostic methods, as well as plain X-ray radiography and abdominal computed tomography (CT) scans.

The inclusion criteria were as follows: Definite diagnosis of small intestinal obstruction by abdominal CT scan or plain X-ray radiography, obstruction caused by a histologically-confirmed malignant tumour, refractory nausea and vomiting, and absence of dysphagia, suffocation and other symptoms. Patients with any of the following characteristics were excluded: Unconsciousness, severe nasopharyngeal or oesophageal diseases, multiple organ dysfunction, including of the heart, liver or lungs, gastrointestinal perforation and active bleeding.

Approval for the study protocol was obtained from the Institutional Ethics Review Board of The Sixth Affiliated Hospital of Sun Yat-Sen University. Written informed consent for the treatment was obtained from each patient prior to long intestinal tube placement.

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**Instruments.** A hydrophilic long intestinal tube (Create Medic, Dalian, China) was used (Fig. 1). The tube had an outer diameter of 16 or 18 French, a working length of 300 cm, an anterior balloon and a posterior balloon at its tip, an injection channel with an anti-reflux valve and a drainage channel. In addition to the hole at the tip, there were 7 side holes near the distal end of the tube. The self-contained guide wire was 1.24 mm in diameter and 350 cm long. Additionally, liquid paraffin oil and a flat panel Innova 3100 digital subtraction angiography system (GE Healthcare, Chicago, IL, USA) were used.

**Procedure.** With the patient in the supine position, a 0.90-mm wide, 150-cm long Terumo guidewire (Terumo Corporation, Tokyo, Japan) and a 5 French DAV catheter (Cook Medical, Bloomington, IN, USA) via an 8 French guiding catheter (Boston Scientific, Marlborough, MA, USA) were placed via the nostril, oesophagus and stomach into the descending duodenum under fluoroscopic guidance. The guide wire was removed, and iodinated contrast medium (meglumine diatrizoate or iopromide) was injected through the DAV catheter to confirm the catheter location in the duodenum, as well as the shape of the jejunum. Following this, a 0.90-mm wide, 450-cm long Zebra guidewire (Boston Scientific) was inserted into the upper jejunum. The DAV catheter and guiding catheter were removed, and the long intestinal tube was placed in the jejunum via the prepositioned Zebra guidewire (Fig. 2).

To aid the passing of the long intestinal tube through the stomach and duodenum more easily, the self-contained guide wire, 1.24 mm in diameter, was also inserted into the tube. In addition, liquid paraffin oil was applied to lessen the friction between the tube and the enteric wall, and to reduce the patients' discomfort.

Finally, 20 ml iodinated contrast medium was injected into the tube to evaluate the extent of small intestine expansion. The anterior balloon of the tube was filled with 20 ml sterilised distilled water to promote intestinal peristalsis and to assist the gradual movement of the tube to the distal end of the small intestine.

Following insertion of the long intestinal tube, intermittent negative pressure drainage was performed to reduce the intraluminal pressure of the small intestine. A plain X-ray radiograph of the abdomen was taken every few days to evaluate the progress of the tube and the degree of decompression.

**Observation of efficacy.** The following clinical data were reviewed to retrospectively assess the safety and efficacy of the treatment: Age, tumour type, procedure duration, insertion depth of the long intestinal tube, daily drainage, changes in abdominal pain and bloating, plain X-ray radiographs of the abdomen prior to and following long tube insertion, and any complications, including gastrointestinal perforation, bleeding, nasal mucosal injury, laryngeal oedema and aspiration pneumonia.

## Results

**Clinical characteristics.** A total of 74 patients were included for analysis in the present study. There were 50 men and 24 women (mean age,  $56.5 \pm 12.4$  years; range, 31-82 years).

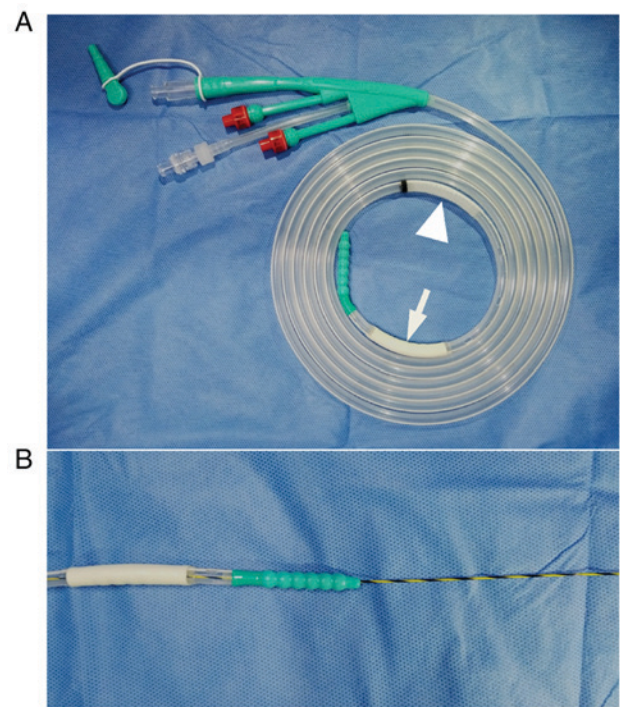


Figure 1. Hydrophilic long intestinal tube with (A) an anterior balloon (arrow) and a posterior balloon (triangle) at the tip, and (B) a prepositioned Zebra guidewire for guidance via the tip hole.

The primary cancer types of the patients with MBO are shown in Table I. The mean time required for placement of the long intestinal tube guided by fluoroscopy was  $31.09 \pm 16.25$  min (range, 10.00-65.00 min). The mean insertion depth of the tube was  $153 \pm 39$  cm (range, 85-260 cm). The characteristics of the treatment with a long intestinal tube in the 74 patients with MBO are shown in Table II.

**Clinical outcomes.** The long intestinal tube was successfully inserted in all patients. Following 1-3 days of tube decompression, the symptoms of abdominal pain, abdominal bloating and vomiting were greatly improved in 58 patients (78.38%) (Fig. 3). Among the 58 patients, following 3-7 days of tube decompression, the symptoms of MBO were further improved or remained stable. Within 1 month of treatment, the symptoms of MBO were completely resolved and the long intestinal tube was removed in 13 cases. Tumour resection or enterostomy was performed for 19 patients. A total of 20 patients kept the long intestinal tube for >1 month and the symptoms of MBO did not deteriorate. Of the 74 patients, 4 were lost to follow-up, and 2 patients succumbed to multiple organ failure and end-stage cancer.

The symptoms of the remaining 16 patients were not effectively relieved following decompression. Of the 16 patients, 10 required surgical treatment for rectal cancer (n=3), carcinoma of the sigmoid colon (n=3), carcinoma of the descending colon (n=2), gastric cancer (n=1) and carcinoma of the ascending colon (n=1). The remaining 6 patients received conservative treatment for carcinoma of the sigmoid colon (n=3), carcinoma of the descending colon (n=2) and gastric cancer (n=1). No serious complications, including gastrointestinal bleeding, perforation, laryngeal oedema and aspiration pneumonia, or

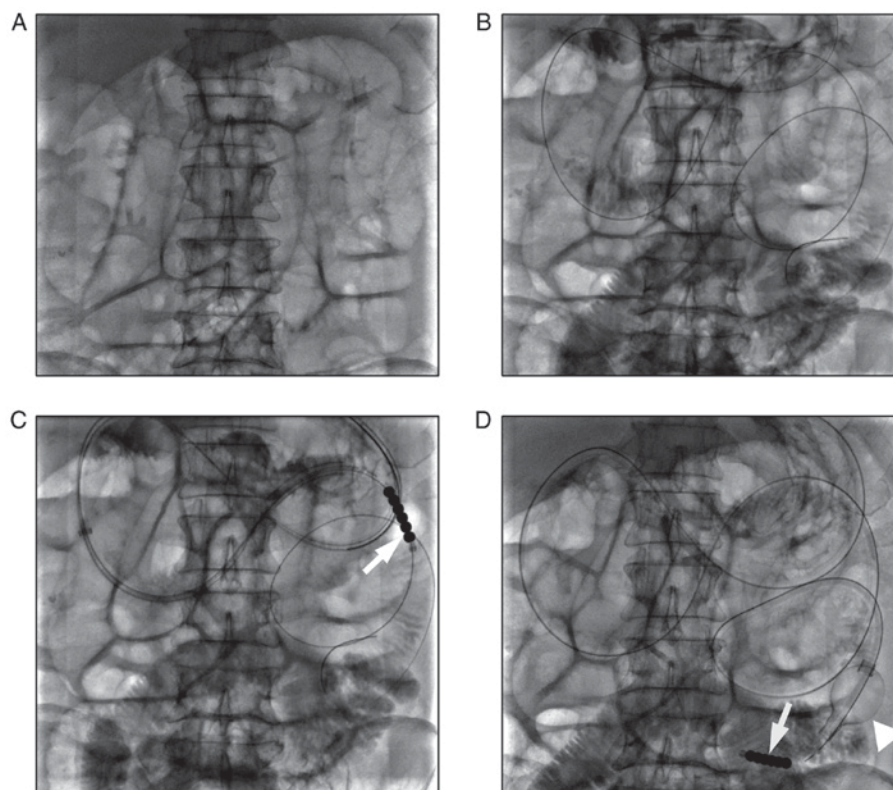


Figure 2. Placement of the long intestinal tube in a 75-year-old male with transverse colon carcinoma. (A) Abdominal X-ray radiograph revealing the dilated bowel tract and bowel pneumatosis. (B) A Zebra guidewire was inserted into the upper jejunum. (C) The tip (arrow) of the long intestinal tube was placed in the jejunum gradually via the prepositioned Zebra guidewire. (D) The anterior balloon (triangle) of the tube was inflated to promote movement of the tube to the distal intestine.

Table I. Primary tumour type of 74 patients with malignant bowel obstruction.

Tumour type	Patients, n (%)
Carcinoma of sigmoid colon	19 (25.7)
Rectal cancer	17 (23.0)
Carcinoma of descending colon	12 (16.2)
Gastric cancer	11 (14.9)
Carcinoma of ascending colon	6 (8.1)
Cervical carcinoma	3 (4.1)
Ovarian cancer	2 (2.7)
Carcinoma of urinary bladder	2 (2.7)
Lung cancer	1 (1.4)
Cholangiocellular carcinoma	1 (1.4)

serious nasal mucosal injury (nasal cavity bleeding, oedema and asphyxia) were observed in these patients.

## Discussion

Although the small intestine accounts for at least 75% of the length of the gastrointestinal tract, small intestinal malignant tumours are unusual and account for only 1-5% of all gastrointestinal tract malignancies (8-10). The incidence of intestinal malignant tumours is significantly lower compared with that of colonic malignancies (11,12). The progression of the majority

Table II. Clinical parameters of treatment with long intestinal tube in 74 patients with malignant bowel obstruction.

Clinical parameters	Mean $\pm$ SD
Insertion depth of tube, cm	153.00 $\pm$ 39.00
Procedure duration, min	31.09 $\pm$ 16.25
Drainage on the first day, ml	708.38 $\pm$ 554.30
Drainage on the second day, ml	706.55 $\pm$ 624.70
Drainage on the third day, ml	527.50 $\pm$ 475.20
SD, standard deviation.	

of advanced colonic and gynaecological malignancies is characterised by multiple segmental obstructions, including small intestinal obstructions (13).

The occurrence of MBO results in a series of pathological and physiological changes, including bowel ischaemia and anoxia, oedema of the intestinal dissepiments, and bacterial translocation and infection, which aggravate the increase in vascular permeability and destroy the liquid secretion absorption equilibrium in the intestinal canal, ultimately resulting in intestinal wall necrosis, perforation, haemorrhage, infection and septic shock (2-5,14,15). Therefore, it is essential to reduce the pressure of the intestinal cavity and drain intestinal contents effectively, as well as to improve the blood supply of the intestinal wall in a timely manner.



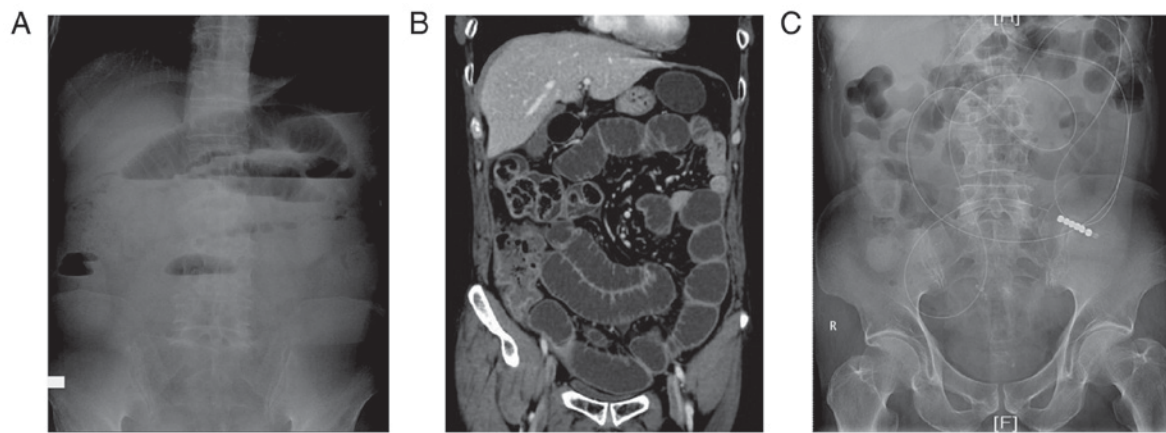


Figure 3. Successful long intestinal tube decompression for a 61-year-old male with rectal carcinoma and peritoneal metastasis. (A) Abdominal X-ray radiograph and (B) abdominal computed tomography scan image revealing the dilated bowel tract and bowel pneumatosis with multiple air-fluid levels. (C) Abdominal X-ray radiograph obtained 7 days after placement of the tube revealing relief of the obstructive symptoms.

Conservative treatments of MBO include fast nasogastric tube decompression, anti-infection treatments, inhibition of the secretion of digestive juice by somatostatin and restoration of the electrolyte balance (16). Nasogastric tube decompression is commonly used for MBO. While traditional nasogastric tube decompression can decompress and drain the gastric cavity fully, the location of the nasogastric tube makes it difficult to effectively drain small intestinal contents and relieve the symptoms of intestinal obstruction, including abdominal pain and abdominal bloating (17-19). More importantly, traditional nasogastric tube decompression may not achieve the restoration of early enteral nutrition (2).

Long-tube decompression is a useful alternative treatment for patients with bowel obstructions (20,21). Several studies report the superiority of decompression tubes in aspects of decompression and drainage (2,3,5-7). However, it is often difficult to insert a long intestinal tube into the small bowel, which results in longer procedure times and a poor postoperative outlook.

Currently, in the majority of patients with MBO, the long intestinal tube is placed with the assistance of endoscopy. However, the preparation for endoscopy, which includes bowel cleaning and gas injection during insertion, can lead to marked discomfort and pain (9,22). In addition, under endoscopic guidance, the tip of the long intestinal tube is often placed in the horizontal segment of the duodenum or just across the Treitz ligament, and the tube is then advanced by gastrointestinal peristalsis. However, due to weak intestinal peristalsis in certain elderly or weak patients, the tube cannot be pushed forward to the jejunum. In the present study, a 450-cm long Zebra guidewire was inserted into the upper jejunum under fluoroscopic guidance, and the long intestinal tube was placed directly into the jejunum via the Zebra guidewire without the aid of intestinal peristalsis. The long intestinal tube was placed successfully in all 74 patients, with a mean insertion depth of 153 cm. Due to the high success rate and good tolerance, patients more readily accepted the fluoroscopy-guided, long intestinal tube placement for the treatment of malignant bowel obstruction. Following 1-3 days of tube decompression, 58 patients (78.38%) improved substantially. The other 16 patients were in the advanced stage of cancer, with multiple

metastases in the intestinal tract and multiple severe obstructions. Therefore, *they* were not effectively relieved following decompression. Of the 16 patients, 10 required surgical treatment and the remaining 6 received conservative treatment. No serious complications, including gastrointestinal bleeding, perforation, laryngeal oedema, aspiration pneumonia and serious nasal mucosa/injury, were observed in the present study.

Another treatment modality for the treatment of MBO, particularly for malignant colorectal obstruction, is the use of a self-expanding stent (23-25). However, the existence of stent-related complications, including perforation, infection, active bleeding, stent migration and re-obstruction, should be emphasised (26). Due to the long distance from the anus, it is often difficult to implant the stent in the hepatic flexure of the colon, the ascending colon or the ileum. In addition, there are often multiple sites of obstruction in MBO patients, which makes it difficult to relieve all of the obstructions using the self-expanding stent (21,27). Long intestinal tube decompression can alleviate the symptoms of obstruction effectively from the proximal bowel, which may partially overcome the difficulties caused by multiple sites of obstruction.

The present study has several limitations. Firstly, a retrospective analysis of the data was performed, and, as such, the study is subject to the inherent limitations of retrospective studies. Secondly, the cost-effectiveness of the treatment has not been assessed, and treatment complications have not been compared with those of the conventional nasogastric tube decompression. Therefore, a multicentre randomised controlled trial between fluoroscopy-guided long intestinal tube placement and the existing invasive therapies may be required to confirm the safety and efficacy of this treatment.

In conclusion, fluoroscopy-assisted long intestinal tube placement is a safe and effective procedure for intestinal decompression in patients with MBO. This procedure can greatly improve quality of life, which is of value to patients and their families.

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## Availability of data and materials

The datasets used and/or analyzed during the present study are available from the corresponding author on reasonable request.

## Authors' contributions

HL and BZ drafted this manuscript. HL, KW and BZ analyzed the imaging data and collected the data. YL, KW and ZZ assisted with statistical analysis. All authors read and approved the final manuscript.

## Ethics approval and consent to participate

The study protocol was approved by the Institutional Ethics Review Board of The Sixth Affiliated Hospital of Sun Yat-Sen University (Guangzhou, China). Written informed consent for this study was obtained from each patient.

## Patient consent for publication

Not applicable.

## Competing interests

The authors declare that they have no competing interests.

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