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# Optimal placement of gastrointestinal decompresion catheter in patients with gastric cancer: A randomized and controlled clinical study

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**Declaration of conflict of interest:** None.

**Ethics approval and consent to participate:** The study protocol was approved by the Institutional Review Committee of Xuzhou Central Hospital (approval no. XZXY-LK-20220114-027) and conducted in accordance with the ethical principles for medical research involving human subjects described in the Declaration of Helsinki. Prior to inclusion in this study, informed consent was obtained from all participants. Trial Registration clinicaltrials.gov Identifier: CTR20200708.

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## Highlights

- Gastrointestinal decompression (GID) near the gastric body reduces nausea, vomiting, and discomfort.
- GID near the gastric body is conducive to exposure of the operative space.
- GID near the gastric body improves postoperative recovery of gastrointestinal function.

## Abstract

**Objective:** To investigate the optimal site for intraoperative gastrointestinal decompression (GID). **Methods:** In this prospective study, 62 gastric cancer patients who underwent surgery at Xuzhou Central Hospital from January 2022 to May 2023 were randomly assigned to either a control or experimental group (31 patients/group). For patients in the control group, the conventional method was used for measurement of the gastric tube length, and GID was placed near the cardia. For patients in the experimental group, the gastric tube length was measured using conventional method with an additional 5–10 cm, and GID was placed near the gastric body. Intraoperative gastric tube placement, intraoperative tube adjustments, gastric contents, GID effectiveness, postoperative gastric fluid drainage volume, and gastrointestinal peristalsis recovery were compared between the two groups. **Results:** Intraoperative gastric tube adjustment ($x^2$=24.952, p<0.001) and volume of gastric fluid drainage ($x^2$=-14.376, p<0.001) significantly affects GID effectiveness. There were notable differences in GID effectiveness between the two groups ($x^2$=-4.353, p<0.001). GID near the gastric body reduced postoperative complications (nausea/vomiting: $x^2$=5.905, p=0.015; aspiration: $x^2$=4.292, p=0.038) and improved gastrointestinal peristalsis recovery ($x^2$=3.085, p=0.032). **Conclusion:** GID near the gastric body is safe and effective.

**Keywords**: Laparoscopy, gastric cancer, gastrointestinal decompression, surgical space exposure, postoperative complications

## Introduction

Gastric cancer is a common malignant tumor typically treated by minimally invasive laparoscopic surgery [1]. Successful laparoscopic surgery for gastric cancer requires adequate exposure of the surgical field and sufficient operating space. Using traditional methods to measure the length of the gastric tube, 91.36% of the tube ends are positioned near the cardia, which limits effective release of accumulated gas and liquid from the gastrointestinal tract

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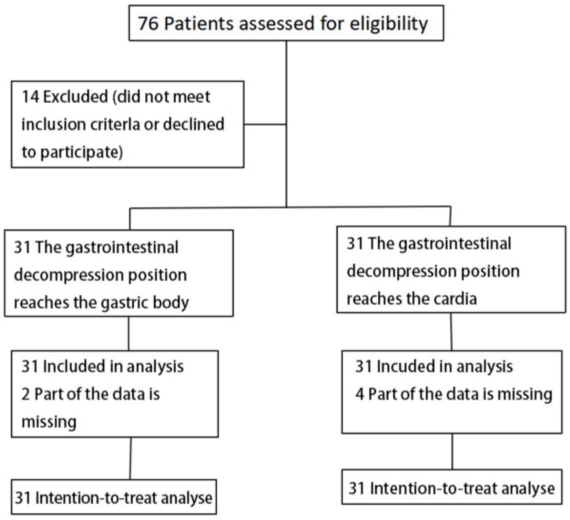


**Figure 1. Flowchart of the patient allocation process.**

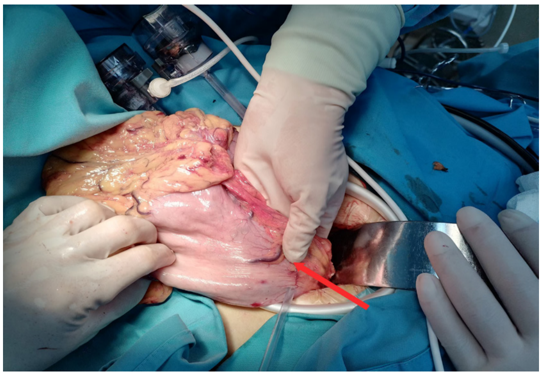

**Figure 2. The anterior end of the gastric tube located in the gastric cardia.** Photo is from the operating room of Xuzhou Central Hospital.

[2, 3]. Moreover, excessive stomach distension leads to poor surgical field exposure and increases the risks of regurgitation/aspiration and postoperative abdominal distension, with reported rates of 10%–70% and 73.3%, respectively [4]. Therefore, traditional methods for measuring gastric tube length fall short in achieving effective gastrointestinal decompression (GID) [5, 6].

Hence, precise gastric tube placement is essential to prevent excessive stomach expansion during surgery, reduce the risk of anastomotic fistula formation, and promote early recovery of gastric function. In our hospital, preoperative GID is routinely performed for patients undergoing laparoscopic gastric cancer surgery. The aim of this study was to assess whether GID near the gastric body offers more advantages over GID near the cardia. The results showed that GID near the gastric body achieved superior outcomes by allowing complete evacuation of gas and gastric juice during surgery, thereby facilitating gastrectomy procedures.

## Methods

### *Study cohort*

The study included 62 patients who underwent gastric cancer surgery at Xuzhou Central Hospital from January 2022 to May 2023, meeting the inclusion criteria. The patients were randomly assigned to either a control group (31 patients) or an experimental group (31 patients) using a computer-based block randomization method (block size of 30) with sealed envelopes (**Figure 1**).

Intention-to-treat (ITT) analysis was employed as the primary analytical approach for this study. This method maintains all randomized participants in their originally assigned groups for analysis, regardless of protocol deviations, treatment adherence, or subsequent withdrawal from the study. The ITT approach helps preserve the benefits of randomization and provides a more realistic estimate of treatment effectiveness in clinical practice.

### *Participants*

Inclusion criteria: (1) age>60 years, (2) gastroscopic findings suggestive of gastric cancer, (3) diagnosis of adenocarcinoma confirmed by biopsy, and (4) complete clinical data. Exclusion criteria: (1) mental illness, (2) cervical vertebrae disease, (3) esophageal or gastric variceal hemorrhage, or (4) tumor rupture/bleeding.

### *Interventions*

**Figure 3. Double-track sign of the gastric tube in the stomach.** The photo is from the operating room of Xuzhou Central Hospital.

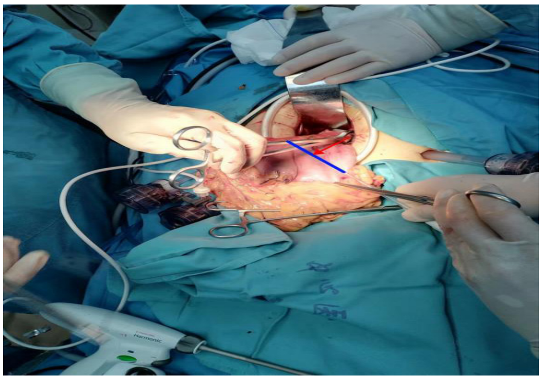

**Figure 4. The anterior end of the gastric tube located in the gastric body.** The photo is from the operating room of Xuzhou Central Hospital.

For patients in the control group, the conventional method was used to measure gastric tube length, with the GID site placed near the cardia. For patients in the experimental group, the gastric tube length was measured conventionally with an additional 5–10 cm, and the site of GID was near the gastric body.

Patients in the control group were placed in the supine position and the distance from the hairline to the xiphoid process or from the nose tip to the earlobe to the xiphoid process (45–55 cm) was measured [7]. Based on the measured length, the gastric tube was inserted up to the stomach cardia under ultrasound guidance [8]. During the procedure, the gastric tube position of the in the stomach was verified by direct observation of the surgeon (**Figure 2**).

The same procedure was used for patients in the experimental groups; however, the length of the gastric tube was extended by an additional 5–10 cm, allowing the gastric tube to reach the gastric body (**Figure 3** and **Figure 4**).

### *Evaluation criteria*

The primary outcome was the effectiveness in gastric emptying following GID, which was evaluated by the surgeon through direct observation of gastric filling before mobilization of the gastric body. Gastric emptying was scored as follows: 5 points for completely empty, 3 points if partially empty, and 1 point if completely full. Higher scores indicated a better effect of intraoperative GID.

The secondary outcomes included: (1) the gastric tube placement as verified by ultrasonography; (2) intraoperative adjustments due to improper gastric tube placement; (3) gastric juice drainage volume, where higher volumes indicate appropriate placement and a better decompression effect; (4) recovery time of postoperative gastrointestinal peristalsis; and (5) postoperative complications (e.g., nausea, vomiting, and aspiration).

### *Statistical analysis*

Statistical analysis was performed using IBM SPSS Statistics for Windows (version 21.0; IBM Corporation, Armonk, NY, USA). Measurement data were compared using an independent sample t-test and were presented as the mean ± standard deviation, while categorical data were compared using the chi-square test and were presented as numbers and percentages. A probability (p) value<0.05 was considered statistically significant.

In this study, we hypothesized that the effect of intraoperative GID would be inferior in the control group than the experimental group. The primary endpoint of this study was the effectiveness of intraoperative GID.

In the preliminary experiment, the effect of intraoperative GID in the control and experimental groups was 0.0% and 12.3% vs. 1.0% and 11.3%, respectively. At an $\alpha$ value of 0.05 and a power (1-$\beta$) of 0.80, a sample size of 30 participants was calculated using the following formula:

$$n_1 = \frac{[u_\alpha \sqrt{p(1-p)(1+c)/c} + u_\beta \sqrt{p_1(1-p_1)+p_2(1-p_2)/c}]^2}{(p_1-p_2)^2}$$

## Results

Of the 76 patients initially selected for this study, 14 did not meet the inclusion criteria and were excluded. Finally, 62 patients who met the inclusion criteria were randomly assigned to the control group (gastric tube near

**Table 1. Comparison of baseline characteristics between the two groups**

| | | Control group (n=31) | Experimental group (n=31) | $X^2$ | p |
|---|---|---|---|---|---|
| Sex (n, %) | Male | 17 (54.84) | 16 (43.24) | 0.065 | 0.799 |
| | Female | 14 (44.16) | 15 (56.76) | | |
| Mean age (years) | | 69.34±8.26 | 67.89±7.21 | 0.736 | 0.464 |
| Mean height (cm) | | 164±7 | 166±8 | -1.048 | 0.299 |
| Mean body weight (kg) | | 67.32±16.66 | 64.85±18.83 | 0.547 | 0.586 |
| Tumor size (n, %) | <4 cm | 22 (70.97) | 19 (61.29) | 0.648 | 0.421 |
| | ≥4 cm | 9 (29.03) | 12 (38.71) | | |
| Differentiation (n, %) | Well-differentiated | 13 (41.94) | 14 (45.16) | 0.069 | 0.966 |
| | Moderately differentiated | 16 (51.61) | 15 (48.39) | | |
| | Poorly differentiated | 2 (6.45) | 2 (6.45) | | |
| TNM stage (n, %) | I | 17 (54.84) | 19 (61.29) | 0.265 | 0.607 |
| | II | 14 (45.16) | 12 (38.71) | | |

**Table 2. Comparison of gastric decompression effectiveness between the two groups (points)**

| | Effect of intraoperative gastric decompression [example (percentage, %)] | | | Average |
|---|---|---|---|---|
| | Completely empty | Partially empty | Full stomach | |
| Control group (n=31) | 5 (16.13) | 22 (70.97) | 4 (12.90) | 3.06 |
| Experimental group (n=31) | 27 (87.10) | 2 (6.45) | 2 (6.45) | 4.61 |
| $X^2$ | 32.458 | | | -4.353 |
| *p* | <0.001 | | | <0.001 |

the cardia) or the experimental group (gastric tube near the gastric body), with 31 patients in each group. As shown in **Table 1**, there were no significant differences in sex, age, height, and weight between the two groups (all p<0.05).

***Primary outcome***

The primary outcome was the effectiveness of intraoperative GID. As shown in **Table 2**, the experimental group demonstrated significantly better efficacy in intraoperative GID, supported by notably higher proportion of patients achieving completely empty (87.10% vs. 16.13%).

***Secondary outcomes***

As shown in **Table 3**, after bedside B-ultrasound verification, 2 cases in the test group had the front end of the gastric tube in the cardia, 14 cases in the control group had the front end of the gastric tube in the lower esophagus, and 17 cases had the front end of the gastric tube in the cardia. The frequency of intraoperative tube adjustment was significantly lower, while the gastric fluid drainage volume was significantly higher in the experimental group compared to the control group (all p<0.001).

As shown in **Table 4**, the experimental group showed significantly lower incidence in nausea and vomiting (p=0.015), as well as aspiration (p=0.038) compared to those in the control group. Additionally, the recovery time of gastrointestinal peristalsis in the experimental group was significantly shorter than that in the control group (p=0.032).

**Discussion**

Gastric cancer, a common malignancy, is typically treated with minimally invasive laparoscopic surgery [9, 10]. Successful laparoscopic surgery for gastric cancer relies on adequate exposure of the surgical field. However, the anatomical structures of the esophagus and stomach can hinder effective removal of accumulated gas and liquid from the gastrointestinal tract. Excessive stomach distension can lead to poor exposure of the surgical field. The reported incidences of reflux/aspiration and abdominal distension are high when a gastric tube is used for GID [11].

Traditional methods for determining tube length often fall short in preventing over-distension

**Table 3. Comparison of gastric tube placement, intraoperative tube adjustment, and gastric fluid drainage volume between the two groups**

| | Placement of gastric tube [example (percentage, %)] | | | Intraoperative adjustment of the gastric tube (n, %) | Gastric fluid drainage (mL, mean ± standard deviation) |
|---|---|---|---|---|---|
| | Lower esophageal segment | Preventriculus | Corpora ventriculi | | |
| Control group (n=31) | 14 (45.16) | 17 (54.84) | 0 | 21 (67.74) | 28.23±11.42 |
| Experimental group (n=31) | 0 | 2 (6.45) | 29 (93.55) | 2 (6.45) | 72.35±12.71 |
| $X^2$ | 54.842 | | | 24.952 | -14.376 |
| *p* | <0.001 | | | <0.001 | <0.001 |

**Table 4. Comparisons of postoperative complications and recovery time of gastrointestinal peristalsis**

| | Nausea and vomiting (n, %) | Aspiration (n, %) | Postoperative recovery time of gastrointestinal peristalsis (h, mean ± standard deviation) |
|---|---|---|---|
| Control group (n=31) | 11 (35.48) | 8 (25.81) | 46.28±7.17 |
| Experimental group (n=31) | 3 (9.68) | 2 (6.45) | 41.36±5.24 |
| $X^2$/t | 5.905 | 4.292 | 3.085 |
| p | 0.015 | 0.038 | 0.032 |

during surgery, reducing postoperative anastomotic tension, preventing anastomotic leakage, and promoting early recovery of gastric function [12]. The results of this study indicate that increasing the gastric tube length by 5-10 cm, allowing the tube to reach the gastric body, significantly improves the effectiveness of intraoperative GID.

Positioning GID in the gastric body can alleviate symptoms of nausea and vomiting. Conventionally, the length of the gastric tube is 45-55 cm, only reaching the lower segment of the esophagus or the cardia [13]. At this position, stimulation of the cardiac sphincter often leads to nausea, vomiting, and discomfort. In addition, due to the shallow depth of catheterization, increased abdominal pressure can cause reflux, aspiration, and other complications, aligning with the findings in our study, as the incidences of nausea, vomiting and aspiration were significantly higher in the control group [14]. Positioning the front end of the gastric tube within the gastric body effectively lowers gastrointestinal tract pressure and minimizes discomfort.

Extending the GID position to the gastric body can better expose the surgical space. The conventional method for gastric tube placement is not ideal to achieve satisfactory GID, as gas and liquid retention in the stomach can significantly impact surgical duration and outcomes. Optimal GID is achieved when the gastric tube's tip is placed in the middle - gastric body, facilitating better exposure of the surgical space [15, 16]. When the length of the gastric tube was extended to 50-65 cm, clinical color Doppler ultrasound verified that the front end of the gastric tube reached the gastric body and the surgical space was fully exposed, which is conducive to gastric separation.

In addition, with the gastric body is effectively decompressed, there is no need to further adjust the gastric tube, which reduces the workload and avoids damage to the gastric mucosa caused by repeated extraction and insertion of the gastric tube.

Extending the position of GID to the gastric body is beneficial to postoperative recovery of gastrointestinal function. A study by Zhang et al. reported that the postoperative indwelling time, and incidence of postoperative abdominal distension were reduced while drainage volume was increased, when the depth of gastric tube was extended 45-55 cm to 50-60 cm [17]. Hence, in the present study, the insertion depth of the gastric tube was increased by 5-10 cm to 50-65 cm, allowing the tip of the gastric tube to reach the gastric body. This placement effectively removed gas and liquid from the gastrointestinal tract, reduced intragastric pressure, improve blood circulation in the gastrointestinal wall, accelerated recovery of gastrointestinal peristalsis, and promoted postoperative recovery [18, 19].

## Conclusion

The effectiveness of GID is improved by placing the gastric tube in the gastric body. Extending the length of the gastric tube by 5–10 cm to reach the gastric body not only minimizes discomfort caused by gastric tube insertion, but also optimizes surgical field exposure, and promotes postoperative recovery of gastrointestinal function.

However, given that most gastric cancer patients undergoing laparoscopic surgery are elderly, who may suffer from physiological gastroptosis, positioning the gastric tube in the gastric body is ideal. Therefore, Doppler color ultrasound is recommended to assist in accurate gastric tube positioning for GID.

**Author contributions:** Mingling Wang contributed to the conception of the study, and performed the experiment; Xiaoyan Wang performed the experiment, reviewed and edited the manuscript, and project administration; Kai Wang and Lien Qi contributed significantly to the analysis and manuscript preparation; Mingling Wang and Jing Zhang helped perform the analysis with constructive discussions.

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