

The Efficacy of Endoscopic India Ink Injection and Fluoroscopy in Laparoscopic Gastrectomy

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ABSTRACT

Background : Laparoscopy-assisted gastrectomy has gained popularity throughout Japan, and totally laparoscopic surgery is performed in some medical institutions. However, both determining the gastric resection line and identifying the primary lesion site are difficult. Therefore, this study evaluated the efficacy of combined use of preoperative endoscopic India ink injection and intraoperative fluoroscopy for determining the gastric cutting line for totally laparoscopic gastrectomy.

Methods : We review 25 patients with gastric cancer who had undergone totally laparoscopic distal gastrectomy. Before surgery 3 sites 1 to 2 cm oral to the primary lesion were clipped with the intramural injection of India ink. During surgery the spot of India ink injection was determined to be the oral margin of the dissections of lymph nodes 1, 3, and 4. During gastric transection C-arm fluoroscopy confirmed that the clips were included in the specimen side after the stomach had been grasped with a stapler.

Results : Specimens obtained from each subject contained all the clips. The average distance between the proximal margins and the tumors was 47.9 ± 26.2 mm. No subjects showed pathologically positive margins.

Conclusion : The combination of preoperative endoscopic India ink injection and intraoperative fluoroscopy is safe and effective in totally laparoscopic distal gastrectomy.

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Key words : localization, laparoscopic gastrectomy, endoscopic India ink injection, intraoperative fluoroscopy

INTRODUCTION

Laparoscopy-assisted gastrectomy has gained popularity in medically advanced countries, including Japan¹. In some medical institutions, all surgical procedures, including anastomosis, are performed with only laparoscopy, i.e., to-

tally laparoscopic surgery. However, with such procedures, determining the line of gastric resection is difficult because identifying the location of the primary lesion is difficult. Rather than totally laparoscopic gastrectomy, laparoscopy-assisted gastrectomy with minilaparotomy is preferred by most surgeons because of technical difficulties with intra-

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corporeal anastomosis. In laparoscopy-assisted gastrectomy with minilaparotomy, the locations of primary lesions can be confirmed by palpating endoscope clips that have been placed before surgery. To overcome a lack of palpation, various alternate methods have been developed. Although such alternate methods as dye injection², intraoperative endoscopy³⁻⁵, intraoperative fluoroscopy⁶, and intraoperative ultrasonography⁷ have been described, these procedures are rarely performed in combination. Therefore, the present study evaluated the efficacy of combined use of preoperative endoscopic India ink injection and intraoperative fluoroscopy for determining the gastric cutting line for totally laparoscopic gastrectomy.

SUBJECTS AND METHODS

Patients

We retrospectively investigated 25 patients in whom early gastric cancer had been diagnosed preoperatively and then treated with totally laparoscopic distal gastrectomy with the combination of preoperative endoscopic India ink injection and intraoperative fluoroscopy from January 2013 through April 2014.

Preoperative marking

Approximately 1 week before surgery, endoscopic clipping was performed with a rotatable clip-fixing device (EZ-

Clip HX-610-090, Olympus Optical Co, Tokyo, Japan) at 3 points 1 to 2 cm oral to the primary lesion. Into 1 of the clips 0.1 to 0.2 mL of India ink was injected (Fig. 1). Biopsy specimens were obtained from these clipping sites and pathologically determined to be cancer-free before gastrectomy.

Surgical procedure

Laparoscopic distal gastrectomy with lymph node dissection was performed via 5 ports. A rough line of gastric resection was drawn at the India ink injection sites and was also determined as the proximal margin of the dissection of lymph nodes 1, 3, and 4, defined by the Japanese Gastric Cancer Association⁸ (Fig. 2). A fluoroscope (Opescope Pleno XUD-200; Shimizu) was used during gastric transection. After the stapler was placed on the stomach oral to the spot of India ink, C-arm fluoroscopy was performed to con-

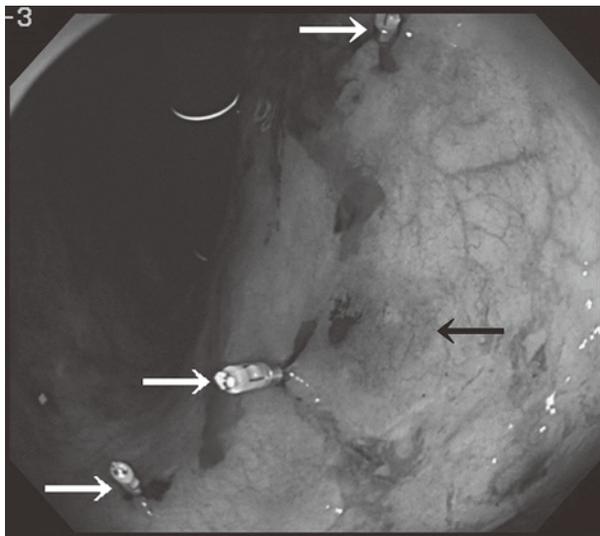


Fig. 1. Preoperative marking procedure. Endoscopic clipping was performed at 3 sites (white arrows). India ink was injected into 1 of the clipping sites (black arrow).



Fig. 2. Typical laparoscopic view of endoscopic India ink injection (white arrow).

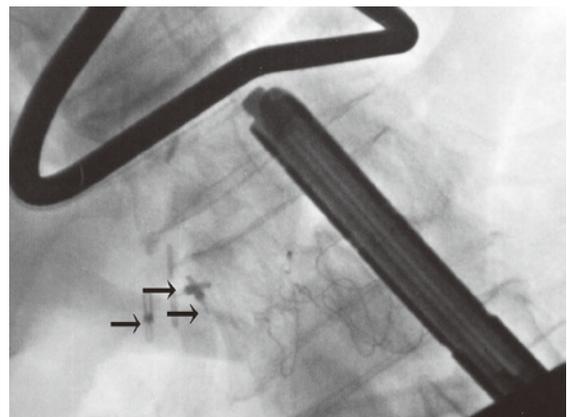


Fig. 3. Intraoperative fluoroscopic image. The clips were oral to the stapler (black arrows).

firm that the clips were oral to the stapler before it was fired (Fig. 3). If the clips were not located on the resection side, the stapler was repositioned orally, and fluoroscopy was repeated to ensure that the clips were indeed on the resection side. After the stomach was transected, the specimen was collected via the camera port, and laparoscopic reconstruction was then performed.

RESULTS

The mean age of the 25 subjects was 68.7 years, and the male : female ratio was 18 : 7 (Table 1). The mean operative time was 293.2 minutes, and estimated mean blood loss was 27.2 mL ; no intraoperative complications were observed. The mean distance between the proximal margins and the tumors was 47.9 ± 26.2 mm (range, 9 to 105 mm), and none of the margins were pathologically positive. Samples extracted from all subjects contained all the endoscope clips.

DISCUSSION

Before laparotomy is performed in patients with early gastric cancer, clips are commonly placed with an endoscope to determine where the primary lesion is located⁹. However, in laparoscopic surgery, the locations of clips cannot be examined manually. Therefore, gastric transection is performed extracorporeally via a small laparotomy incision. For this reason, laparoscopy-assisted surgery has become more common than totally laparoscopic surgery.

To determine the location of primary lesions during laparoscopic surgery, a variety of methods have been described^{2-7,9}. A widely used method is intraoperative endoscopy, but an endoscope must be used by a skilled endoscopist during surgery. An additional disadvantage of intraoperative endoscopy is that distention of the stomach is required during the procedure but results in an extremely poor surgical exposure. Another method, intraoperative ultrasonography, requires a skilled technician to be successful and has not been widely used. Intraoperative fluoroscopy or portable abdominal radiography has been shown to be an ef-

Table 1. Patient characteristics and operative data ($n = 25$)

| Variables | Data |
|--|------------------------------------|
| Age* | 68.7 \pm 7.7 years (44-83) |
| Sex | 18 men and 7 women |
| Operative time* | 293.2 \pm 65.6 minutes (195-450) |
| Intraoperative blood loss* | 27.2 \pm 52.8 ml (5-250) |
| Reconstruction | |
| Billroth-I/Roux-en-Y | 21/4 |
| Tumor size* | 37.8 \pm 21.9 mm (8-84) |
| Proximal margin* | 47.9 \pm 26.2 mm (9-105) |
| Distal margin* | 57.7 \pm 29.0 mm (17-135) |
| Tumor location | |
| upper/middle/lower | 1/11/13 |
| Lymph node dissection | |
| D1/D1+/D2 | 3/21/1 |
| Histological type | |
| well-differentiated/moderately-differentiated/ poorly-differentiated/signet ring cell | 11/5/3/6 |
| Tumor classification | |
| 1a/1b/3 | 18/4/3 |
| Node classification | |
| N0/N1 | 24/1 |
| pStage [†] | |
| IA/IIA/IIB | 22/2/1 |

*mean \pm standard deviation (range)

[†]According to the 3rd English edition of the Japanese Classification of Gastric Carcinoma

fective method for tumor localization^{6,10}.

When we switched from laparoscopy-assisted gastrectomy with minilaparotomy to totally laparoscopic surgery, we first used only intraoperative fluoroscopy. However, because primary lesions could not initially be identified from the outside of the stomach wall, we often failed to dissect sufficient lymph nodes in the lesser and greater curvatures. In addition, when clips were placed on the proximal side during gastric transection, additional lymph nodes must often be resected in the lesser and greater curvatures, which then extend the operation time. To avoid additional dissection, we inject India ink for fluoroscopy because we have found that it is extremely effective for determining the primary lesion site from outside the stomach wall and for guiding lymph node resection. Although intraoperative fluoroscopy is extremely useful for gastric transection, at some institutions a portable X-ray machine can instead be used with similar effectiveness. Indocyanine green has also been injected, but studies have shown that it is not retained for long in the tissue^{11,12}; therefore, endoscopy must be performed during the surgical procedure. Because India ink is retained in the tissue for a longer time, marking can be performed before surgery. Thus, the surgical procedure does not need to be interrupted and stress for the surgeon is reduced.

CONCLUSION

The combined use of India ink injection and intraoperative fluoroscopy to determine the line for gastric transection is a simple and reliable technique for totally laparoscopic distal gastrectomy.

Authors have no conflict of interest.

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