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SURGICAL TECHNIQUE

Robotic distal gastrectomy with a novel *"Preemptive retropancreatic approach"* during dissection of suprapancreatic lymph nodes for gastric cancer

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Running title
Usefulness of RDG using our novel " Preemptive retropancreatic approach"

An authorship declaration
YE and YK drafted the manuscript; SM, TN, TS and SH critically revised the manuscript.

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Abstract

Introduction: Abrogating contact with the pancreas in suprapancreatic lymph nodes dissection for gastric cancer can prevent pancreatic fistula due to postoperative pancreatic damage. Our novel "*Preemptive retropancreatic approach*" is a useful technique that minimizes pancreatic compression during robotic distal gastrectomy (RDG) with multi-jointed forceps. Here, we report the usefulness of RDG for gastric cancer surgery using our novel *"Preemptive retropancreatic approach"*.

Materials and Surgical Technique: *"Preemptive retropancreatic approach"*: initial dissection of the bilateral retropancreatic space, the adherence between the retroperitoneum surface and the pancreas (fusion fascia) is released, providing a good operative field and hindering contact with the pancreas in suprapancreatic lymph nodes dissection during RDG. We herein reported consecutive 30 patients with gastric cancer who underwent RDG at Hokkaido University from September 2014 to March 2020.

Results: All operations were performed by a single surgeon (YE). The median operating time was 281 minutes (132-415). The median intraoperative bleeding was 0 ml of blood (0-255). There were two incidences of postoperative complications (≥ Clavien-Dindo classification II), and there were no cases of postoperative pancreas-related complications. The median length of hospital stay after the surgery was 10 days (6-33).

Conclusion: As RDG for gastric cancer is still in its early introductory phase, its superiority has yet to be definitively established. However, we believe that *"Preemptive retropancreatic approach"* may reduce postoperative pancreatic-related complications in suprapancreatic lymph nodes dissection.

Keywords

robotic distal gastrectomy, suprapancreatic lymph nodes, postoperative complications, pancreatic fistuula

Introduction

Recently, among the minimally invasive treatments such as laparoscopic gastrectomy (LG) for gastric cancer, robotic gastrectomy (RG) has been gaining popularity. In RG, high-resolution three-dimensional images and the use of forceps with multi-joint functions eliminate the limitations of conventional LG and enable sophisticated procedures[1]. In particular, it is expected that improvement in local operability will ensure lymph node dissection for malignant tumor surgery and reduce postoperative complications[2]. In LG, it is often difficult to maintain a good operative field during suprapacreatic lymph node dissection. In RG, unique multi-joints may be useful for suprapacreatic lymph nodes dissection[3]. A unique approach with RG during suprapancreatic lymph node dissection may further reduce postoperative pancreatic-related complications.

We report about our novel *"Preemptive retropancreatic approach"* technique and its usefulness during suprapacreatic lymph nodes dissection.

Materials

From September 2014 to March 2020, we enrolled 30 consecutive patients who underwent robotic distal gastrectomy (RDG) in the Department of Gastroenterological Surgery II at the Hokkaido University Hospital (Sapporo, Japan). All operations were performed by a single surgeon (YE). The eligibility criteria were preoperative cStage I/II gastric cancer diagnosed by endoscopy, computed tomography, and endoscopic ultrasound. Written informed consent to participate in the study was obtained from all the patients. Specimens were evaluated essentially according to the Japanese Classification of Gastric Carcinoma established by the Japanese Research Society for Gastric Cancer. This study was a retrospective clinical trial (UMIN000012763).

Surgical technique

Setup for robotic distal gastrectomy

Patients were placed under general anesthesia in the supine position as previously reported[4]. For RDG, we usually used a 5-trocar system with Nathanson hook liver retractor (Yufu Itonaga, Tokyo, Japan). After carbon dioxide pneumoperitoneum was achieved at a pressure of 10 mmHg, an electrolaparoscope was introduced through the trocar, and four other trocars were positioned as shown in Figure 1. Robotic third, first, and second arms were docked on 8-mm left upper, left lower, and right upper trocars, respectively. The 8-mm left lower trocar was placed through the 12/75-mm trocar (trocar-introcar technique) and the assistant surgeon used the right lower trocar (Fig.1). The basic extent of lymph node dissection was D1+ (D1+ No.7, 8a and 9 lymph nodes) or D2, and lymph node dissection was performed. Regions of lymph nodes and lymph node dissection were defined according to the Japanese Classification of Gastric Carcinoma[5].

“Preemptive retropancreatic approach”

Initially, the peritoneum is opened in the lesser omentum of the stomach, preserving the vagus nerve branch of the liver. After the right margin of the crus was exposed, the abdominal branch of the vagus nerve was identified and divided on the dorsal side of the esophagus. Thereafter, the retropancreatic space is dissected with confirming anterior surface of the left adrenal gland and the left inferior phrenic artery as landmarks. The adherence between the retroperitoneum surface and the retropancreatic facia (Toldt fusion fascia) is released. Gauze is placed in the dissected left retropancreatic space. Mesenterization of the mesogastrium was performed by dissection of the left retropancreatic space (Fig.2). On the right side, the peritoneum is incised from in front of the inferior vena cava to the front of the right inferior phrenic artery, and gauze is placed in the dissected right retropancreatic space (Fig3.). By the dissection of bilateral retropancreatic space, the adherence between the retroperitoneum and the retropancreatic facia is released, providing a good operative field and hindering contact with the pancreas in suprapancreatic lymph nodes dissection (Fig.4).

Results

Table 1 shows the clinical characteristics and operative outcomes of the patients. All 30 patients underwent RDG for gastric cancer using our novel *“Preemptive retropancreatic approach”*. The patients’ median age was 69 years (45-82), twenty male and ten female, the median BMI was 22.5 kg/m^2 (16.1-32.1). Of the 30 patients, 28 patients underwent D1+ lymphadenectomy, and the remaining 2 patients underwent D2 lymphadenectomy, and 2 patients underwent Billroth I reconstruction, and 28 patients underwent Roux-en-Y. The median operating time was 281 minutes (132-415). The median intraoperative bleeding was 0 ml of blood (0-255). There were two incidences of postoperative complications (≥CD II: Clavien-Dindo classification II).

However, there were no cases of postoperative pancreas-related complications (≥CD II). The median length of hospital stay after the surgery was 10 days (6-33). None of the patients died during surgery or hospitalization.

Discussion

In 2003, Hashizume et al[6]. reported the world’s first robot-assisted gastrectomy for gastric cancer. Studies comparing RG with LG for gastric cancer have mainly been retrospective, with almost all of them reporting prolonged operation time, reduced blood loss, and similar incidence of postoperative complications for RG. Further, a meta-analysis of 10 studies conducted up until 2017 reported outcomes similar to those of the retrospective studies and concluded that both RG and LG had similarly short operation times[7),8)]. In RG, high-resolution three-dimensional images and the use of forceps with multi-joint functions eliminate the limitations of conventional laparoscopic surgery and enable sophisticated procedures However, few studies have assessed the advantages of RG over LG [9),10)]. In

RG, there is a risk of serious postoperative pancreatic-related complications due to the lack of palpation and pancreatic damage by the arm, which can lead to serious postoperative pancreatic-related complications. The incidence of POPF after LG is reported to range from 5 % to 7 %[11), 12)]. One cause of postoperative pancreatic-related complications may be the compression of the pancreas during dissection of suprapancreatic lymph nodes. Regarding pancreatic juice leakage during gastrectomy in particular, Tsujira et al[3)]. reported that pancreatic juice leakage after laparoscopic gastrectomy may be attributable to either operator or assistant-related causes. The operator can injure pancreatic tissue by direct cutting or causing thermal injury from energy devices used during dissection of suprapancreatic lymph nodes. In their study using a swine model, Ida et al[13)]. reported that pancreatic compression by the assistant's forceps can contribute to pancreatic juice leakage and that their findings will help to improve the procedure for lymph node dissection around the pancreas during laparoscopic gastrectomy. Numerous studies have similarly reported postoperative pancreatic juice leakage due to pancreatic compression during surgical field preparation for the dissection of suprapancreatic lymph nodes during gastrectomy. Hence, with our novel *"Preemptive retropancreatic approach"*, maximum avoidance of pancreatic compression may be adopted as a safe and precise standard technique in RG where tactile sensation is absent. The initial dissection of the bilateral retropancreatic space in this approach is a useful technique that minimizes pancreatic compression during robotic surgery with multi-jointed forceps. Moreover, gastrointestinal cancer surgery requires en bloc removal of the primary tumor and organ-specific mesentery[14)]. Kumamoto et al[15)]. reported about a systematic mesogastric excision (SME) concept for gastric cancer, SME takes advantage of the surgical anatomy and achieves en bloc removal of the primary tumor and gastric mesentery. In our novel *"Preemptive retropancreatic approach"*, bilateral retropancreatic space is dissected for robotic suprapancreatic lymphadenectomy using SME concept.

Further, although the number of patients investigated was low, the extensively prolonged operation times reported during the initial period when robotic surgery was first introduced were not observed in this study's surgical outcomes. Reduced operation time due to the *"Preemptive retropancreatic approach"* was noted, indicating its effectiveness. In the present study, drain amylase measurements were not performed because an intraperitoneal drain was not placed. However, there were no cases of postoperative pancreas-related complications (≥CD II).

We intend to further substantiate this approach's usefulness through studies with more participants. As robot-assisted gastrectomy for gastric cancer is still in its early introductory phase, its superiority has yet to be definitively established. In the future, robot-assisted surgeries that take the patient's physical constitution, cancer stage, and research regarding optimal operative approach into consideration can be expected to continue building solid evidence toward its universal acceptance as conventional therapy.

Conclusion

Our novel *"Preemptive retropancreatic approach"* is a useful technique that minimizes pancreatic compression and creates a good operative field for the supra-pancreatic lymphadenectomy, allowing the dissection to proceed following SME concept during RDG with multi-jointed forceps. We believe that this approach may reduce postoperative pancreatic-related complications.

Ethics and consent

This study was approved by the Hokkaido University Ethics Committee (No. 017-0016). The consent form stated the aim of the study on the hospital's website and offered the participants the right to decline to participate or opt out at any time. Comprehensive informed consent to use patient information for this study was obtained from all individual participants before surgery.

Acknowledgment

None.

Figure legend

Fig. 1: Positions of surgical trocars. For robotic distal gastrectomy, we usually used a 5-trocar system with Nathanson hook liver retractor (Yufu Itonaga, Tokyo, Japan). Robotic third, first, and second arms were docked on 8-mm left upper, left lower, and right upper trocars, respectively. The 8-mm left lower trocar was placed through the 12/75-mm trocar (trocar-introcar technique) and the assistant surgeon used the right lower trocar. ○; 12-mm trocar site, △; 8-mm trocar, ×; Umbilicus.

Fig. 2: Operative findings of the suprapancreatic lymph node dissection (*"Preemptive retropancreatic approach"*; left side). A: The peritoneum is opened in the lesser omentum of the stomach. *Arrow heads; Incision line of the peritoneum. B: The retropancreatic space is dissected with confirming anterior surface of the left adrenal gland and the left inferior phrenic artery. The adherence between the retroperitoneum surface and the retropancreatic fascia (Toldt fusion fascia) is released. *Arrow heads; the left inferior phrenic artery. *Circle; left side of retropanceratic space. C: Gauze is placed in the dissected left retropancreatic space. D: Mesenterization of the mesogastrium was performed by dissection of the left retropancreatic space. *Arrow; Dissection line of the suprapancreatic lymph node dissection. E: Left side of the mesogastrium was dissected. *Arrow; Dissection line of the mesogastrium. F: Final view of the suprapancreatic lymph node dissection. LGA; left gastric artery.

Fig. 3: Operative findings of the suprapancreatic lymph node dissection (*"Preemptive retropancreatic approach"*; Right side). A: The peritoneum is incised from in front of the inferior vena cava to the front of the right inferior phrenic artery. *Arrow heads; Incision line of the peritoneum. IVC; inferior vena cava. B: Mesenterization of the mesogastrium was performed by dissection of the right retropancreatic space. C: Right side of the mesogastrium was dissected. *Arrow heads; the right inferior phrenic artery. D: Final view of the suprapancreatic lymph node dissection. *Circle; right side of retropanceratic space.

Fig. 4: Operative schema of the suprapancreatic lymph node dissection (*"Preemptive retropancreatic approach"*; left side). A: The schema of the fusion fascia and mesogastrium. B: Dissection of the retropancreatic space, the adherence between the retroperitoneum surface and the retropancreatic facia (Toldt Fusion fascia) is released. The mesogastrium (including suprapancreatic lymph nodes) was lifted forward and providing a good operative field and hindering contact with the pancreas in suprapancreatic lymph nodes dissection.

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Table1. Clinicopathological patient characteristics and operative outcomes

	n=30
Clinicopathological patient characteristics	
Age, years, median (range)	69 (45-82)
Gender, male/ female	20/10
BMI, kg/m^2, median (range)	22.5 (16.1-32.1)
TMN* pStage I/II	28/2
Lymphadenectomy; D1+/D2	28/2
Reconstruction; Billroth I/ Roux-en-Y	2/28
Operative outcomes	
Operation time, min, median (range)	281 (132-415)
Intraoperative blood loss, ml, median (range)	0 (0-255)
Postoperative complications (CD ≥II) (gastric emptying / intra-abdominal hematoma)	2 (1/1)
Postoperative pancreas-related complications (CD ≥II)	0
Hospital stay after surgery, day, median (range)	10 (6-33)
Mortality	0

BMI: body mass index, TMN: tumor-node-metastasis, CD: Clavien-Dindo classification

*International Union Against Cancer TMN classification Eighth Edition.