Does Intestinal Peristalsis Cause Suture Failure After Instrument Suture?

YASUSHI RINO1, TORU AOYAMA1, YUKIO MAEZAWA1, ITARU HASHIMOTO1, SHO SAWAZAKI1, KEISUKE KAZAMA1, MASAKATSU NUMATA1, HIROSHI TAMAGAWA1, TSUTOMU SATO2, TAKANOBU YAMADA1, TAKASHI OSHIMA1, AYA SAITO1 and NORIO YUKAWA1

1Department of Surgery, Yokohama City University, School of Medicine, Yokohama, Japan; 2Gastroenterological Center, Medical Center, Yokohama, Japan; 3Department of Gastrointestinal Surgery, Kanagawa Cancer Center, Yokohama, Japan

Abstract. Background/Aim: Gastrectomy with lymphadenectomy is a standard treatment for gastric cancer. Anastomotic leakage remains a potentially fatal complication of gastrectomy. Forceful stapler extraction may cause anastomotic complications. We focused on the duodenal peristalsis, as we hypothesized that it might cause forceful stapler extraction. We then retrospectively investigated duodenal peristalsis and reviewed videos of Da Vinci system cases to clarify the relationship between peristalsis and anastomotic complications. Patients and Methods: Forty-nine cases with stored videos of laparoscopic surgery using the Da Vinci system from 2015 to March 2021 were included. Peristalsis was defined by repeated contraction and expansion that was clearly visible three or more times in a row. The duodenum was investigated because it is frequently observed during gastrectomy. Suture failure was evaluated in cases with and without peristalsis. Results: The study population included 49 patients [male, n=32; female, n=17; median age, 71 (42-82) years]. Duodenal peristalsis was observed in 14 (28.6%) cases. Three patients experienced complications. A comparative study of cases with and without complications showed significant peristalsis in cases with complications (p=0.0198). Conclusion: A new definition to evaluate duodenal peristalsis was established. Anastomotic complications were significantly more frequent in cases with peristalsis (p=0.0198). Our results suggest the utility of manual over-sewing or the use of reinforcement material.

Gastrectomy with lymphadenectomy is a standard treatment for gastric cancer. Even with advances in surgical techniques and perioperative management, anastomotic leakage remains a serious and potentially fatal complication of gastrectomy (1-3). According to a textbook, numerous factors cause or are associated with an increased risk of anastomotic leakage. These factors are classified into definitive and related factors. The definitive factors include technical aspects, the location on gastrointestinal tract, local factors, and bowel-related factors. The related factors include mechanical bowel preparation, drains, advanced malignancy, shock and coagulopathy, emergency surgery, blood transfusion, malnutrition, obesity, sex, smoking, steroid therapy, neoadjuvant therapy, deficiency of vitamin C, iron, zinc, and cysteine. Additionally, the related factors included stapler-related factors (i.e., forceful stapler extraction, tears caused by anvil or gun insertion, and failure of the stapler to close) (4). As noted above, forceful stapler extraction is a potential cause of anastomotic complications. We focused on duodenal peristalsis, which sometimes occurs, and hypothesized that it might cause forceful stapler extraction. We retrospectively investigated duodenal peristalsis. In our search of the relevant literature, we could not find any articles reporting a relationship between peristalsis and anastomotic complications.

Laparoscopic surgery for gastric cancer is recorded. However, shaking of the video camera is inevitable in these operations. In order to observe peristalsis, we observed shake-free surgery videos obtained using the Da Vinci system. We started performing laparoscopic surgery for gastric cancer using the Da Vinci system in 2015 (5). This allows peristalsis to be better observed. We reviewed the videos in these Da Vinci system cases to clarify the relationship between the frequency of peristalsis and anastomotic complications.
Patients and Methods

Forty-nine cases with stored laparoscopic surgery videos obtained using the Da Vinci system from 2015 to March 2021 were included. Informed consent was obtained from all individuals included in the study. This study was pre-approved by the Yokohama City University Ethical Committee.

These patients were diagnosed with clinical T1N0M0 and did not receive neoadjuvant chemotherapy. All patients quit smoking preoperatively. No patients received blood transfusion. Since there was no definition of peristalsis that could be applied to intestinal observation, peristalsis was defined by repeated contraction and expansion that was clearly visible three or more times in a row. We investigated the duodenum because it is frequently observed during gastrectomy. We evaluated suture failure in cases with and without peristalsis. Suture failure was defined by confirmed inflammatory findings around the anastomotic site, even if there was no obvious suture failure.

Results

The study population included 49 patients [male, n=32; female, n=17; median age, 71 (42-82) years]. Duodenal peristalsis was observed in 14 (28.6%) cases. Duodenal peristalsis appeared to cause forceful stapler extraction. Complications were observed in three cases. The postoperative complications included duodenal stump fistula in one case, which was observed on video, and intra-abdominal abscess (suspected Billroth-I reconstructive suture failure) in two cases. Duodenal peristalsis was observed in all three cases with these complications. A comparative study of cases with and without complications showed significant peristalsis in cases with complications (p=0.0198) (Table I). Age, sex, body mass index (BMI), operation time, blood loss, preoperative albumin, white blood cells (WBC), hemoglobin, and prognostic nutritional index (PNI) were not significantly associated with complications (Table II).

Discussion

Anastomotic leakage remains a serious and potentially fatal complication of gastrectomy. The incidence of anastomotic leakage after total gastrectomy is reported to range from 2.1 to 14.6% (2). After subtotal gastrectomy with Billroth-I reconstruction, the incidence of anastomotic leakage is reported to range from 1.2 to 5% (6-8). Duodenal stump fistula represents an infrequent but severe complication after total or subtotal gastrectomy for gastric cancer, with an incidence of 3% and a mortality rate ranging from 7% to 67% (3). Anastomotic leakage has a negative impact on other postoperative outcomes, elongating the median length of hospital stay, delaying oral feeding, increasing the risk of anastomotic stricture, and increasing the need for re-operation (9). Anastomotic leakage after gastrectomy is associated with a mortality rate of up to 50% and is the leading cause of death (2, 9-12). Thus, surgeons should make efforts to prevent anastomotic leakage.

Various risk factors for anastomotic leakage have been reported. Blood transfusion, malnutrition, obesity, sex, smoking, steroid therapy, and neoadjuvant therapy are well-known risk factors (1, 2, 4, 13). In this study, these factors were not associated with adverse effects at the anastomotic site. Even if patients were younger, had good nutrition, were managed without neoadjuvant chemotherapy, and were non-smokers, anastomotic leakage could still occur. Thus, it was necessary to evaluate other factors.

Reported risk factors include patient and tumor characteristics and intraoperative factors. Sufficient blood supply and adequate tension on the anastomotic site are essential for proper healing. A long operation time, invasive surgery, the anastomotic procedure, and surgeon’s inexperience (<30 cases) have all been reported as intraoperative risk factors (2). Antiadhesive agents have an adverse effect on the anastomotic site (14). We do not use antiadhesive agents around the anastomotic site. Forceful stapler extraction is a risk factor for anastomotic leakage (4). This is the first retrospective study to evaluate duodenal peristalsis during gastrectomy for gastric cancer. We hypothesized that duodenal peristalsis would apply extreme tension on the stapler. Peristalsis can be expected to twist and apply pressure to the stapler. In this study, we established a new definition to evaluate duodenal peristalsis when the repetition of contraction and expansion was clearly visible three or more times in a row. Using this definition, we observed whether peristalsis was present or not. The rate of anastomotic complications was significantly higher in cases with peristalsis (p=0.0198).

Some authors have reported a relationship between the intestinal staple line and leak pressure. Devices that produce a better mucosal capture have been associated with a significantly higher leak pressure in a porcine model (15). In contrast, in a porcine model, the integrity of the mucosal staple lines was associated with the postoperative leak pressure on day 0. However, there was no association with the leak pressure from postoperative day two (16). A lack of a statistically significant difference in the leak rate in laparoscopic sleeve gastrectomy with or without staple-line reinforcement was reported (17).

Some authors investigated over-sewing of the laparoscopic sleeve gastrectomy staple line vs. reinforcement with bovine

| Table I. Relationship between duodenal peristalsis and complications. |
|--------------------------------------|-----------------|-----------------|
| Without complications | With peristalsis | Without peristalsis |
|-------------------------|----------------|------------------|
| Without complications   | 6              | 3                |
| With peristalsis        | 40             | 0                |
| χ² test; p<0.001.       |                |                  |

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pericardial strips to reduce perioperative gastric leak. Relative to over-sewing, staple-line reinforcement with bovine pericardium was readily accomplished, safe, and was associated with a lower staple-line leak rate (18). In comparison to manual over-sewing for reinforcement, this device is associated with a shorter time for reinforcement and generalizability, irrespective of the technical difficulty. The use of a reinforcement material for closure of the duodenal stump during gastrectomy for gastric cancer is both safe and feasible (19).

In conclusion, when duodenal peristalsis is observed, we think that reinforcement material should be used in cases requiring duodenal stump closure and that reinforcement by over-sewing should be performed for gastroduodenal anastomosis. Further verification in a large-scale comparative study is necessary to determine the relationship between the duodenal peristalsis and complications.

Limitations. The present study has some limitations. First, this study is limited by the single-institute setting and retrospective design. Second, the sample size in this study is relatively small. Third, we established a new definition of peristalsis. This definition simply considers the repetition of contraction and expansion without considering the speed or power of contraction and expansion. Using this definition, anastomatic complications were significantly associated with peristalsis. This gave us confidence in the integrity of the study design. Fourth, this study did not evaluate differences between staplers. Design differences include the use of pre-compression, cartridge surface design, manual vs. powered activation, and staple height. We used an Endo GIATM Tri-Stapler, ECHELON FLEXTM GST or SureFormTM 60 with a SmartFireTM System using EGIA60AMT, GST60G, or SureForm™ 60(blue). We did not evaluate the thickness of the duodenum.

Conflicts of Interest

The Authors declare no conflicts of interest in association with the present study.

Authors’ Contributions

YR, TA and YM conceived and designed the study. IH, SS, KK, MN, HT, TS, TY, TO, AS, and NY collected patients’ clinical data and reviewed the video. YR, YM and TA had a major contribution in writing the manuscript. All Authors read and approved the final manuscript.

Acknowledgements

This study was supported, in part, by the non-profit organization Yokoyama surgical research group (YSRG).

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Received April 26, 2023
Revised May 12, 2023
Accepted May 15, 2023