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Original Article

Stapled vs handsewn anastomosis and anastomotic leaks in gastric cancer surgery—a population-based nationwide study in Finland

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ABSTRACT

Background: There is a lack of evidence regarding anastomotic technique and postoperative complications in gastric cancer surgery. This study aimed to evaluate whether there are differences between stapled and handsewn anastomosis and anastomotic leaks.

Methods: This was a population-based, retrospective, nationwide cohort study in Finland using the Finnish National Esophago-Gastric Cancer Cohort. Patients undergoing gastrectomy with available postoperative complication data were included. Logistic regression analysis was used to calculate the odds ratios with 95% CIs, adjusted for calendar period of surgery, age at surgery, sex, comorbidity, tumor stage, neoadjuvant therapy, minimally invasive surgery, type of gastrectomy, radical resection, and type of anastomosis.

Results: Of the 2164 patients, 472 of all patients (21.8%) had handsewn anastomosis and 1692 of all patients (78.2%) had stapled anastomosis. In the unadjusted analysis, anastomotic leaks were significantly lower in the handsewn group (hazard ratio [HR], 0.42; 95% CI, 0.22-0.79) than the stapled group, but after adjustment for known prognostic factors, this association was no longer significant (HR, 0.57; 95% CI, 0.27-1.21). In the analysis stratified by gastrectomy type (distal or total), no differences in anastomotic leaks were observed between anastomotic techniques.

Conclusion: In this population-based nationwide study, anastomotic technique (stapled or handsewn) was not associated with anastomotic leaks in any, distal or total, gastrectomy.

Introduction

Gastric cancer is the third leading cause of cancer mortality worldwide [1]. Multimodality treatment including surgical resection is the only curative treatment for gastric cancer, although endoscopic resection is possible in early gastric cancer. Distal gastrectomy and total gastrectomy are the 2 main procedures [2]. The anastomosis can be either handsewn or stapled (circular stapler or a linear stapler) [3]. The stapled anastomosis is the standard approach, although there are no defined indications. Anastomotic leaks occur frequently after

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gastrectomy and are associated with increased mortality and prolonged hospitalization [4].

Some single- and multicenter studies have suggested no difference between stapled and handsewn anastomosis and anastomotic complications in laparoscopic distal [5,6] or total gastrectomy [7-9] in gastric cancer. A previous study from 2014 suggested a lower incidence of anastomotic leaks and hemorrhage with stapled anastomosis than handsewn anastomosis in gastric carcinoma [10]. Nevertheless, the evidence regarding anastomotic technique and postoperative anastomotic leaks remains scarce and population-based studies are lacking.

This study aimed to evaluate the anastomotic leaks between stapled and handsewn anastomosis in gastric cancer surgery in a population-based setting. Based on previous evidence, we hypothesized that handsewn anastomosis is associated with more anastomotic leaks than stapled anastomosis in gastric cancer.

Materials and methods

Study design and data sources

This was a population-based, nationwide, retrospective cohort study based on the Finnish National Esophago-Gastric Cancer Cohort [11]. The gastric cancer cohort includes all patients undergoing gastrectomy for gastric cancer in Finland from 2005 to 2016 [12]. The study was approved by the Ethical Committee of Northern Ostrobothnia (EETMK 115/2016) and the relevant governmental bodies.

The patients were identified from the Finnish Cancer Registry and the Finnish Patient Registry. The registry data were used to identify patients that fulfill the inclusion criteria (cancer diagnosis and a related surgical operation code) and provided information on age, sex (male or female), and Charlson comorbidity index [11]. The patient records were obtained from all hospitals in Finland treating these patients for their gastric cancer. Detailed information on clinical variables were obtained from surgical and patient records by expert surgeons, including tumor stage translated to TNM eighth edition [13], resection type, margin positivity, anastomosis type, and anastomotic leaks.

Exposures

The study exposure was anastomosis technique: stapled or handsewn anastomosis.

Outcome

The primary outcome was an anastomotic leak, which is defined as full-thickness gastrointestinal defect involving the anastomosis, staple line, or conduit regardless of presentation or method of identification. Anastomotic leaks were further classified by their severity according to the Esophagectomy Complications Consensus Group classification. In this classification, leaks are divided into 3 types based on the needed therapy. Type I leaks does not require change in therapy or is treated only medically or with dietary modification. Type II leaks require interventional but not surgical therapy (eg, interventional radiology drain, stent or bedside opening, and packing of incision). Type III leaks require surgical therapy [14].

Statistical analysis

Logistic regression analysis was used to calculate the odds ratios (ORs) with 95% CIs. The crude model was not adjusted for confounders. Model 2 was adjusted for confounding variables including (1) calendar period of surgery (2005-2008, 2009-2012, and 2013-2016), (2) age at surgery (continuous variable), (3) sex (male or female), (4) comorbidity (Charlson comorbidity index score 0, 1, or ≥ 2), (5) tumor stage (0-I, II, III, or IV), (6) neoadjuvant therapy (yes or no), (7) type of surgery (minimally invasive or open), and (8) type of gastrectomy (distal or total). Given that the proportion of missing data was very low, only complete case analysis was conducted. In addition, a sensitivity analysis including only those with R0 resection was conducted. All statistical analyses were calculated using IBM SPSS 28 (IBM Corporation).

Results

Patients

A total of 2708 patients with a gastric cancer diagnosis were identified in the registries. After exclusion of missing records (n = 79) and patients not fulfilling the inclusion criteria (n = 83), there were 2546 patients left. Of these, 2176 patients underwent distal or total gastrectomy and had adenocarcinoma histology and 2164 had both complication and anastomosis data available. Of the 2164 patients, 472 of all patients (21.8%) had a handsewn anastomosis and 1692 of all patients (78.2%) had a stapled anastomosis. In the total gastrectomy group, the proportion of handsewn anastomosis was only 2.6%, and the characteristics of these patients are presented in Supplementary Table 1. In the distal gastrectomy group, the proportion of handsewn anastomosis was 52.2%, and the characteristics of these patients are presented in Supplementary Table 2. Anastomotic leaks occurred in 4.7% of the patients. Stapled anastomosis became more common over time and was used more often in patients with laparoscopic gastrectomy and total gastrectomy and in those with R0 or R1 resection (Table 1).

Anastomotic technique and anastomotic leaks

Handsewn anastomosis was associated with significantly lower risk of anastomotic leaks (2.3%; OR, 0.42; 95% CI, 0.22-0.79) than stapled anastomosis (5.4%) (Table 2). Particularly, the proportion of type III leaks was higher in the stapled group in total gastrectomy (3.5%) and in distal gastrectomy (3.0%) than the handsewn group in total gastrectomy (0%) and in distal gastrectomy (1.1%) (Table 3). After adjustment for confounding factors, the association between anastomosis technique and leaks was attenuated (adjusted OR, 0.57; 95% CI, 0.27-1.21). In the sensitivity analysis of patients with R0 resection, there were no differences in the risk of anastomotic leak comparing handsewn with stapled anastomosis (Table 2).

Anastomotic technique in distal or total gastrectomy and anastomotic leaks

In the analysis stratified by distal or total gastrectomy, no differences in leaks were observed between anastomotic techniques. In the sensitivity analysis of patients with R0 resection stratified by distal or total gastrectomy, there were no differences in the risk of anastomotic leaks comparing handsewn with stapled anastomosis (Table 4).

Discussion

The result of the present study indicated that handsewn anastomosis is not associated with less anastomotic leaks after gastric cancer surgery.

The advantages of this study include its size allowing robust analysis of estimates, population-based design reducing selection bias, and only few missing patient records. Furthermore, several confounding variables were included in the analysis. Weaknesses of this study include the relatively low number of patients with total gastrectomy and handsewn anastomosis, and therefore, these results should be cautiously applied to total gastrectomy. Furthermore, the

Table 1
Characteristics of the 2163 patients who underwent distal or total gastrectomy for gastric cancer divided into 2 groups by anastomotic technique

Variable	Anastomotic technique		
	Handsewn (%)	Stapled (%)	Total
Total	472 (21.8)	1692 (78.2)	2164 (100)
Calendar period			
2005-2008	223 (47.2)	635 (37.5)	858 (39.6)
2009-2012	147 (31.1)	558 (33.0)	705 (32.6)
2013-2016	102 (21.6)	499 (29.5)	601 (27.8)
Age at surgery, median (IQR)	72 (65-80)	70 (61-78)	71 (62-78)
Sex			
Male	260 (55.1)	945 (55.9)	1205 (55.7)
Female	212 (44.9)	747 (44.1)	959 (44.3)
Comorbidity			
0	218 (46.2)	871 (51.5)	1089 (50.3)
1	134 (28.4)	518 (30.6)	652 (30.1)
2 or more	120 (25.4)	303 (17.9)	423 (19.5)
Tumor stage			
0-1	126 (27.2)	403 (24.3)	529 (24.9)
II	126 (27.2)	490 (29.5)	616 (29.0)
III	145 (31.3)	606 (36.5)	751 (35.4)
IV	67 (14.4)	160 (9.6)	227 (10.7)
Neoadjuvant therapy			
Yes	50 (10.6)	250 (14.8)	300 (13.9)
No	420 (89.2)	1437 (85.0)	1857 (85.9)
Missing	1 (0.2)	4 (0.2)	5 (0.2)
Type of surgery			
Minimally invasive	7 (1.5)	93 (5.5)	100 (4.6)
Open	465 (98.5)	1599 (94.5)	2064 (95.4)
Type of gastrectomy			
Distal gastrectomy	443 (94.1)	403 (23.8)	846 (39.1)
Total gastrectomy	28 (5.9)	1289 (76.2)	1317 (60.9)
Type of resection			
R0	312 (69.6)	1251 (76.7)	1563 (75.2)
R1	22 (4.9)	156 (9.6)	178 (8.6)
R2	49 (10.9)	117 (7.2)	166 (8.0)
Palliative	65 (14.5)	107 (6.6)	172 (8.3)
Type of anastomosis			
End-to-end	28 (5.9)	89 (5.3)	117 (5.4)
End-to-side	249 (52.8)	1287 (76.1)	1536 (71.0)
Side-to-side	188 (39.8)	314 (18.6)	502 (23.2)
Missing	7 (1.5)	2 (0.1)	9 (0.4)

Table 2
Anastomotic technique and leaks after 30 days of gastrectomy for cancer, expressed as ORs with 95% CIs

Variable	No. patients	Anastomotic technique	
		Handsewn	Stapled
Anastomotic leaks			
Crude	2164	0.42 (0.22-0.79)	1.00 (reference)
Adjusted[a]	2123	0.57 (0.27-1.21)	1.00 (reference)
Sensitivity analysis: R0 resection only			
Crude	1563	0.49 (0.23-1.03)	1.00 (reference)
Adjusted[b]	1563	0.63 (0.26-1.55)	1.00 (reference)

ORs, odds ratios.
[a] Adjusted for confounding variables time period, age, sex, comorbidity, tumor stage, neoadjuvant therapy, type of surgery, type of gastrectomy, type of resection, and type of anastomosis.
[b] Adjusted for confounding variables time period, age, sex, comorbidity, tumor stage, neoadjuvant therapy, type of surgery, type of gastrectomy, and type of anastomosis.

Table 3
Anastomotic technique and anastomotic leak grade after 30 days of gastrectomy for cancer

Variable	Anastomotic technique		
	Handsewn (%)	Stapled (%)	Total (%)
Anastomotic leak (30 d from surgery)			
Total gastrectomy			
No	32 (94.1)	1217 (94.3)	1249 (94.3)
Yes	2 (5.9)	74 (5.7)	76 (5.7)
Distal gastrectomy			
No	429 (97.9)	384 (95.8)	813 (96.9)
Yes	9 (2.1)	17 (4.2)	26 (3.1)
Anastomotic leak grade (30 d from surgery)			
Total gastrectomy			
0	32 (94.1)	1217 (94.3)	1249 (94.3)
I	2 (5.9)	16 (1.2)	18 (1.4)
II	0 (0)	13 (1.0)	13 (1.0)
III	0 (0)	45 (3.5)	45 (3.4)
Distal gastrectomy			
0	429 (97.9)	384 (95.8)	813 (96.9)
I	3 (0.7)	2 (0.5)	5 (0.6)
II	1 (0.2)	3 (0.7)	4 (0.5)
III	5 (1.1)	12 (3.0)	17 (2.0)

Table 4
Anastomotic technique and leaks after 30 days of distal or total gastrectomy for cancer, expressed as ORs with 95% CIs

Variable	No. patients	Anastomotic technique	
		Handsewn	Stapled
Anastomotic leaks			
Total gastrectomy			
Crude	1325	1.03 (0.24-4.37)	1.00 (reference)
Adjusted[a]	1302	1.10 (0.26-4.74)	1.00 (reference)
Distal gastrectomy			
Crude	839	0.47 (0.21-1.08)	1.00 (reference)
Adjusted[a]	821	0.49 (0.21-1.16)	1.00 (reference)
Sensitivity analysis: R0 resection only			
Total gastrectomy			
Crude	1004	0.73 (0.10-5.49)	1.00 (reference)
Adjusted[b]	993	0.76 (0.10-5.78)	1.00 (reference)
Distal gastrectomy			
Crude	559	0.59 (0.23-1.55)	1.00 (reference)
Adjusted[b]	552	0.64 (0.23-1.78)	1.00 (reference)

ORs, odds ratios.
[a] Adjusted for confounding variables time period, age, sex, comorbidity, tumor stage, neoadjuvant therapy, type of surgery, type of gastrectomy, type of resection, and type of anastomosis.
[b] Adjusted for confounding variables time period, age, sex, comorbidity, tumor stage, neoadjuvant therapy, type of surgery, type of gastrectomy, and type of anastomosis.

lack of potentially relevant factors, such as patient nutritional status and physical fitness measurements, could confound the results. However, these were indirectly adjusted for by adjusting for Charlson comorbidity index. In addition, individual surgeon experience may affect the anastomotic complication rate, and a lack of this information could result in some confounding in the analysis. The proportion of patients receiving neoadjuvant therapy was low, which is a limitation but should not have a great influence on the association between anastomosis type and anastomotic leaks.

There are some previous studies on anastomotic technique and anastomotic leaks in surgical treatment of gastric cancer. A retrospective American study from 2017 (n = 72) [9] found no differences in postoperative leaks for patients who underwent prophylactic or therapeutic handsewn or stapled total gastrectomy performed by a single surgeon. A prospective Japanese study from 2004 (n = 187) [6] suggested that there are no significant differences in anastomotic leaks in handsewn vs stapled anastomoses in distal gastrectomy for cancer. A Chinese study from 2016 (n = 478) [3] suggested no difference between handsewn and stapled anastomoses and anastomotic leaks in totally laparoscopic distal or total gastrectomy for cancer. Another Chinese retrospective study (n = 188) [10] suggested lower incidence of anastomotic leaks with stapled anastomosis in

gastrectomy for gastric carcinoma. All these studies were relatively small, preventing any robust conclusions.

In the present study, which is much larger than any previous study on the topic, there was no significant difference in stapled vs handsewn anastomosis and anastomotic leaks in surgical treatment of gastric cancer. The findings suggest that handsewn and stapled anastomoses are both useful and can be applied as anastomotic techniques per surgeon preference.

This study has both clinical and research implications. Stapled anastomoses can result in higher costs [3], and anvil implantation may be challenging or the cutting edge uncertain for cancer infiltration [7]. The cost of stapler devices can be a disadvantage to surgery in some countries. Therefore, handsewn anastomosis can be useful option. Handsewn anastomosis during laparoscopy may overcome the limitations of the stapled anastomosis given that the required esophageal stump is not as long and traction is avoided [3]. The downside is that handsewn anastomosis requires more laparoscopic suturing experience [3] and it takes a longer time to do [3,7]. Larger studies are needed to establish whether there is a difference between stapled and handsewn anastomosis and anastomotic leaks in total gastrectomy for cancer. Leaks in stapled anastomosis may be more severe than handsewn anastomosis, but this association should be evaluated in randomized studies.

Conclusion

In this population-based nationwide study, anastomotic technique (stapled or handsewn) was not associated with anastomotic leaks.

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Author contributions

Elina Kvist: Writing - original draft. All FINEGO authors: Conceptualization, Methodology, Investigation, Writing - review & editing. Joonas H. Kauppila: Formal analysis, Resources, Data curation, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

The authors declare no competing interests.

Supplementary material

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.gassur.2024.03.005.

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