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Comparison of textbook outcomes between laparoscopic and open total gastrectomy for gastric cancer

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Abstract

Introduction While surgery remains an important part of the multimodal treatment of gastric cancer, laparoscopy is increasingly being used in these procedures. The aim of our study is to compare open and laparoscopic total gastrectomy using the concept of 'textbook outcome', which has become popular as an important and comprehensive tool in evaluating the quality of surgical treatment.

Methods Gastric cancer patients underwent total gastrectomy with curative intent between July 2018 and January 2024 in a single center were included in this retrospective study. Exclusion criteria were emergency surgery, recurrent or metastatic disease, conversion to open, robotic gastrectomy. Patients divided to two groups as open and laparoscopic groups and compared in terms of demographic data, tumor characteristics, operative data and textbook outcome.

Results A total of 94 patients were enrolled in the study, while the majority of whom were male (73.4%, $n=69$). Laparoscopic surgery was found longer but there was no significant difference in the incidence of anastomotic leak and other postoperative complications between the two groups. The textbook outcome rate was 50.8% in the open group while 51.5% in the laparoscopic total gastrectomy group ($p=0.949$). The most significant variables associated with the inability to achieve the textbook outcome were readmissions, reinterventions and postoperative complications.

Conclusion Achievement of textbook outcomes was found to be similar between the open and laparoscopic groups. Laparoscopic total gastrectomy can be safely preferred taking into account patient status, surgeon expertise and center conditions.

Keywords Gastrectomy, Textbook outcome, Laparoscopy

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Introduction

Gastric cancer is the fifth most common cancer and one of the leading causes of cancer-related deaths worldwide [1]. Despite advances in multimodal treatment regimens, surgery remains the most important tool we have in the fight against gastric cancer [2, 3].

Traditional evaluation of surgical care has focused on morbidity and mortality. However, this approach did not seem sufficient to cover the different aspects of perioperative surgical care. In 2017, the Dutch Upper Gastrointestinal Cancer Audit group developed a composite measure for gastric cancer surgery. Initially defined as a 'textbook outcome' in colorectal surgery, the concept was subsequently carried over to and popularised in the field of gastric surgery [4, 5]. Subsequently, it has been employed to examine the quality of surgical care in a range of complex surgical procedures, including those pertaining to oesophageal and pancreatic cancers [4, 6, 7]. On the other hand, minimally invasive surgery (MIS) is becoming increasingly common both in general and in gastric cancer surgery [8]. The efficacy and safety of the minimally invasive approach in subtotal gastrectomy has been strongly supported by both short-term and long-term results [9]. But, the use of MIS for total gastrectomy is still a topic of research [7, 8, 10–12]. Although robotic surgery has also been used, laparoscopy continues to be the main route of access to minimally invasive surgery. In our study, we aimed to compare the results of laparoscopic total gastrectomy (LTG) with the open method through the textbook outcome data, which is a current concept.

Methods

Gastric cancer patients underwent total gastrectomy with curative intent between July 2018 and January 2024 in a single center were included in this retrospective observational study. Exclusion criteria were designed to achieve highly homogeneous groups and to focus on total gastrectomy. These were emergency surgery, recurrent or metastatic disease, conversion to open surgery, robotic gastrectomy. Enrolled patients divided to two groups as open total gastrectomy (open group) and laparoscopic total gastrectomy (lap group).

Data of patients obtained via the hospital software system. Demographic data, body mass index(BMI), Charlson comorbidity index (CCI) score and baseline characteristics, operative and postoperative results, tumor characteristics and textbook outcome results were investigated. Postoperative complications were pancreatic fistula, pleural effusion, pneumonia, anastomotic leak, intraabdominal abscess, surgical site infection, postoperative ileus.

All patients were already curative-intent surgery patients and underwent total gastrectomy and D2 lymphadenectomy. Four surgeons experienced in gastrointestinal surgery and advanced laparoscopy performed the procedures. Apart from this, the list of textbook outcome criteria [4] for a patient who had a textbook outcome was as follows: no intraoperative complication, achievement of tumor-negative margins, including ≥ 15 harvested lymph nodes in resected specimen, no severe postoperative complication(Clavien-Dindo Score ≥ 3, (CD)), no reintervention, no readmission to intensive care unit after once coming to the surgical ward, no prolonged hospital stay (≤ 21 days), no postoperative mortality (30 days) and no readmission after discharge from the hospital.

Pearson chi-square, the Fisher exact and Mann-Whitney U tests were used when appropriate. Decision for normal distribution was given according to Shapiro Wilk test. Categorical variables are expressed as number and percentage. The variables that not showed a normal distribution expressed as median and 25–75 interquartile range values. Statistical significance level was set at 0.05 and. The data were compiled and analyzed using the software SPSS for Windows, version 29.0 (SPSS, Chicago, IL).

Institutional ethical board approval was obtained for this study. The study was registered with the Clinical Trials Protocol Registration and Results System (Trial ID: NCT06758934). The study also followed the "Strengthening The Reporting of Cohort, Cross-sectional, and Case-control Studies (STROCCS)" statement [13] and complied with the principles of The Code of Ethics of the World Medical Association (Declaration of Helsinki).

Results

A total of 94 patients were enrolled in the study, while the majority of whom were male (73.4%, $n = 69$). There were 61 patients who underwent open total gastrectomy, while the remaining 33 patients were in the laparoscopic total gastrectomy group. Flowchart of the study shown in Fig. 1. Groups were similar regarding demographic data, BMI and CCI scores. Baseline characteristics are presented in Table 1. Of the patients, 25% received neoadjuvant treatment.

Groups were similar regarding tumor characteristics (Table 2). High grade and advanced gastric cancer was the majority in both groups. Laparoscopic surgery was found to have a significantly longer duration than open conventional approach ($p < 0.001$, CI 95%: -0.770–0.430). Furthermore, there was no significant difference in the incidence of anastomotic leak and other postoperative complications between the two groups. Length of hospital stay did not differ between groups ($p = 0.715$, CI 95%: -0.108-0.212). Particularly, while not carrying a statistical significance, rate of complications such as surgical site infection, pneumonia were higher in the open total gastrectomy group.

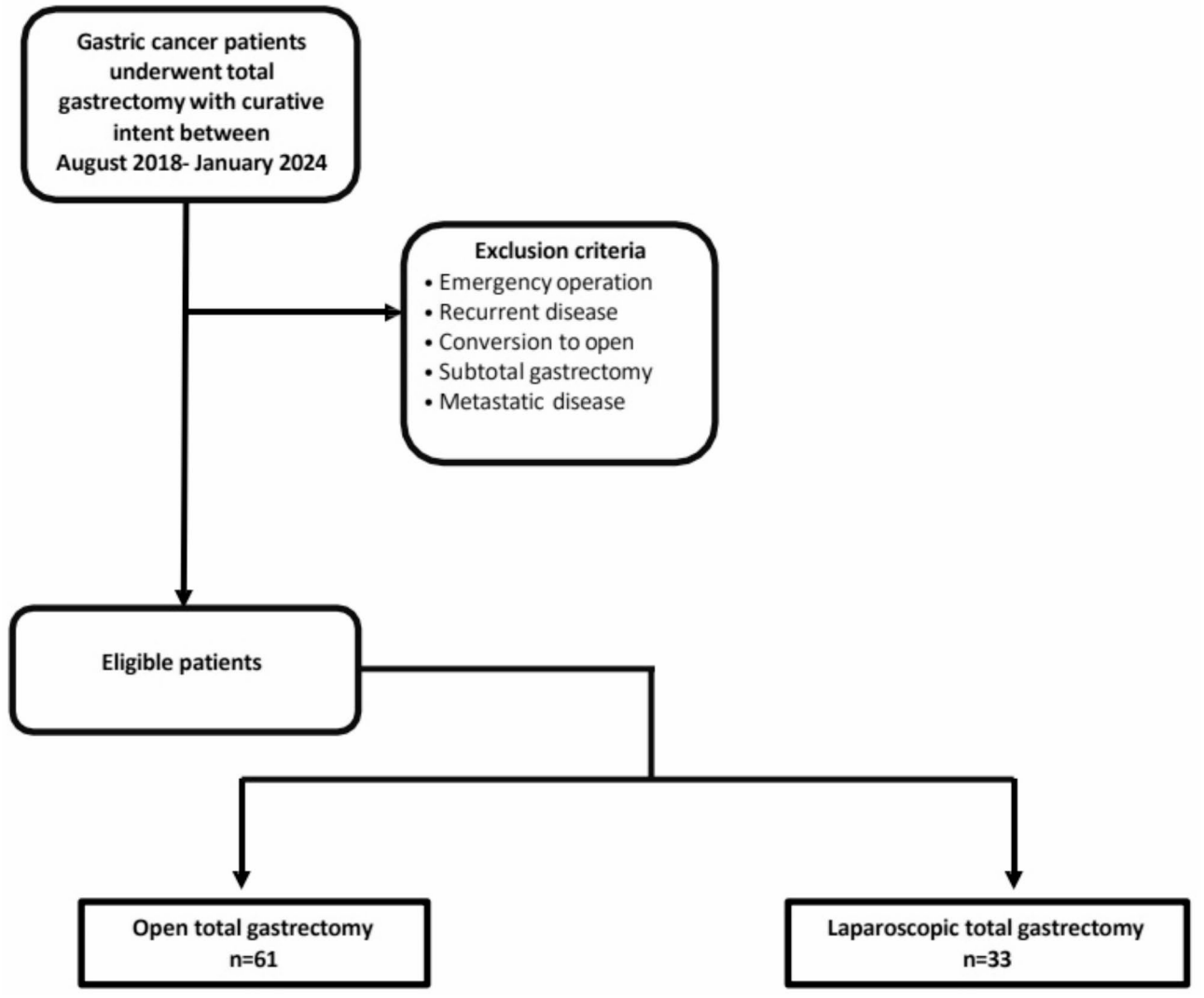

Fig. 1 Flowchart diagram of the study

Table 1 Baseline characteristics of the groups

	Open (*n* = 61)	Lap (*n* = 33)	*p* value
Age	67(57.5–71.5)	66(57–75)	0.855
Male	48(78.7)	21(63.6)	0.115
BMI	25.2(21.1–27.6)	26.1(23.1–29.5)	0.123
ASA			
II	29(47.5)	10(30.3)	0.105
III	32(52.5)	23(69.7)	
CCI			
≤ 3	32(52.5)	13(39.4)	0.226
≥ 4	29(27.5)	20(60.6)	
Neoadjuvant treatment	16(26.2)	9(27.3)	0.913
Tumor location			
EGJ	12(19.7)	7(21.2)	0.962
Cardia	22(36.1)	11(33.3)	
Corpus	27(44.3)	15(45.5)	

Abbreviations: ASA: American Society of Anesthesiologists; BMI: Body mass index; CCI: Charlson comorbidity index; EGJ: Esophagogastric junction

Table 2 Comparison of tumor characteristics, operative and postoperative data

	Open (*n* = 61)	Lap (*n* = 33)	*p* value
Grade			
I	4(6.6)	4(12.1)	0.639
II	21(34.4)	10(30.3)	
III	36(59.0)	19(57.6)	
T stage			
I	7(11.9)	5(17.2)	0.714
II	7(11.9)	3(10.3)	
III	18(30.5)	11(37.9)	
IV	27(45.8)	10(34.5)	
Total lymph nodes	26(18–37)	26(17.5–39)	0.727
Metastatic lymph nodes	3(0–9)	2(0–12)	0.987
Duration of operation (min)	210(190–255)	350(302–375)	**< 0.001**
Postoperative complications	25(41)	9(27.3)	0.187
Pancreatic fistula	2(3.3)	0(0)	0.539
Pleural effusion	17(27.9)	7(21.2)	0.480
Pneumonia	8(8.5)	2(2.1)	0.290
Esophagojejunal leakage	4(6.7)	3(9.1)	0.672
Duodenal stump leakage	3(4.9)	1(3)	> 0.999
Intraabdominal abscess	6(9.8)	3(9.1)	0.907
Surgical site infection	14(23)	3(9.1)	0.096
Postoperative ileus	3(4.9)	1(3.0)	0.665
Clavien-Dindo			
I	31(50.8)	21(63.6)	0.634
II	20(32.8)	8(24.2)	
III	6(9.8)	4(12.1)	
IV	1(1.6)	0(0)	
V	1(1.6)	0(0)	
Length of hospital stay (days)	7(6-8.5)	7(6-8.5)	0.715

Table 3 Comparison of textbook outcome data

	Open (*n* = 61)	Lap (*n* = 33)	*p* value
Curative-intent resection	61(100)	33(100)	
No intraoperative complication	58(95.1)	31(93.9)	0.814
Tumor-negative resection margins	55(90.2)	28(84.8)	0.444
≥ 15 lymph nodes in resected specimen	55(90.2)	29(87.9)	0.732
No severe postoperative complication	53(86.9)	29(87.9)	0.890
No reintervention	51(83.6)	28(84.8)	0.875
No readmission to ICU	56(91.2)	31(93.9)	0.707
No prolonged hospital stay	60(98.4)	32(97)	0.656
No postoperative mortality	55(90.2)	32(97.0)	0.415
No readmission after discharge	43(70.5)	27(81.8)	0.229
Textbook outcome	31(50.8)	17(51.5)	0.949

Abbreviations: ICU: Intensive care unit

The textbook outcome rate in the open group was 50.8% 95% CI 41.1–60.5 and in the laparoscopy group, the textbook outcome rate was 51.5% 95% CI 41.8–61.1. The difference in the textbook outcome rates between the two groups was 0.7%, and the CI 95%: -13.2-14.6 (RR: 1.01, $p = 0.949$) (Table 3). The most significant variables associated with the inability to achieve the textbook outcome were readmissions, reinterventions and postoperative complications.

Discussion

Laparoscopic total gastrectomy is a technically demanding procedure due to the extent of lymph node dissection, the type of anastomosis and the relatively higher risk of bleeding compared to subtotal gastrectomy. Therefore, confirmation of it's safety by the surgical literature seems not achieved synchronously to studies on minimally invasive subtotal gastrectomy [8]. In this context some

studies include mixed data of gastrectomies (proximal, distal, total) [8]. To our knowledge, this study is the first to compare open surgery with laparoscopy for only total gastrectomy within the textbook outcome parameters.

In our study, the textbook outcome rate was found to be 51.5% for laparoscopic procedures, 50.8% for open procedures, and 51.1% for the total cohort of patients. This rate is comparable to other examples in the literature and slightly higher than the mean outcome rate reported in the DUCA audit [4, 5, 7, 14] while it is lower than that reported in some rare studies [6, 15]. In this study, the inclusion of a significant number of advanced tumors may have prevented the achievement of a higher TO rate, as exemplified in another study too [16]. Eventually in our study laparoscopic surgery provided similar textbook outcome rate to open gastrectomy as in the study by Bolger et al. [10] or some other several clinical trials most of which were from East Asia [3]. This study showed consistent outcomes in a different region in terms of the textbook outcome.

The criteria that were primarily responsible for the failure to achieve textbook outcome were tumor-negative resection margins, no reintervention, no readmission after discharge. In a systematic review focused to TO in gastrectomy, worst contributors for TO in most of the studies were ≤ 15 lymph nodes and severe complications [15]. But to note a difference, in some of them severe complication defined as CD ≥ II [15].

The number of male patients was significantly higher than the number of female patients, a finding that is consistent with other examples and global cancer data [1, 7, 17]. No notable discrepancy was observed between the groups with respect to BMI scores. However, we can note that the mean BMI score of all patients in this study is slightly higher than most of the literature examples, which are generally from East Asia [8] while similar to a European study [17]. We should also remember that BMI score has been found to be associated with adverse outcomes and lower TO rate [5].

The extent of lymph node dissection and the number of harvested lymph nodes are crucial factors in determining the oncological adequacy of the surgical procedure [8, 18, 19]. The completion of the surgical procedure via laparoscopy can facilitate superior lymph node harvesting and a more comprehensive examination of the surgical area through the use of an endoscope. This is undoubtedly a significant advantage in this context. In the present study, all patients underwent D2 dissection, and no significant intergroup differences were observed with regard to the total number or the number of metastatic lymph nodes. A systematic review by Yang et al. also shared similar outcome [20]. A significantly longer operative time was detected in LTG group which can be expected finding like in other studies [19, 21]. The clearance of optical instruments during operation and the necessity for additional time to change instruments have been identified as potential contributors to prolonged surgical procedures in laparoscopy [22]. But longer surgery does not mean more complications [19, 20].

Perioperative complications have significant impact on short term results and survival [23, 24] The most prevalent type of complications in our study were postoperative pulmonary complications which align with the findings of a similar study (Table 2) [10, 20]. Pulmonary complications identified as a major cause of post-operative mortality [25]. We should keep in mind that shorter incisions associated with better postoperative pulmonary functions. In particular, incisions in the upper abdomen have a negative impact on lung function, and poorer pain scores lead to poorer diaphragmatic movement and, ultimately, poorer respiratory function [20, 25, 26]. On the other hand, the less exposure of the peritoneal cavity, the more likely it is that there will be fewer adhesions, which would improve bowel movements [26]. Also the anastomotic leakage rate in our study (7.5%, $n = 7$) shared a similar range within previous examples [12, 17, 21]. It has been mentioned minimally invasive surgery reduce overall perioperative complications [8, 10]. Despite our study results confirmed this tendency in terms of some particular complication types, different complication rates between groups were not statistically significant (Table 2). A multicenter randomized study also revealed a comparable incidence of postoperative complications between open and laparoscopic gastrectomy techniques [21]. Comparison of major complications between groups also showed no significant difference which is consistent with the findings of another example [17].

Primary limitation is the single-centre, retrospective nature of the study. Number of patients can be added as another limiting factor. However, focusing solely on patients who underwent total gastrectomy and forming more homogeneous groups offered a superior potential for the generalizability of the results. Additionally, the age and BMI scores of the patients, along with the high percentage of advanced tumors observed in the study, contributed to the generalizability of the outcomes. In this regard, the present study offers a valuable contribution to the evaluation of the benefits and potential of minimally invasive total gastrectomy for gastric and esophagogastric cancers. Conversely, the incorporation of quality of life and survival data would undoubtedly enhance the study's value. However, the absence of these data points represents a further limitation.

Conclusions

Laparoscopic total gastrectomy for esophagogastric junction and gastric cancers was found to be as safe as the conventional open method. The achievement of textbook

outcome rates was demonstrated to be similar between open and laparoscopy groups.

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Author contributions
Conceptualization: YMK, MK, AYG, BA; Data curation BA, SB, YMK; Formal analysis SB, YMK, AS, TD; Investigation: AS, AYG, TD, MK; Methodology; YMK, MK, AYG, TD; Project administration; YMK, BA, SB, TD, MK; Supervision: MK, AYG, TD, AS; Writing – original draft: YMK, SB, TD, MK, AYG; Writing – review & editing: YMK, SB, BA, AS, TD, AYG, MK. All authors reviewed the manuscript.

Data availability
The datasets generated and analysed during the current study are not publicly available due to institutional policies but are available from the corresponding author on reasonable request.

Declarations

Ethical approval and consent to participate
This study was approved by the Institutional Ethics Committee of Bakırköy Dr. Sadi Konuk Training and Research Hospital with protocol number 2024/213 on 22.07.2024. Informed consent to participate was obtained from all patients. The study was registered with the Clinical Trials Protocol Registration and Results System (Trial ID: NCT06758934 Record Date 16.12.2024). The study also complied with the principles of The Code of Ethics of the World Medical Association (Declaration of Helsinki).

Consent for publication
Not applicable. No identifying images or other personal or clinical details of participants included.

Competing interests
The authors declare no competing interests.

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