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ORIGINAL ARTICLE

Impact of conversion during laparoscopic gastrectomy on outcomes of patients with gastric cancer

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Summary

Purpose: *This study reports the impact of conversion from laparoscopic gastrectomy to open gastrectomy on the short- and long-term outcomes of patients with gastric cancer.*

Methods: *Retrospective analysis of clinical and follow-up data of 236 patients with gastric cancer who underwent laparoscopic gastrectomy between January 2010 and October 2016 was performed. Patients were divided into the conversion and complete laparoscopy groups based on whether conversion to open gastrectomy occurred during surgery or not. Short- and long-term outcomes were compared between these two groups.*

Results: *The conversion rate was 10.1% (24/236). The reported reasons for conversion were adhesion, obesity, uncontrollable bleeding, and T4 stage tumor during surgery. Compared to the complete laparoscopy group, patients in the conversion group had longer operation time (p=0.028), greater intraoperative blood loss (p=0.011), and longer hospital stay (p=0.030). No statistically significant differences were found in the incidence and severity of complications within postoperative 30 days between the two groups. Obesity, tumor site in the upper gastric region, and surgery performed between 2010 and 2012 were independent predictors for conversion. Additionally, no statistical differences in the pathological findings and long-term outcomes were found between the two groups.*

Conclusion: *Except from increased operation time, intraoperative blood loss, and length of hospital stay, conversion from laparoscopic gastrectomy to open gastrectomy had no impact on postoperative complications and long-term outcomes of patients with gastric cancer.*

Key words: *conversion, gastric carcinoma, laparoscopic gastrectomy, minimally invasive surgery, prognosis*

Introduction

In recent years, due to developments in laparoscopic equipment, improved training, and accumulation of surgical experience, laparoscopic gastrectomy is increasingly used for the treatment of gastric cancer [1-8]. Compared to open gastrectomy, laparoscopic gastrectomy involves a smaller surgical wound, faster postoperative recovery, and lower or comparable complication rates [1-8]. Furthermore, several authors indicated that tumor recurrence rate, overall survival rate, and disease-free survival rate were comparable between laparoscopic and open gastrectomy [5-8]. However, conversion to open gastrectomy during laparoscopic gastrectomy is an unavoidable phenomenon in a number of patients [1-4]. Common reasons for conversion are adhesions, uncontrollable bleeding, obesity, narrow operative field, T4 tumor stage, bulky tumors, tumor infiltration of other organs, laparoscopic anastomotic failure, etc [1-5]. Experience from laparoscopic colectomy has shown that compared with patients without conversion, patients with conversion had longer operation time, increased intraoperative blood loss, and longer hospital stay [9-12]. However, a

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search of large databases (such as Medline, Embase, Web of Science) by the authors did not yield any literature reports regarding the impact of conversion of laparoscopic gastrectomy to open gastrectomy on short-term and long-term outcomes of patients with gastric cancer. Hence, this study aimed to report the impact of conversion on short-term and long-term outcomes of patients with gastric cancer.

Methods

This study retrospectively analyzed the clinical and follow-up data of 236 patients with gastric cancer who underwent laparoscopic gastrectomy between January 2010 and October 2016 in our hospital. Patients were divided into conversion and complete laparoscopy groups, based on whether conversion to open gastrectomy occurred during surgery or not. Indications for laparoscopic gastrectomy were: (1) early stages of gastric cancer (cT1-3N0-1M0); (2) no prior upper abdominal surgery, such as cholecystectomy or splenectomy; (3) no prior tumor-related therapy, such as neoadjuvant therapy. Patients underwent endoscopy, endoscopic ultrasound, and brain, chest, and abdominal computed tomography (CT) scans to confirm the clinical stage of cancer and exclude tumor metastases. Positron emission tomography (PET)-CT and bone scans were performed if necessary [13-16].

The details of the surgical procedure were described elsewhere [17]. The severity of postoperative 30-day complications was evaluated according to the Clavien-Dindo classification. The definition of Clavien-Dindo system was as follows: Grade 1: oral medication or bedside medical care required; Grade 2: intravenous medical therapy required; Grade 3: radiologic, endoscopic, or operative intervention required; Grade 4: chronic deficit or disability associated with the event; and Grade 5: death related to surgical complication. Mild complications were defined as Grades 1 and 2, while severe complications were defined as Grades 3, 4, and 5 [18-23]. Patients with pathological stage ≥ II, with no obvious contraindications for chemotherapy, were administered adjuvant chemotherapy according to the surgeon's recommendation [24]. The adjuvant chemotherapy regimen was decided by the medical oncologist. Discharged patients were followed-up through outpatient consultation, telephone, or postal mail. Postoperative follow-up was performed once every three months in the first year, once every four months in the second year, once every six months in the third year, and once a year thereafter [25-27]. In addition, patients received in-hospital treatment for any instance of physical discomfort. As all patients were local residents, the follow-up rate was 100%. The last follow-up was in December 2016. The research was approved by our local ethics committees. The requirement of informed consent from patients was waived because of the retrospective nature of the research, since it was not a prospective study.

Statistics

Data are presented as means and standard deviations for variables with normal distribution. For data with a non-normal distribution, results are expressed as medians and ranges. Survival rates were analyzed using the Kaplan-Meier method. Univariate analyses were performed to identify prognostic variables related to overall survival (OS) and disease free survival (DFS). Univariate analyses were performed to identify the prognostic variables related to conversion. Univariate variables with probability values <0.05 were selected for inclusion in the multivariate Cox proportional hazard regression model. A p value < 0.05 was considered statistically significant. SPSS 14.0 (SPSS Inc., Chicago, IL, USA) for Windows was used for all statistical analyses.

Results

Twenty-four patients underwent conversion to open gastrectomy during laparoscopic gastrectomy; therefore, the conversion rate was 10.1% (24/236). Reasons for conversion were adhesions (10 cases), uncontrollable bleeding (6 cases), obesity (5 cases), and T4 tumor found in surgery (3 cases) (Table 1).

Table 2 shows no statistically significant differences in age, sex, ASA (American Society of Anesthesiologists) grading, and clinical stages between the complete laparoscopy and conversion groups. However, a higher proportion of obese patients (BMI > 30 kg/m^2), and patients with tumor in the upper gastric region were found in the conversion group compared to the complete laparoscopy group. Furthermore, patients who underwent surgery between 2010 and 2012 had a higher conversion rate compared to those who underwent surgery between 2013 and 2016.

Tables 3 and 4 show the short-term outcomes and reveal that, compared with the complete laparoscopy group, patients in the conversion group had a higher rate of total gastrectomy, longer operation times, increased blood loss, and longer hospital stay. No statistically significant differences were found in time to flatus and time on liquid diet. No intraoperative or postoperative 30-day death occurred in this study. Additionally, no statistically significant differences in the incidence and severity of postoperative 30-day complications and in pathological data, such as TNM stage,

Table 1. Reasons for conversion

Reasons	*n (%)*
Adhesion	10 (41.7)
Bleeding	6 (25.0)
Obesity	5 (20.8)
Intraoperative T4 tumor	3 (12.5)

lymph node dissection, and grade of tumor differentiation, were found between the two groups.

Multivariate analysis indicated that obesity, tumor site in the upper gastric region, and surgery performed between 2010 and 2012 were independent predictors for conversion (Table 5).

The median follow-up time was 37 months in the complete laparoscopy group and 34 months in the conversion group, with no statistically significant difference between the two groups (p=0.102). On the last follow-up visit, tumor relapse was detected in 46 patients in the complete laparoscopy group and 8 patients in the conversion group (p=0.303). No statistically significant differences in disease recurrence rate was noticed (p=0.303). The 5-year OS rates were 57 and 51% in the complete laparoscopy group and conversion group, respectively, with no statistically significant difference between the two groups (p=0.995, Figure 1). The 5-year DFS rates were 41 and 43% in the complete laparoscopy and conversion groups, respectively, with no statistically significant difference between the two groups (p=0.624, Figure 2).

Table 2. Baseline characteristics in the complete laparoscopic and converted group

Characteristics	*Complete laparoscopy group (n=212)*	*Converted group (n=24)*	*p value*
Age, years, median (range)	58 (41-74)	61 (40-75)	0.108
Gender			0.801
Male	138	15	
Female	74	9	
BMI (kg/m2), median (range)	24 (19-28)	29 (23-35)	0.027
Clinical TNM stage, n			0.467
T1	41	7	
T2	680	8	
T3	103	9	
Location of the primary tumor, n			
Upper	65	15	0.002
Middle	68	4	0.120
Lower	79	5	0.111
ASA score, n			0.453
I	156	16	
II	51	7	
III	5	1	
Date of surgery, n			0.002
2010-2012	84	18	
2013-2016	129	6	

BMI: body mass index, ASA: American Society of Anesthesiologists

Table 3. Surgical outcomes in the complete laparoscopic and converted group

Outcomes	*Complete laparoscopy group (n=212)*	*Converted group (n= 24)*	*p value*
Type of surgery			0.008
Total gastrectomy	98	18	
Distal gastrectomy	114	6	
Operative time (min), median (range)	170 (140–270)	200 (160–300)	0.028
Estimated blood loss (ml), median (range)	210 (160–600)	280 (210–560)	0.011
Blood transfusion, n	41	8	0.181
Hospital stay after gastrectomy (d), median (range)	7 (5-21)	10 (6-22)	0.030
Time to first flatus (d), mean±SD	3.1±0.8	3.5±0.6	0.239
Liquid diet start time (d), mean±SD	4.2±1.1	4.5±1.4	0.158
Soft diet start time (d), mean±SD	6.3±0.9	6.8±1.2	0.358
Patients with complications, n	34	6	0.411
Intra-abdominal abscess	4	2	
Intra-abdominal bleeding	4	1	
Anastomotic leakage	5	1	
Pancreatic fistula	6	1	
Ileus	7	0	
Lymphatic fistula	4	0	
Heart failure	4	1	
Patients with major complications, n	5	1	1.000
Mortality within 30 postoperative days	0	0	-

Table 4. Pathological outcomes in the laparoscopic and converted group

Outcomes	*Complete laparoscopy group (n=212)*	*Converted group (n= 24)*	*p value*
Retrieved lymph nodes, median (range)	23 (16-28)	18 (16-24)	0.145
Pathological TNM stage			0.497
I	38	5	
II	97	8	
III	77	11	
Histological differentiation, n			0.216
Well differentiated	45	7	
Moderately differentiated	88	11	
Poorly differentiated	67	5	
Signet ring-cell type	12	1	
Lauren classification, n			0.104
Intestinal	69	9	
Diffuse	76	13	
Mixed	67	2	
Residual tumor, n			1.000
R0	212	24	
R1	0	0	

Table 5. Risk factors of conversion

Variables	*Univariate analysis OR (95% CI)*	*p value*	*Multivariate analysis Adjusted OR (95% CI)*	*p value*
Age (≥70 vs < 70 years)	1.1874 (0.485–1.450)	0.269	-	-
Tumor location (upper vs middle and lower)	1.697 (1.257–2.403)	0.048	1.369 (1.100–2.589)	0.018
BMI (≥30 vs <30 kg/m2)	1.874 (1.489–3.012)	0.010	1.450 (1.204–2.367)	0.020
Date of surgery (2010-2012 vs 2013-2016)	1.248 (1.128–2.320)	0.044	1.650 (1.328–2.410)	0.020
Clinical TNM stage (III vs I and II)	1.160 (0.452–1.820)	0.229	-	-

OR: odds ratio, CI: confidence interval, BMI: body mass index

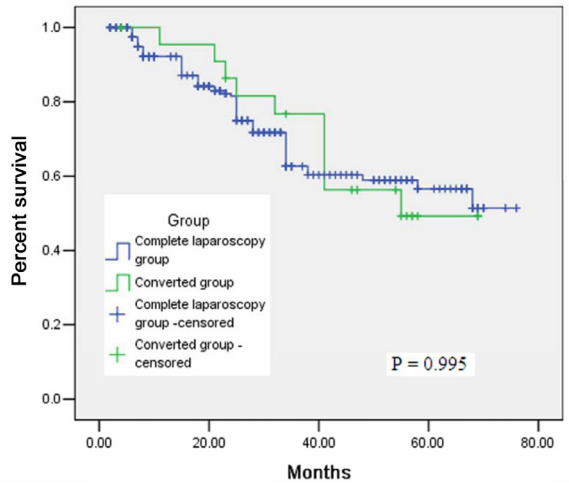

Figure 1. Overall survival of complete laparoscopy versus converted groups.

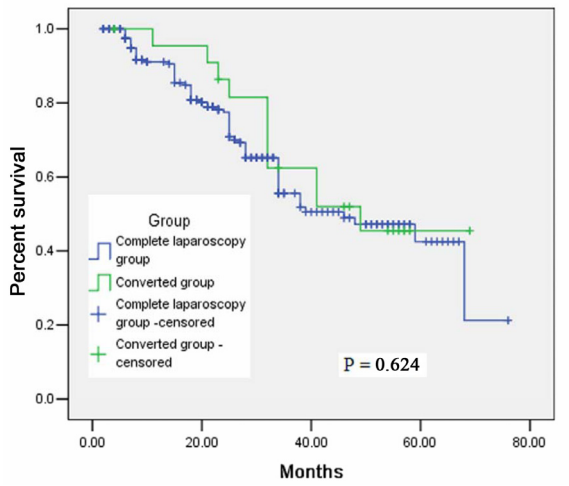

Figure 2. Disease-free survival of complete laparoscopy versus converted group.

Discussion

Laparoscopic gastrectomy is a technically demanding operation of minimally invasive surgery. Studies have shown that the learning curve for laparoscopic gastrectomy is 50 cases, i.e., surgeons will need to operate on 50 cases to be familiar with this technique [28-33]. Hence, conversion is unavoidable. Previous large-sample studies have shown that the conversion rates for laparoscopic gastrectomy ranged between 0–20% [28-33]. Experience from laparoscopic colectomy has shown that conversion leads to longer operation time, increased blood loss, increased incidence of postoperative complications, and longer hospital stay [9-12]. However, no study regarding the impact of conversion on short- and long-term outcomes in patients who underwent laparoscopic gastrectomy is available. To the best of our knowledge, this study is the first to show that in patients who underwent laparoscopic gastrectomy, conversion led to increased operation time, increased blood

loss, and longer hospital stay. However, no differences in the incidence and severity of postoperative complications were found. This is because postoperative complications are affected by multiple factors, such as underlying disease and surgical experience. In this study, once conversion had occurred, an experienced surgeon would take over the surgery. Thus, the incidence and severity of postoperative 30-day complications were similar between the complete laparoscopy and conversion group.

This study has shown that conversion had no impact on long-term outcomes, with comparable tumor recurrence rate, 5-year OS rate and 5-year DFS rate between the two groups. The reason for this was that conversion was mainly due to technical reasons, with only three patients undergoing conversion due to tumor factors (detected as T4 during surgery). Most surgeons have listed T4 gastric cancer as a contraindication for laparoscopic gastrectomy, because pneumoperitoneum, which is used in laparoscopic technique, could cause tumor spread. Nevertheless, a study has shown that in patients with stage T4 gastric cancer, long-term outcomes were similar between those who underwent laparoscopic gastrectomy and those who underwent open gastrectomy [34]. However, in that study, the sample size was 61 patients and it was a retrospective analysis, hence the level of evidence was relatively low [34]. The suitability of laparoscopic gastrectomy in T4 tumor warrants further investigation.

The key to lower conversion rates lies in patient selection. In the present study, it was shown that obesity, tumor site in the upper gastric region, and surgery conducted between 2010 and 2012 were independent predictors of conversion. Currently, no studies are available in the English literature on the predictors affecting conversion during laparoscopic gastrectomy. In obese patients, the exposure of the laparoscopic visual field is poor and tissue structure is unclear, which could easily affect the surgical procedure [29]. Tumors located in the upper gastric region is an indication for total gastrectomy, which requires more lymph node dissection and is technically more challenging than laparoscopic distal gastrectomy [30]. Hence, it is a predictor for conversion. Our unit began performing laparoscopic gastrectomies in January 2010. At that point, we had less initial experience, and had not crossed the learning curve. As a result, the rate of conversion in the initial stages of conducting this surgery was high. The initial stages of laparoscopic gastrectomy should begin with the selection of patients with BMI < 30 kg/m^2, who are suitable for distal gastrectomy, and conducted under the guidance of surgeons with more than 50 cases of experience. This will lower the conversion rate and enable the accumulation of experience for more complicated operations.

This study has several strengths. To the best of our knowledge, our study is the first to evaluate both potential predictors and effects of conversion on long-term survival and disease recurrence. Additionally, we were able to detect the time of laparoscopic attempt before conversion to assess whether early conversion would influence perioperative complications. However, this study also presents some limitations. First, it was a single-center study, thus the relative small sample size may reduce the study robustness. Second, it was a nonrandomized study subject to selection bias, because the decision for laparoscopic gastrectomy was made at the discretion of the surgeon based on experience.

Conclusion

In conclusion, apart from increased operating time, intraoperative blood loss, and hospital stay, conversion did not affect the rate and severity of complications and long-term outcomes in patients with gastric cancer who underwent laparoscopic gastrectomy. Obesity, tumor site in the upper gastric region, and lack of surgical experience are independent predictors for conversion.

Conflict of interests

The authors declare no confict of interests.

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