Clinical Significance of Conversion Surgery for Gastric Cancer with Peritoneal Dissemination: A Retrospective Study

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Keywords
Conversion surgery · Gastric cancer · Peritoneal dissemination

Abstract
Objective: Although chemotherapy has been clinically recommended as the initial treatment for patients with peritoneal dissemination of gastric cancer, poor prognosis has been noted among the same patients. However, the prognostic significance of conversion surgery after chemotherapy remains unclear. The present study therefore aimed to assess the clinical impact of conversion surgery among patients with peritoneal dissemination of gastric cancer.

Methods: A total of 93 patients with peritoneal dissemination of gastric cancer undergoing chemotherapy between February 2002 and October 2019 were retrospectively enrolled and subsequently divided into progressive disease (PD) and non-PD groups based on tumor response to chemotherapy.

Results: Among the included patients, 17 developed distant metastases at another site besides peritoneal dissemination. Based on tumor response, 24 and 69 patients were determined to have PD and non-PD, respectively, with the former having significantly poorer prognosis than the latter \((p < 0.0001)\). A total of 19 patients underwent conversion surgery after chemotherapy, with the presence or absence of conversion surgery being significantly correlated with age, first-line chemotherapy regimen, and tumor response \((p = 0.0134, p = 0.0337, \text{ and } p = 0.0024, \text{ respectively})\). Patients in the non-PD group who underwent conversion surgery or chemotherapy alone had 3-year overall survival rates of 55.6 and 6.6%, respectively. Multivariate analysis identified conversion surgery alone as an independent prognostic factor in the non-PD group \((p < 0.0001)\).

Conclusion: Our retrospective study demonstrated that conversion surgery for gastric cancer with peritoneal dissemination might improve the prognosis of responders who developed no peritoneal dissemination after chemotherapy.

Introduction
Gastric cancer is one of the most common gastrointestinal malignancies in Asia and the third leading cause of cancer death worldwide \([1]\). Although recent developments in chemotherapy have considerably improved the
prognosis of patients with unresectable advanced or recurrent gastric cancer, studies have reported a 8.8–14.9% 5-year survival rate among patients with stage IV disease [2, 3]. In particular, peritoneal dissemination has been one of the representative metastatic patterns among patients with advanced gastric cancer, with large type 3 and type 4 tumors frequently leading to peritoneal dissemination (P1) or positive peritoneal cytology (CY1) [4]. A retrospective study based on staging laparoscopy reported that 53.4% of patients with large type 3 and type 4 gastric cancer develop P1 or CY1 [4]. Reports have shown that patients with CY1 and P1 have a poor prognosis with a 5-year overall survival (OS) rate of 12.3 and 8.3%, respectively [2]. Currently, CY1 and P1 have been defined as distant metastasis (M1) in both the Tumor-Node-Metastasis (TNM) classification for gastric carcinoma established by the International Union Against Cancer and the Japanese Classification of Gastric Carcinoma [5, 6]. Consequently, gastric cancers with CY1 or P1 are classified into stage IV [5, 6]. The aforementioned findings demonstrate that peritoneal dissemination is one of the most important prognostic factors among patients with gastric cancer.

The Japanese Gastric Cancer Treatment Guidelines 2018 recommend systemic chemotherapy as the standard first-line treatment for patients with M1 gastric cancer, including peritoneal dissemination [7]. Recently, Yoshida et al. [8] proposed a new biological classification for the therapeutic guidance for patients with stage IV gastric cancer. This new classification categorizes patients with stage IV gastric cancer into four groups (categories 1–4), with those having P1 belonging to category 3 or 4 [8]. Moreover, the therapeutic strategy for patients with various malignancies, including gastric cancer, focuses on conversion therapy based on the concept that patients with category 3 and 4 can achieve curative resection (R0) following surgery [8]. To date, several investigators have reported the clinical utility of conversion surgery after chemotherapy among patients with colorectal, pancreatic, esophageal, and gastric cancer [9–12]. Unfortunately, only a few studies have been conducted on conversion surgery among responders with P1 gastric cancer after chemotherapy [13–15]. Hence, the clinical impact of conversion surgery remains unclear among patients with peritoneal dissemination of gastric cancer.

The present study therefore aimed to investigate tumor response and the presence or absence of conversion surgery among patients with P1 gastric cancer and to evaluate the relationship between tumor response and conversion surgery. Furthermore, the study assessed the prognostic significance of conversion surgery as a promising therapeutic strategy among chemotherapy responders.

**Patients and Methods**

**Patients**

We retrospectively reviewed 93 patients (55 men and 38 women; age range, 30–86 years; mean age, 64.2) with peritoneal dissemination of gastric cancer who underwent chemotherapy at Kagoshima University Hospital (Kagoshima, Japan) between February 2002 and October 2019. Patients with synchronous or metachronous cancer in other organs and disease recurrence were excluded from the present study. All patients underwent blood examinations, esophagogastroduodenoscopy, endoscopic ultrasonography, fluoroscopy, and computed tomography before starting chemotherapy. The patients were categorized and staged based on the TNM classification for gastric carcinoma [6].

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**Table 1. Clinicopathological features (n = 93)**

| Factor                                | Patients |
|---------------------------------------|----------|
| Gender, n (%)                         | 55 (59.1) |
| Male                                  | 55 (59.1) |
| Female                                | 38 (40.9) |
| Mean age (range), years               | 64.2 (30–86) |
| Tumor location, n (%)                 | 27 (29.0) |
| Whole                                 | 27 (29.0) |
| Upper                                 | 20 (21.5) |
| Middle                                | 19 (20.4) |
| Lower                                 | 19 (20.4) |
| Macrosopic type, n (%)                | 2 (2.2)   |
| Type 1                                | 2 (2.2)   |
| Type 2                                | 42 (45.2) |
| Type 3                                | 46 (49.5) |
| Type 4                                | 1 (1.1)   |
| Depth of tumor invasion, n (%)        | 5 (5.4)   |
| CT3                                   | 5 (5.4)   |
| CT4                                   | 88 (94.6) |
| Lymph node metastasis, n (%)          | 23 (24.7) |
| cN0                                   | 23 (24.7) |
| cN1                                   | 18 (19.4) |
| cN2                                   | 27 (29.0) |
| cN3                                   | 25 (26.9) |
| Number of distant metastatic sites, n (%) | 76 (81.7) |
| 1 (peritoneal dissemination alone)    | 76 (81.7) |
| ≥2                                    | 17 (18.3) |
| Histological type, n (%)              | 15 (16.1) |
| Differentiated                        | 15 (16.1) |
| Undifferentiated                      | 78 (83.9) |
| First-line chemotherapy regimen, n (%)| 56 (60.2) |
| Platinum-based chemotherapy           | 56 (60.2) |
| Taxane-based chemotherapy             | 37 (39.8) |
Table 1 shows the clinicopathological features of the patients enrolled herein. Among the 93 patients identified, 5 and 88 had T3 and T4 tumors, respectively. Lymph node metastasis was clinically detected in 70 patients, while 18, 27, and 25 patients had N1, N2, and N3 nodal status, respectively. Furthermore, 76 patients had peritoneal dissemination alone, while 17 had more than two distant metastatic sites, including peritoneal dissemination. Among the 17 patients with more than two distant metastatic sites, 5, 12, 1, and 1 had liver metastasis, distant lymph node metastasis, ovarian metastasis, and bone metastasis, respectively.

Chemotherapy and Assessment of Tumor Response

Among the 93 patients included herein, 56 and 37 received platinum-based and taxane-based chemotherapy, including intraperitoneal paclitaxel therapy, as their first-line regimen, respectively. Moreover, 16 patients with human epidermal growth factor receptor 2-positive gastric cancer received trastuzumab combined with chemotherapy. Tumor response was determined every 3 chemotherapy cycles and was evaluated using the Response Evaluation Criteria in Solid Tumors (RECIST) [16]. The present study classified tumor response into the following two groups: progressive disease (PD) and non-PD. Survival time was defined as the duration from chemotherapy initiation to death or last follow-up.

Conversion Surgery

Conversion surgery was clinically indicated for patients with a performance status of at least 0–2, non-PD after chemotherapy, and tumors determined to fulfill curative R0 resection. Therefore, patients underwent staging laparotomy or laparoscopy before conversion surgery. Those who had tumors with noncurative factors, such as P1 and CY1, during staging laparotomy or laparoscopy were not considered for conversion surgery.

Assessment of Pathological Treatments in Resected Specimens

Tumor specimens resected following conversion surgery were pathologically examined, after which appropriate therapeutic responses were determined according to the Japanese Classification of Gastric Carcinoma [5]. Surgical resection was classified into R0, R1, and R2 based on the presence or absence of residual tumors after conversion surgery, while the histological response of primary tumors was categorized into grades 0, 1a, 1b, 2, and 3 [5].

Statistical Analysis

The relationship between the presence or absence of conversion surgery and categorical clinicopathological factors, including tumor response, was determined using the χ² test, Fisher’s exact test, or Wilcoxon rank-sum test. Kaplan-Meier survival curves were generated, after which prognostic differences were determined using the log-rank test. Prognostic factors were determined using univariate and multivariate analyses (Cox proportional-hazards regression modeling). All data were analyzed using SAS statistical software (SAS Institute Inc., Cary, NC, USA), with a value of \( p < 0.05 \) being considered statistically significant.

Results

Tumor Response and Prognosis after Chemotherapy

Table 2. Surgical and pathological findings of patients undergoing conversion surgery (n = 19)

| Factor                        | Patients, n (%) |
|-------------------------------|-----------------|
| Operative procedure           |                 |
| Total gastrectomy             | 16 (84.2)       |
| Distal gastrectomy            | 3 (15.8)        |
| Lymph node dissection         |                 |
| D1+                           | 5 (26.3)        |
| D2                            | 12 (63.2)       |
| D2+                           | 2 (10.5)        |
| Depth of tumor invasion       |                 |
| pT1                           | –               |
| pT2                           | 2 (10.5)        |
| pT3                           | 10 (52.6)       |
| pT4                           | 7 (36.8)        |
| Lymph node metastasis         |                 |
| pN0                           | 9 (47.4)        |
| pN1                           | 3 (15.8)        |
| pN2                           | 1 (5.3)         |
| pN3                           | 6 (31.6)        |
| Residual tumor status         |                 |
| R0                            | 18 (94.7)       |
| R1                            | 1 (5.3)         |
| R2                            | 0 (0.0)         |
| Histological response         |                 |
| Grade 1a                      | 15 (78.9)       |
| Grade 1b                      | 2 (10.5)        |
| Grade 2                       | 2 (10.5)        |
| Grade 3                       | 0               |

Based on the RECIST, 24 and 69 patients had PD and non-PD, respectively. Accordingly, the disease control
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Rate was 74.2% (69/93), while the median survival times of the patients with PD and those with non-PD were 163 and 562 days, respectively (Fig. 1), the difference therein being statistically significant ($p < 0.0001$).

**Conversion Surgery and Pathological Findings**

Among the 93 patients included herein, 19 (20.4%) underwent gastrectomy with lymphadenectomy as conversion surgery after chemotherapy. The surgical and pathological findings are summarized in Table 2. Distal gastrectomy and total gastrectomy were performed on 3 and 16 patients, while D1+, D2, and D2+ lymphadenectomy was performed on 5, 12, and 2 patients, respectively. Although 18 patients achieved R0 resection, 1 patient developed occult metastasis identified during pathological examinations of the greater omentum. Moreover, 9, 3, 1, and 6 patients had a pathological nodal status of N0,
N1, N2, and N3, respectively. Histological assessment revealed 15, 2, and 2 patients with grade 1a, 1b, and 2 tumor response, respectively, with no patient exhibiting grade 3 response.

Relationship between Conversion Surgery and Clinicopathological Findings

The mean age (±SD) of the 19 and 74 patients who underwent conversion surgery and chemotherapy alone was 57.6 ± 12.2 and 65.9 ± 11.5 years, respectively (Table 3). Accordingly, we determined that the presence or absence of conversion surgery was significantly correlated with age (p = 0.0134). Among the 37 patients receiving taxane-based chemotherapy, 12 (32.4%) underwent conversion surgery. On the other hand, among the 56 patients receiving platinum-based chemotherapy, 7 (12.5%) underwent conversion surgery. Accordingly, we determined that conversion surgery was significantly associated with the first-line regimen (p = 0.0337; Table 3). Furthermore, among the 69 patients with non-PD, 19 (27.5%) underwent conversion surgery. None of the patients who underwent conversion surgery had PD. Accordingly, we determined that conversion surgery was significantly correlated with tumor response (p = 0.0024; Table 3).

| Independent factor | Univariate analysis | | Multivariate analysis | |
|--------------------|---------------------|----------------|--------------------|----------------|
|                    | hazard ratio | 95% CI | p value | hazard ratio | 95% CI | p value |
| Gender             | 0.1585 | | | 0.6698 | | |
| Female             | 1.000 | Reference | | 1.000 | Reference | |
| Male               | 1.384 | 0.881–2.191 | | 1.446 | 0.899–2.395 | |
| Age                | 0.1306 | | | 0.3623 | | |
| <60 years          | 1.000 | Reference | | 1.000 | Reference | |
| ≥60 years          | 1.446 | 0.899–2.395 | | 1.239 | 0.777–1.954 | |
| Tumor location     | 0.3696 | | | 0.6592 | | |
| Whole/upper        | 1.000 | Reference | | 1.000 | Reference | |
| Middle/lower       | 1.239 | 0.777–1.954 | | 1.239 | 0.777–1.954 | |
| Macroscopic type   | 0.4435 | | | 0.8917 | | |
| Type non-T4        | 1.000 | Reference | | 1.000 | Reference | |
| Type 4             | 0.812 | 0.516–1.284 | | 1.248 | 0.513–4.121 | |
| Depth of tumor invasion | 0.0156 | | 1.000 | Reference | |
| cT3                | 1.000 | Reference | | 1.000 | Reference | |
| cT4                | 1.248 | 0.513–4.121 | | 2.382 | 1.269–4.238 | |
| Lymph node metastasis | 0.0081 | | 0.0092 | | |
| cN0–1              | 1.000 | Reference | | 1.000 | Reference | |
| cN2–3              | 1.757 | 1.112–2.811 | | 1.113 | 0.681–1.836 | |
| Number of distant metastatic sites | 0.0081 | | 0.0092 | | |
| ≥2                 | 2.382 | 1.269–4.238 | | 2.410 | 1.258–4.403 | |
| Histological type  | 0.4435 | | | 0.8917 | | |
| Differentiated     | 1.000 | Reference | | 1.000 | Reference | |
| Undifferentiated   | 1.291 | 0.690–2.693 | | 0.969 | 0.610–1.528 | |
| First-line chemotherapy regimen | 0.0001 | | <0.0001 | | |
| Platinum-based chemotherapy | 1.000 | Reference | | 1.000 | Reference | |
| Taxane-based chemotherapy | 0.969 | 0.610–1.528 | | 0.969 | 0.610–1.528 | |
| Tumor response to chemotherapy | 0.0001 | | <0.0001 | | |
| Non-PD             | 1.000 | Reference | | 1.000 | Reference | |
| PD                 | 5.793 | 3.330–9.922 | | 4.559 | 2.530–8.176 | |
| Conversion surgery | <0.0001 | | <0.0001 | | |
| Absence            | 1.000 | Reference | | 1.000 | Reference | |
| Presence           | 0.177 | 0.082–0.347 | | 0.234 | 0.105–0.482 | |

CI, confidence interval; PD, progressive disease.
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Table 5. Univariate and multivariate analyses of survival in the non-PD group alone (n = 69)

| Independent factor | Univariate analysis | Multivariate analysis |
|--------------------|---------------------|----------------------|
|                    | hazard ratio | 95% CI | p value | hazard ratio | 95% CI | p value |
| Gender             |             |        |         |             |        |         |
| Female             | 1.000       | Reference | 0.5799 | 1.000       | Reference | 0.5799 |
| Male               | 1.166       | 0.674–2.006 | 0.7465 | 1.366       | 0.778–2.358 | 0.2725 |
| Age
<60 years         | 1.000       | Reference |        | 1.000       | Reference |        |
| ≥60 years          | 1.095       | 0.633–1.926 |        | 1.366       | 0.778–2.358 |        |
| Tumor location     |             |        |         |             |        |         |
| Whole/upper        | 1.000       | Reference | 0.3455 | 1.000       | Reference | 0.3455 |
| Middle/lower       | 1.366       | 0.778–2.358 |        | 0.768       | 0.444–1.335 |        |
| Macrosopic type    |             |        |         |             |        |         |
| Type non-T4        | 1.000       | Reference |        | 1.000       | Reference |        |
| Type 4             | 0.768       | 0.444–1.335 |        | 0.768       | 0.444–1.335 |        |
| Depth of tumor invasion |     |        |         |             |        |         |
| cT3                | 1.000       | Reference | 0.3063 | 1.000       | Reference | 0.3063 |
| cT4                | 1.954       | 0.599–12.023 |        | 1.954       | 0.599–12.023 |        |
| Lymph node metastasis |             |        |         |             |        |         |
| cN0–1              | 1.000       | Reference | 0.0224 | 1.000       | Reference | 0.0224 |
| cN2–3              | 1.888       | 1.095–3.300 | 1.637  | 1.888       | 1.095–3.300 | 1.637  |
| Number of distant metastatic sites |         |        |         |             |        |         |
| 1 (peritoneal dissemination alone) | 1.000 | Reference | 0.0092 | 1.000       | Reference | 0.0092 |
| ≥2                 | 2.953       | 1.332–6.095 | 1.932  | 2.953       | 1.332–6.095 | 1.932  |
| Histological type  |             |        |         |             |        |         |
| Differentiated     | 1.000       | Reference | 0.0338 | 1.000       | Reference | 0.0338 |
| Undifferentiated   | 2.656       | 1.069–8.873 | 2.454  | 2.656       | 1.069–8.873 | 2.454  |
| First-line chemotherapy regimen |         |        |         |             |        |         |
| Platinum-based chemotherapy | 1.000 | Reference | 0.3648 | 1.000       | Reference | 0.3648 |
| Taxane-based chemotherapy | 0.774 | 0.440–1.345 |        | 0.774       | 0.440–1.345 |        |
| Conversion surgery |             |        |         |             |        |         |
| Absence            | 1.000       | Reference | <0.0001 | 1.000       | Reference | <0.0001 |
| Presence           | 0.212       | 0.096–0.429 | 0.243  | 0.212       | 0.096–0.429 | 0.243  |

CI, confidence interval; PD, progressive disease.

Prognostic Analysis in Both the Non-PD and the PD Group
Among all included patients (n = 93), those who underwent conversion surgery and chemotherapy alone had a 3-year OS rate of 55.6 and 4.2%, respectively (p < 0.0001; Fig. 2).

Univariate analysis indicated that lymph node metastasis status (N0–1 vs. N2–3), the number of distant metastatic sites (1 vs. ≥2), tumor response, and conversion surgery were significantly correlated with survival among patients with non-PD and PD (p = 0.0156, p = 0.0081, p < 0.0001, and p < 0.0001, respectively; Table 4). Multivariate analysis further identified the number of distant metastatic sites (1 vs. ≥2), tumor response, and conversion surgery as independent prognostic factors (p = 0.0092, p < 0.0001, and p < 0.0001, respectively; Table 4).

Prognostic Analysis in the Non-PD Group Alone
Among the patients in the non-PD group (n = 69), those who underwent conversion surgery and chemotherapy alone had a 3-year OS rate of 55.6 and 6.6%, respectively (p < 0.0001; Fig. 3).

Univariate analysis showed that lymph node metastasis status (N0–1 vs. N2–3), the number of distant metastatic sites (1 vs. ≥2), histological type, and conversion surgery were significantly associated with survival in the non-PD group (p = 0.0224, p = 0.0092, p = 0.0338, and p < 0.0001, respectively; Table 5). Multivariate analysis further identified conversion surgery alone as a significant independent predictor of favorable survival (p < 0.0001; Table 5).
Discussion

Although patients with P1 gastric cancer conventionally undergo gastrectomy with lymphadenectomy, chemotherapy has recently been proposed as the initial treatment, given the remarkable progress in cytotoxic drugs, molecular targeted drugs, and immune checkpoint inhibitors [7]. Moreover, while conversion surgery has currently been proposed for responders to chemotherapy [8], little is understood about the clinical indications for and prognostic impact of surgical interventions after chemotherapy among patients with P1 gastric cancer. Therefore, the current study retrospectively examined the clinical data on patients with P1 who underwent chemotherapy and assessed the clinical significance of conversion surgery after chemotherapy.

Surprisingly, the present study found that 94.7% of the patients with P1 had type 3 or type 4 tumors. Moreover, all patients who had type 3 and type 4 tumors and no clinical P1 determined through imaging examinations underwent staging laparoscopy. Furthermore, P0 and CY0 in all patients undergoing conversion surgery were confirmed through staging laparoscopy or laparotomy. Such findings indicated that staging laparoscopy was clinically useful for identifying occult peritoneal dissemination among patients with large type 3 and type 4 tumors. In the near future, staging laparoscopy may become an essential tool for determining therapeutic strategies among patients with P1 gastric cancer.

The present study found that chemotherapy induced a disease control rate of 74.2% (69/93). Moreover, our results showed that patients with PD had a significantly poorer prognosis than those with non-PD, with multivariate analysis identifying tumor response as an independent prognostic factor. These results suggest that the strategic management of patients with P1 gastric cancer should aim for good tumor response based on a high chemosensitivity. The present study also showed a close relationship between the presence of conversion surgery and taxane-based chemotherapy. Among the 93 patients included herein, 14 and 11 received intraperitoneal paclitaxel plus systemic chemotherapy as their first- and second- or later-line treatment, respectively. Accordingly, we found that patients receiving at least intraperitoneal paclitaxel therapy significantly outnumbered those not receiving the same ($p = 0.0399$, data not shown). A randomized phase III trial comparing intraperitoneal and intravenous paclitaxel plus S-1 (IP) and S-1 plus cisplatin (SP) among patients with P1 gastric cancer showed median survival times of 17.7 and 15.2 months and 3-year OS rates of 21.9 and 6.0% for the IP and the SP arm, respectively [17]. These findings suggest that intraperitoneal paclitaxel therapy better controlled peritoneal dissemination among patients with advanced gastric cancer than S-1 plus cisplatin. Consequently, intraperitoneal chemotherapy might be a promising therapeutic strategy for patients with P1 gastric cancer.

The Japanese Classification of Gastric Carcinoma categorizes the histological response of primary tumors into four grades, with grade 3 indicating the absence of viable tumor cells [5]. Nakamura et al. [14] reported that 5.9% of patients with P1 or CY1 gastric cancer undergoing conversion surgery after chemotherapy exhibited grade 3 response. Similarly, Kinoshita et al. [18] reported that among 34 patients with stage IV gastric cancer who underwent conversion surgery following docetaxel, cisplatin, and S-1 therapy, only 2 (5.9%) displayed grade 3 histological response. In the present study, however, none of the patients exhibited grade 3 histological response. The aforementioned findings suggest the difficulty of completely eradicating primary gastric tumor cells through chemotherapy. Considering that conversion surgery after chemotherapy allows for the removal of viable tumor cells in primary sites and lymph nodes, its clinical advantage may lie in its ability to eliminate chemoresistant tumor cells.

Clinical indications for conversion surgery after chemotherapy among patients with P1 gastric cancer have remained uncertain. However, recent studies have dem-

Fig. 3. Kaplan-Meier survival curves according to surgical intervention in the non-progressive disease (non-PD) group ($n = 69$). Among the patients with non-PD, those who underwent conversion surgery had significantly better survival than those who underwent chemotherapy alone.
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...demonstrated the clinical importance of R0 resection in conversion surgery [19–21]. Fukuchi et al. [19] reported that patients with unresectable gastric cancer undergoing R0 and R1/R2 resections had a 5-year OS rate of 49 and 15%, respectively. Furthermore, the same study identified R0 resection as an independent predictor of favorable OS after multivariate analysis [19]. An Italian retrospective cohort study also identified residual tumor status after conversion surgery (R0 vs. R1) as an independent prognostic factor for progression-free survival among patients with stage IV unresectable gastric cancer following multivariate analysis [21]. The present study obtained an R0 resection rate of 94.7% (18/19). Hence, responders confirmed to have P0 and CY0 after staging laparoscopy during chemotherapy may at least be clinically indicated for conversion surgery. Moreover, univariate analysis among responders indicated a close relationship between survival and lymph node status, the number of distant metastatic sites, or histological type. Unfortunately, these factors were not selected as an independent prognostic factor in multivariate analysis. In particular, tumor tissues with gastric cancer have a histological heterogeneity and it is difficult to accurately assess histological types in patients with gastric cancer. Although further study would be required to strictly evaluate these relationships, the aforementioned clinicopathological factors might become important predictors for determining indications for conversion surgery. Furthermore, multivariate analysis identified conversion surgery as an independent prognostic factor among responders. Several studies among patients with P0 and CY1 gastric cancer have shown that those who underwent conversion surgery had significantly better prognosis than those who did not receive surgical treatments [14, 15]. Therefore, conversion surgery could potentially improve the clinical prognosis after chemotherapy among patients with P1 gastric cancer.

Several limitations of the present study are worth noting. First, this was a single-center retrospective study including only a small population (n = 93). Second, platinum-based chemotherapy was clinically selected as the first-line regimen based on the Japanese Gastric Cancer Treatment Guidelines after 2018 [7]. However, varying chemotherapy regimens had been included considering a registration of clinical trials, the patients’ conditions, or physicians’ discretion. These limitations might have resulted in bias that could have impacted our results. Accordingly, larger prospective studies would be needed to validate our conclusions.

In conclusion, the present study suggested that conversion surgery for P1 gastric cancer might be a promising strategy for considerably improving the prognosis of responders with P0 and CY0 after chemotherapy.

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Statement of Ethics

This retrospective observational study was approved by the Ethics Committee of Kagoshima University in accordance with the Declaration of Helsinki (approval No. 200014). Written informed consent was obtained from all patients.

Conflict of Interest Statement

The authors declare that they have no competing interests.

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Author Contributions

All authors contributed to the study design; T.A., D.M., K.O., K.S., M.N., Y.K., and S.M. were involved in data collection and data interpretation; T.A., H.K., S.Y., Y.U., S.I., T.O., and S.N. contributed to the statistical analyses; T.A. wrote the manuscript; all authors read and approved the final manuscript.

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