Original Article

The clinical effect of conversion surgery for advanced gastric cancer patients with peritoneal metastasis

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Contributions: (I) Conception and design: Both authors; (II) Administrative support: Both authors; (III) Provision of study materials or patients: Both authors; (IV) Collection and assembly of data: Both authors; (V) Data analysis and interpretation: Both authors; (VI) Manuscript writing: Both authors; (VII) Final approval of manuscript: Both authors.

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Background: The prognosis of gastric cancer (GC) patients with peritoneal metastasis (PM) is extremely poor. We developed a new promising regimen combining intraperitoneal (*i.p.*) paclitaxel (PTX) with systemic PTX and S-1 chemotherapy for GC patients with PM. However, the value of conversion surgery (CS) for GC patients with PM remains unclear. This study aimed to clarify the clinical effect of CS from our updated previous report.

Methods: We retrospectively analyzed 50 GC patients, divided into chemotherapy alone (CTx; n=15) and conversion surgery intervention (CSI; n=35) groups. In the CTx group, chemotherapy was continued in responders, while in the CSI group, surgery was performed in chemotherapy-responders. The primary endpoint was overall survival (OS) of the two groups. The secondary endpoint was the safety of CS.

Results: In the CTx group, 9 of 15 patients (60%) responded to chemotherapy. In the CSI group, PM disappeared in 22 of 35 patients (62.9%), all of whom underwent CS. Post-operative complications occurred in 2 patients (9%) who underwent CS. There were no treatment-related deaths. Regarding OS, there was no significant difference between the two groups [P=0.14; 95% confidence interval (CI), 0.3016–1.197], nor between chemotherapy-responders in the two groups (P=0.059; 95% CI, 0.1473–1.039). However, four patients in the CSI group have survived more than 5 years after CS.

Conclusions: CS may be a promising treatment strategy for some GC patients with PM who have responded to chemotherapy.

Keywords: Gastric cancer (GC); intraperitoneal chemotherapy (*i.p.* chemotherapy); paclitaxel (PTX); peritoneal metastasis (PM); conversion surgery (CS)

Submitted Jul 19, 2021. Accepted for publication Apr 15, 2022.
doi: 10.21037/jgo-21-431
View this article at: https://dx.doi.org/10.21037/jgo-21-431

Introduction

Gastric cancer (GC) is the fifth most common cancer and the third most common cause of cancer-related death worldwide (1,2). In particular, GC patients with peritoneal metastasis (PM) are known to have a very short survival period.

Systemic chemotherapy is the standard treatment for unresectable GC (3). The prognosis of patients treated with systemic chemotherapy has steadily improved, but median survival time (MST) remains between 10 and 16 months (4,5). New approaches such as intraperitoneal (*i.p.*) chemotherapy are needed to improve the prognosis of these patients, especially with PM.

We have demonstrated the efficacy of paclitaxel (PTX) in *i.p.* chemotherapy for PM (6). Following this result, we designed a new regimen combining *i.p.* PTX and S-1

and intravenous (*i.v.*) PTX for GC patients with PM and demonstrated its feasibility in a preliminary study (7). However, no patients underwent surgery in our preliminary study, and the most common progression onset region was the primary tumor, not malignant ascites. These patients had obstructed stomachs owing to the increased size of the primary lesions (7). Based on these results, we considered that gastrectomy might improve the prognosis of the patients for whom our new regimen was effective. Therefore, in our next phase II trial, gastrectomy called conversion surgery (CS) (8), was performed in patients who responded to chemotherapy. The result showed a promising MST of 21.3 months for GC patients with PM (9).

Several retrospective studies have reported the long-term survival in selected patients after CS (10-12), but as yet, the role of CS is unclear. Because these previous studies have evaluated the significance of CS for the chemotherapy responder group compared with the chemotherapy non-responder group, it is difficult to identify whether these results are caused by the effect of chemotherapy or the effects of surgery.

Prospective randomized controlled trials are needed to verify the efficacy of CS in patients who respond to chemotherapy. However, undertaking such a randomized study to evaluate the efficacy of CS might be difficult in this patient population, and so we conducted a retrospective study making use of updated our preliminary and phase II trial data (7,9). We present the following article in accordance with the STROBE reporting checklist (13) (available at https://jgo.amegroups.com/article/view/10.21037/jgo-21-431/rc).

Methods

Patient population and treatment groups

This retrospective study included 50 GC patients with PM who underwent *i.p.* and systemic chemotherapy at Kindai University Hospital between May 2003 and October 2008. Patients were followed up in the outpatient or inpatient department or through telephone calls every 3 months for the first 2 years, every 6 months for 3–5 years, and annually thereafter by May 2020. In this study, the median follow-up time was 22.27 (4.40–160.2) months.

Inclusion criteria were diagnosis with histologically proven adenocarcinoma of the stomach; the presence of PM confirmed by staging laparoscopy; absence of non-curative factors except for PM. Eastern Cooperative Oncology Group (ECOG) performance status of 0 or 1. The TNM categories were based on the *Japanese Classification of Gastric Carcinoma* (3rd English edition) (14).

This study was approved by the institutional review board of Kindai University Hospital (No. 31-085) and was conducted according to the principles of the Declaration of Helsinki (as revised in 2013). Informed consent or an alternative was obtained from all patients.

Patients were divided into two groups, chemotherapy alone (CTx) and conversion surgery intervention (CSI). In the CTx group (May 2003 to December 2004) (7), PTX was administered into the peritoneal cavity at the staging laparoscopy. One week after *i.p.* chemotherapy, S-1 was administered orally and PTX was administered *i.v.* as previously reported (15). The treatment course was repeated until unacceptable toxicity or disease progression was observed. In the case of disease progression, 2nd line chemotherapy was administered, if possible. Second line chemotherapy regimens varied, including irinotecan, docetaxel, S-1 and cisplatin with or without combination.

The CSI group (January 2005 to October 2008) (9) received the same combination chemotherapy as the CTx group. Systemic chemotherapy was repeated until either sufficient response for a macroscopically curative operation or unacceptable toxicity or disease progression was observed. In the case of disease progression, 2nd line chemotherapy was administered, if possible.

Disease assessment and indication for CS

Assessment of chemotherapy efficacy has already published (7,9). In patients with target lesions, the antitumor effect was assessed based on the RECIST guidelines (16). In contrast, in patients without target lesions, the antitumor effect was assessed based on the wall thickness of the primary tumor. More than 30% improvement in wall thickness was considered a responder (9). Pathological efficacy was assessed by pathologists based on the *Japanese Classification of Gastric Carcinoma* (3rd English edition) (14).

In the CSI group, second-look laparoscopy was performed if the response to chemotherapy was complete response, partial response or improvement in wall thickness of 30% or more. CS was performed if the results confirmed negative PM and negative peritoneal cytology findings and curative resection was deemed possible. Intraoperative and postoperative complications were reported according to the Clavien-Dindo classification (17). Complications were

Table 1 Patient characteristics and tumor response

Characteristics	CTx group (n=15)	CSI group (n=35)	P value
Age (years), median [range]	62 [22–75]	64 [32–75]	0.656
Gender (men/women), n	9/6	23/12	0.750
ECOG performance status (0/1), n	13/2	35/0	0.458
Macroscopic type, n (%)			0.652
Type non-T4	5 (33%)	13 (37%)	
Type 4	10 (67%)	22 (63%)	
Histological subtype, n (%)			0.633
Intestinal	3 (20%)	10 (29%)	
Diffuse	12 (80%)	25 (71%)	
Chemo cycle, median [range]	8 [2–20]	8 [5–12]	0.685
Tumor response, n (%)			
RECIST guideline	n=5	n=13	0.805
Complete response	0 (0%)	1 (8%)	
Partial response	3 (60%)	7 (54%)	
Stable disease	1 (20%)	3 (23%)	
Progressive disease	1 (20%)	2 (15%)	
Wall thickness	n=10	n=22	0.714
Over 30% decrease	6 (60%)	15 (68%)	
Increase	4 (40%)	7 (32%)	

ECOG, Eastern Cooperative Oncology Group; RECIST, Response Evaluation Criteria in Solid Tumours; CTx, chemotherapy alone; CSI, conversion surgery intervention.

defined and recorded according to the National Cancer Institute Common Toxicity Criteria version 4.0 (18).

Post-operative adjuvant chemotherapy using with one course of weekly *i.v.* PTX (19) and S-1 monotherapy (20) was administered for at least 1 week after CS. Treatment after recurrence was at the discretion of the attending physician.

Statistical analysis

Differences between the two groups were analyzed by using Fisher's exact, chi-square or Mann-Whitney U tests. The overall survival (OS) rates were estimated by the Kaplan-Meier method and compared the survival curves with the log-rank test. Prognostic factors were determined using by univariate and multivariable analyses (Cox proportional-hazards regression modeling).

A P value of less than 0.05 was considered statistically significant. All statistical analyses were performed using SAS software (version 9.4; SAS Institute, Cary, NC, USA).

Results

Patient characteristics and tumor response

Clinical outcomes of 50 GC patients with PM (32 men and 18 women) treated with chemotherapy (7,9) were analyzed and updated. Patients were classified into either CTx (n=15) (7) or CSI (n=35) groups (9). There were no significant differences in age, sex, ECOG performance status, histological subtype or chemo cycle between the two groups (*Table 1*). Regarding tumor response, in the CTx group, three patients with a measurable target lesion showed a partial response, and six patients without a measurable target lesion demonstrated a 30% decrease

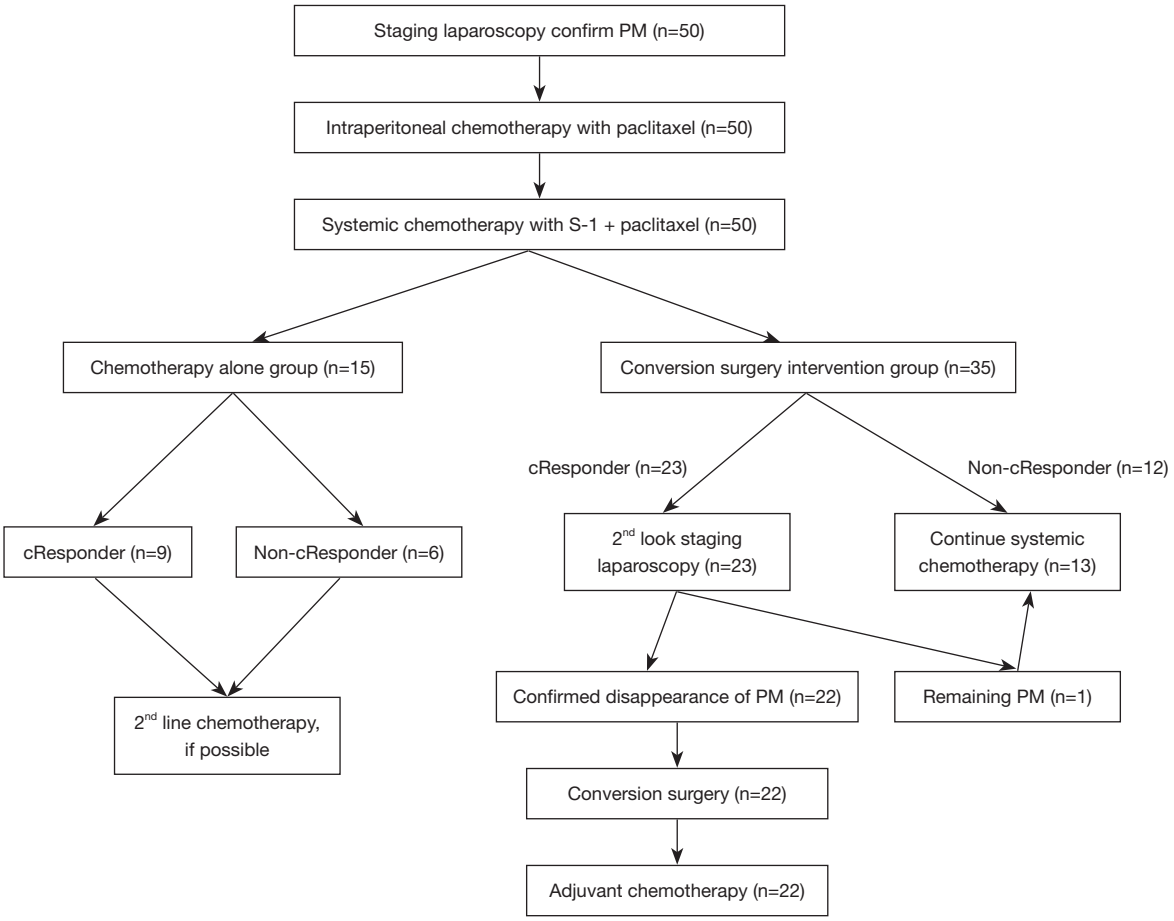


Figure 1 Flow diagram of treatment. PM, peritoneal metastasis; cResponder, chemotherapy-responder.

in wall thickness. Thus, in the assessment of antitumor efficacy, 9 of 15 patients (60%) were diagnosed as responders.

Conversely, in the CSI group, there was one complete response and seven partial responses. And a further 15 patients showed a 30% decrease in wall thickness. Thus, 23 of 35 patients (65.7%) were diagnosed as responders (*Table 1*). Therefore, second-look laparoscopy was performed in the 23 patients in the CSI group. Unfortunately, however, one patient was found to have residual PM. Therefore, CS was performed in 22 patients with resolved PM (*Figure 1*).

Surgery and pathological findings

CS was performed 4–6 weeks (median, 5 weeks) after the last administration of S-1. All CS were performed by laparotomy. Curative total gastrectomy was performed in 19 patients, while curative distal gastrectomy and pancreaticoduodenectomy were performed in two and one patient, respectively. Four patients underwent splenectomy and one underwent transverse colon resection. Postoperative complications were observed in only two patients (9%), one with anastomotic leakage and one with pancreatic fistula. Both of these patients recovered with conservative treatment. Further details of surgical findings are presented in *Table 2*. The pathological effects of chemotherapy were grade 0 in 3 (13.6%) patients, grade 1a in 12 (54.5%), grade 1b in 2 (9.0%), grade 2 in 4 (18.2%), and grade 3 in 1 (4.5%) patients (*Table 2*).

Adjuvant chemotherapy

Adjuvant chemotherapy was initiated in all 22 CS patients. And there were no treatment-related deaths during the treatment period.

Table 2 Surgical and pathological findings in patients who underwent CS

Finding	Number (n=22)
Peritoneal lavage cytology	
CY0/CY1	22/0
PM	
Negative/positive	22/0
Type of surgery	
Total gastrectomy	19
Distal gastrectomy	2
Pancreaticoduodenectomy	1
Combined resection	
Spleen	4
Colon	1
Surgical approach	
Open/laparoscopic	22/0
Lymph node dissection	
D1/D1+/D2	0/0/20
Residual tumor	
R0/R1/R2	22/0/0
Operative time (min)	
Median [range]	333 [230–600]
Intraoperative bleeding (mL)	
Median [range]	731 [195–1,987]
Postoperative hospital stay (days)	
Median [range]	13 [10–28]
Postoperative complications	
Anastomotic leakage	1 (Gr. 2)
Pancreatic fistula	1 (Gr. 2)
Depth of tumor invasion	
ypT0/T1a/T1b/T2/T3/T4a/T4b	1/1/2/1/16/1/0
Lymph node metastasis	
ypN0/N1/N2/N3a/N3b	10/2/5/1/4
JCGA-histological response (primary tumor)	
Grade 0/1a/1b/2/3	3/12/2/4/1

CS, conversion surgery; CY0, peritoneal cytology negative for carcinoma cells; CY1, peritoneal cytology positive for carcinoma cells; PM, peritoneal metastasis; JCGA, Japanese Classification of Gastric Carcinoma (3rd English edition); Gr., toxicity grade according to the Clavien-Dindo classification.

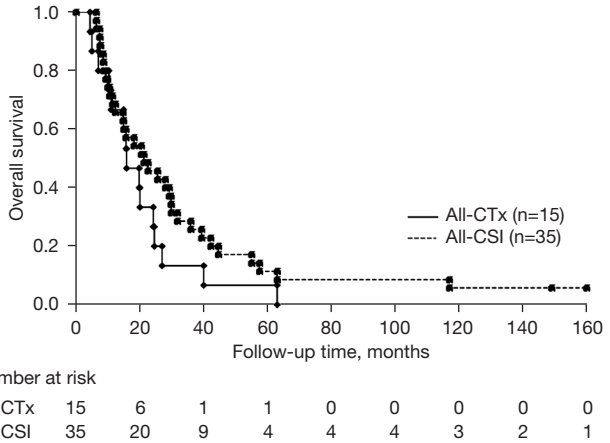


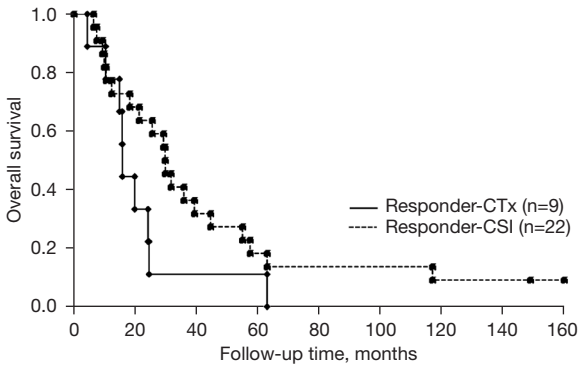
Figure 2 Kaplan-Meier survival curve for all in CTx (n=15) and CSI (n=35) groups. CTx, chemotherapy alone; CSI, conversion surgery intervention.

Survival

The OS of both groups is shown in *Figure 2*. In the CTx group, the MST reached 15.8 months, with 1-, 2-, and 5-year OS rates of 66.7%, 26.7% and 6.7%, respectively, whereas the MST was 21.3 months and the 1-, 2-, and 5-year OS rates were 68.6%, 45.7% and 13.7%, respectively, in the CSI group. There was no significant difference in survival between the two groups [P=0.14; 95% confidence interval (CI), 0.3016–1.197].

OS rates were analyzed in the two groups, taking into account differences in chemotherapy efficacy and surgery. In the CTx group who have responded to chemotherapy, the 1-, 2-, and 5-year OS rates were 77.7%, 22.2% and 11.1%, respectively, and the MST was 15.8 months. In the CSI group who underwent surgery, the 1-, 2-, and 5-year OS rates were 77.2%, 59.1% and 21.8%, respectively, and the MST was 29.8 months. In chemotherapy-responders, there was no significant difference in OS between the two groups (P=0.059; 95% CI, 0.1473–1.039) (*Figure 3*). However, four patients in the CSI group survived for more than 5 years. In addition, at the time of analysis (May 2020), two patients are still alive for more than 12 years after CS.

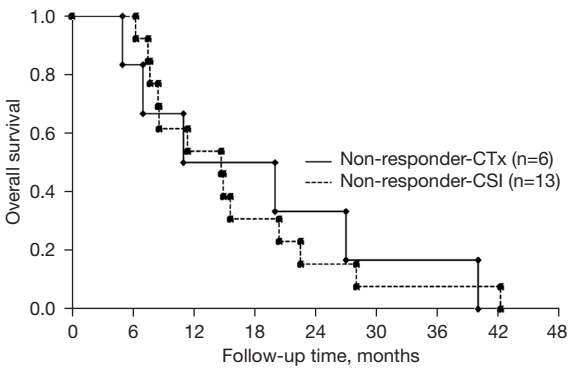
The MST for chemotherapy non-responders in the CTx group was 15.4 months, with 1- and 2-year OS rates of 50.0% and 33.3%, respectively. The 1- and 2-year OS rates for chemotherapy non-responders in the CSI group who did not undergo surgery were 53.8% and 15.3%, respectively, with an MST of 14.7 months; there was no significant differences in OS between the two groups of chemotherapy non-responders (P=0.957; 95% CI, 0.383–2.758) (*Figure 4*).



Number at risk

Responder-CTx	9	3	1	1	0	0	0	0	0
Responder-CSI	22	15	7	4	4	4	3	2	1

Figure 3 Kaplan-Meier survival curve for responders in CTx (n=9) and CSI (n=22) groups. CTx, chemotherapy alone; CSI, conversion surgery intervention.



Number at risk

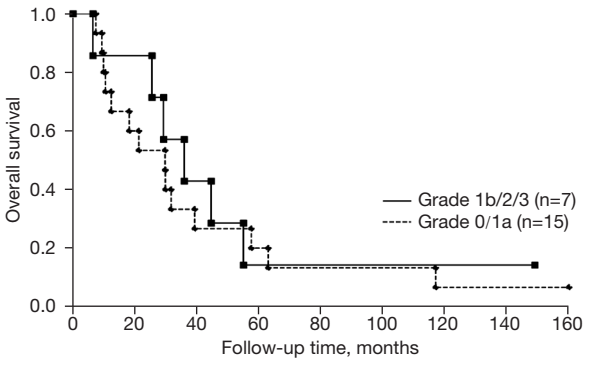
Non-responder-CTx	6	5	3	3	2	1	1	0
Non-responder-CSI	13	13	7	4	2	1	1	1

Figure 4 Kaplan-Meier survival curve for non-responders in CTx (n=6) and CSI (n=13) groups. CTx, chemotherapy alone; CSI, conversion surgery intervention.

Survival differences about histological response and failure patterns

The survival rates did not differ significantly between grade 1b over response group (n=7) and grade 0 or grade 1a response group (n=15) among those who have undergone CS in the CSI group, (log-rank test, P=0.653) (*Figure 5*).

Recurrence was observed in 16 of the 22 patients who underwent CS. The site of recurrence was the peritoneum in 9 cases and other sites in 7 cases. The site of metastasis other than peritoneal were bone in 4 cases and liver in 3 cases.



Number at risk

Grade 1b/2/3	7	6	3	1	1	1	1	1	0
Grade 0/1a	15	9	4	3	3	3	2	1	1

Figure 5 Kaplan-Meier survival curve for grade 1b over response group (n=7) and grade 0 or grade 1a response group (n=15) in the CS patients. CS, conversion surgery.

Prognostic analysis in the responder group

Multivariable analysis indicated lymph node metastasis (P=0.0317) and CS (P=0.0380) as independent prognostic factors (*Table 3*).

Discussion

Recently, CS for GC patients has attracted considerable attention as a novel treatment strategy (12). However, evidence on whether CS provides a considerable survival benefit for GC patients with PM is lacking. Therefore, in the present study, we attempted to clarify the significance of CS for GC patients with only PM. The OS rate of chemotherapy-responsive patients in the CSI group was not significantly different to responders in the CTx group (P=0.059; 95% CI, 0.1473–1.039). However, in the multivariable analysis indicated lymph node metastasis and CS as independent prognostic factors. Furthermore, only in the CSI group, four patients were alive for more than 5 years. Additionally, two patients were alive for more than 12 years after CS. We thus concluded that the advantage of CS was evident in some patients in the chemotherapy-responder group.

In contrast, only one patient in the CTx group survived for more than 5 years. Based on this case, we might need a better way to distinguish the chemotherapeutic response. Therefore, the development of chemosensitivity and biological maker is awaited in clinical practice.

Chemotherapy regimens for advanced GC with PM

Table 3 Univariate and multivariable analyses of survival in both the responder in CTx group (n=9) and CSI group (n=22)

Independent factors	Univariate analysis			Multivariable analysis		
	Hazard ratio	95% CI	P value	Hazard ratio	95% CI	P value
Age			0.4499			
<60 years	1.000	Reference				
>60 years	1.258	0.693–2.285				
Macroscopic type			0.5694			
Type non-T4	1.000	Reference				
Type 4	1.210	0.627–2.335				
Lymph node metastasis			0.0109			0.0317
cN0–1	1.000	Reference		1.000	Reference	
cN2	2.432	1.226–4.823		2.892	1.148–7.285	
Histological type			0.4208			
Differentiated type	1.000	Reference				
Undifferentiated type	0.760	0.390–1.481				
CS			0.0020			0.0380
Absence	1.000	Reference		1.000	Reference	
Presence	0.369	0.197–0.694		0.331	0.118–0.925	

CTx, chemotherapy alone; CSI, conversion surgery intervention; CS, conversion surgery; CI, confidence interval.

are also an interesting issue. Nakamura *et al.* reported a negative conversion rate of only 15.2% (5 of 33 patients) in PM using S-1 based regimens (21). Furthermore, Chan *et al.* reported a negative conversion rate of only 18.2% (4 of 22 patients) in PM treated with *i.p.* PTX and systemic capecitabine and oxaliplatin (22). On the other hand, our combination regimen showed a high conversion rate (62.8%) compared with other reports. As in our previous report, we considered that the direct effect on *i.p.* cancer-free cells by *i.p.* PTX and better translation of *i.v.* PTX to the peritoneal cavity induced the high negative conversion rate (23). In brief, we concluded that the *i.p.* PTX and systemic S-1/PTX regimen might be a promising alternative therapy in advanced GC with PM.

In this study, most of the resected primary gastric tumors were classified as histological grade 1a. This suggests that the chemotherapy performed at our institution had little effect on the primary tumor. Kurokawa *et al.* reported that histological response seemed to be a better surrogate endpoint of OS (24). While, our subclass analysis indicates the histological response did not affect the OS of CS patients, four patients who have survived for more than 5 years were ypN0 cases and one patient obtained pathological CR in the primary tumor.

Furthermore, in unresectable metastatic GC, some reports indicate that R0 provides long-term survival and that microscopic residual tumor (R1) and macroscopic residual tumor (R2) are strong prognostic factors for surgery (25,26). Therefore, CS should be performed for R0 resection to achieve long-term survival if the disappearance of PM is observed.

There were no surgical-related deaths in the present study. Our operative time, blood loss and operative morbidity were acceptable compared with previous studies (27,28). These results indicated that CS after our combination chemotherapy was safe and well tolerated.

The low number of surgical complications allowed the resumption of adjuvant chemotherapy early in the postoperative period. This may have contributed to the better prognosis of patients who underwent CS (29).

In conclusion, CS is safe and may prolong the survival of GC patients with PM. CS may be a promising treatment strategy for some GC patients with PM responding well to chemotherapy.

There are still some limitations to our study. First, this was a retrospective single-arm study. Second, the number of cases is relatively small. Third, the 2nd line chemotherapy regimens for chemotherapy non-responders were different and novel modalities (such as trastuzumab) were not used in this study period. These limitations might have affected the tumor-response to chemotherapy, negative conversion rate of PM and eventually the OS of the patients. Therefore, our conclusions need to be verified by more clinical trials.

Acknowledgments

We thank Gillian Campbell, PhD, from Edanz Group (https://www.edanzediting.com/ac) for editing a draft of this manuscript.
Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the Guest Editors (Paul H. Sugarbaker and Kurt Van der Speeten) for the series "Intraperitoneal Chemotherapy for Peritoneal Metastases: HIPEC, EPIC, NIPEC, PIPAC and More" published in *Journal of Gastrointestinal Oncology*. This article has undergone external peer review.

Reporting Checklist: The authors have completed the STOBE reporting checklist. Available at https://jgo.amegroups.com/article/view/10.21037/jgo-21-431/rc

Data Sharing Statement: Available at https://jgo.amegroups.com/article/view/10.21037/jgo-21-431/dss

Peer Review File: Available at https://jgo.amegroups.com/article/view/10.21037/jgo-21-431/prf

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at https://jgo.amegroups.com/article/view/10.21037/jgo-21-431/coif). The series was sponsored by the Peritoneal Surface Oncology Group International (PSOGI). The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring the questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the institutional review board of Kindai University Hospital (No. 31-085) and was conducted according to the principles of the Declaration of Helsinki (as revised in 2013). Informed consent or an alternative was obtained from all patients.

References

1. Ferlay J, Soerjomataram I, Dikshit R, et al. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer 2015;136:E359-86.
2. Japanese Gastric Cancer Association. Japanese gastric cancer treatment guidelines 2014 (ver. 4). Gastric Cancer 2017;20:1-19.
3. PDQ Adult Treatment Editorial Board. Gastric Cancer Treatment (PDQ®). Health Professional Version. 2020. In: PDQ Cancer Information Summaries. Bethesda: National Cancer Institute, 2002-. Available online: http://www.ncbi.nlm.nih.gov/books/NBK65766/
4. Koizumi W, Narahara H, Hara T, et al. S-1 plus cisplatin versus S-1 alone for first-line treatment of advanced gastric cancer (SPIRITS trial): a phase III trial. Lancet Oncol 2008;9:215-21.
5. Bang YJ, Van Cutsem E, Feyereislova A, et al. Trastuzumab in combination with chemotherapy versus chemotherapy alone for treatment of HER2-positive advanced gastric or gastro-oesophageal junction cancer (ToGA): a phase 3, open-label, randomised controlled trial. Lancet 2010;376:687-97.
6. Imano M, Imamoto H, Itoh T, et al. Safety of intraperitoneal administration of paclitaxel after gastrectomy with en-bloc D2 lymph node dissection. J Surg Oncol 2012;105:43-7.
7. Imano M, Peng YF, Itoh T, et al. A preliminary study of single intraperitoneal administration of paclitaxel followed by sequential systemic chemotherapy with S-1 plus paclitaxel for advanced gastric cancer with peritoneal metastasis. Anticancer Res 2012;32:4071-5.

8. Yoshida K, Yamaguchi K, Okumura N, et al. Is conversion therapy possible in stage IV gastric cancer: the proposal of new biological categories of classification. Gastric Cancer 2016;19:329-38.
9. Imano M, Yasuda A, Itoh T, et al. Phase II study of single intraperitoneal chemotherapy followed by systemic chemotherapy for gastric cancer with peritoneal metastasis. J Gastrointest Surg 2012;16:2190-6.
10. Okabe H, Ueda S, Obama K, et al. Induction chemotherapy with S-1 plus cisplatin followed by surgery for treatment of gastric cancer with peritoneal dissemination. Ann Surg Oncol 2009;16:3227-36.
11. Fukuchi M, Ishiguro T, Ogata K, et al. Prognostic Role of Conversion Surgery for Unresectable Gastric Cancer. Ann Surg Oncol 2015;22:3618-24.
12. Yamaguchi K, Yoshida K, Tanahashi T, et al. The long-term survival of stage IV gastric cancer patients with conversion therapy. Gastric Cancer 2018;21:315-23.
13. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol 2008;61:344-9.
14. Japanese Gastric Cancer Association. Japanese classification of gastric carcinoma: 3rd English edition. Gastric Cancer 2011;14:101-12.
15. Narahara H, Fujitani K, Takiuchi H, et al. Phase II study of a combination of S-1 and paclitaxel in patients with unresectable or metastatic gastric cancer. Oncology 2008;74:37-41.
16. Eisenhauer EA, Therasse P, Bogaerts J, et al. New response evaluation criteria in solid tumours: revised RECIST guideline (version 1.1). Eur J Cancer 2009;45:228-47.
17. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240:205-13.
18. U.S. Department of Health and Human Services. National Events (CTCAE) version 4.0. 2009. Available online: https://evs.nci.nih.gov/ftp1/CTCAE/CTCAE_4.03/CTCAE_4.03_2010-06-14_QuickReference_5x7.pdf
19. Hironaka S, Zenda S, Boku N, et al. Weekly paclitaxel as second-line chemotherapy for advanced or recurrent gastric cancer. Gastric Cancer 2006;9:14-8.
20. Sasako M, Sakuramoto S, Katai H, et al. Five-year outcomes of a randomized phase III trial comparing adjuvant chemotherapy with S-1 versus surgery alone in stage II or III gastric cancer. J Clin Oncol 2011;29:4387-93.
21. Nakamura M, Ojima T, Nakamori M, et al. Conversion Surgery for Gastric Cancer with Peritoneal Metastasis Based on the Diagnosis of Second-Look Staging Laparoscopy. J Gastrointest Surg 2019;23:1758-66.
22. Chan DY, Syn NL, Yap R, et al. Conversion Surgery Post-Intraperitoneal Paclitaxel and Systemic Chemotherapy for Gastric Cancer Carcinomatosis Peritonei. Are We Ready? J Gastrointest Surg 2017;21:425-33.
23. Imano M, Imamoto H, Itoh T, et al. Impact of intraperitoneal chemotherapy after gastrectomy with positive cytological findings in peritoneal washings. Eur Surg Res 2011;47:254-9.
24. Kurokawa Y, Shibata T, Sasako M, et al. Validity of response assessment criteria in neoadjuvant chemotherapy for gastric cancer (JCOG0507-A). Gastric Cancer 2014;17:514-21.
25. Han DS, Suh YS, Kong SH, et al. Outcomes of surgery aiming at curative resection in good responder to induction chemotherapy for gastric cancer with distant metastases. J Surg Oncol 2013;107:511-6.
26. Sato Y, Ohnuma H, Nobuoka T, et al. Conversion therapy for inoperable advanced gastric cancer patients by docetaxel, cisplatin, and S-1 (DCS) chemotherapy: a multi-institutional retrospective study. Gastric Cancer 2017;20:517-26.
27. Sasako M, Sano T, Yamamoto S, et al. D2 lymphadenectomy alone or with para-aortic nodal dissection for gastric cancer. N Engl J Med 2008;359:453-62.
28. Yoshikawa T, Sasako M, Yamamoto S, et al. Phase II study of neoadjuvant chemotherapy and extended surgery for locally advanced gastric cancer. Br J Surg 2009;96:1015-22.
29. Nakanishi K, Kanda M, Ito S, et al. Delay in initiation of postoperative adjuvant chemotherapy with S-1 monotherapy and prognosis for gastric cancer patients: analysis of a multi-institutional dataset. Gastric Cancer 2019;22:1215-25.

Cite this article as: Shinkai M, Imano M. The clinical effect of conversion surgery for advanced gastric cancer patients with peritoneal metastasis. J Gastrointest Oncol 2022;13(5):2169-2177. doi: 10.21037/jgo-21-431

