Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

HHS Public Access

Author manuscript

J Surg Oncol. Author manuscript; available in PMC 2019 March 01.

Published in final edited form as:

J Surg Oncol. 2018 March ; 117(4): 678–684. doi:10.1002/jso.24912.

Risk of peritoneal metastases in patients who had negative peritoneal staging and received therapy for localized gastric adenocarcinoma

Dilsa Mizrak Kaya, MD[1], **Graciela M. Nogueras-González, MPH**[2], **Kazuto Harada, MD PhD**[1], **Fatemeh G. Amlashi, MD**[1], **Sinchita Roy-Chowdhuri, MD PhD**[3], **Jeannelyn S. Estrella, MD**[3], **Prajnan Das, MD**[4], **Jeffrey H. Lee, MD**[5], **Brian Weston, MD**[5], **Manoop S. Bhutani, MD**[5], **Aurelio Matamoros Jr., MD**[6], **Irene Thomas, PA-C**[1], **Quan Lin, MD**[1], **Brian D. Badgwell, MD**[7], and **Jaffer A. Ajani, MD**[1]

[1]Department of Gastrointestinal Medical Oncology, The University of Texas M. D. Anderson Cancer Center, Houston, TX, USA.

[2]Department of Biostatistics, The University of Texas M.D. Anderson Cancer, Houston, TX, USA.

[3]Department of Pathology, The University of Texas M. D. Anderson Cancer Center, Houston, TX, USA.

[4]Department of Radiation Oncology, The University of Texas M. D. Anderson Cancer Center, Houston, TX, USA.

[5]Department of Gastroenterology, The University of Texas M. D. Anderson Cancer Center, Houston, TX, USA.

[6]Department of Radiology, The University of Texas M. D. Anderson Cancer Center, Houston, TX, USA.

[7]Department of Surgical Oncology, The University of Texas M. D. Anderson Cancer Center, Houston, TX, USA.

Abstract

Background—Positive peritoneal cytology (+PCyt) or gross carcinomatosis (GPC) carries a poor prognosis. Laparoscopic staging to detect +PCyt/GPC is recommended for all ≥T1b gastric adenocarcinoma (GAC). The natural history of patients with GAC who have baseline −PCyt and then undergo multimodality therapy is not well documented, particularly for the risk of subsequent GPC.

Methods—We identified 238 GAC patients with baseline −PCyt who were followed for the development of peritoneal carcinomatosis (PC). Standard statistical methods were employed.

Correspondence to: Jaffer A. Ajani, MD, Department of Gastrointestinal Medical Oncology, The University of Texas MD Anderson Cancer Center, 1515 Holcombe Blvd (FC10.3022), Houston, TX 77030, Tel.: +1-13-792-2828; Fax: +1-93-745-1163; jajani@mdanderson.org.

Presented partly as a poster presentation at the ASCO Gastrointestinal Cancers Symposium, 19–21 January 2017.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Results—Of 238 patients, 192 had attempted surgery after preoperative therapy. Of these, 13 patients (6.8%) had GPC and 1 had liver metastases, thus surgery was aborted. We followed 164 patients who had an R0 resection. The median follow-up duration was 3.4 (range, 0.6–18) years. The rate of PC was 13.4%, (22/164 patients) and the median time to PC was 15.6 months. Female gender was associated with PC on multivariate analysis. The 5-year OS rate for patients without subsequent PC was 75%.

Conclusion—Even with baseline −Cyt, ~25% of patients develop PC following multimodality therapy. Patients who do not develop PC have an excellent OS rate. Further research is warranted to detect PC at baseline by the use of biomarkers.

Keywords

negative peritoneal cytology; gastric cancer; laparoscopy; staging; preoperative therapy

Introduction

Gastric adenocarcinoma (GAC) remains as a global health problem with an estimated 951,600 new cases and 723,100 deaths occurred in 2012 [1]. In the United States, the 5-year overall survival rate for GAC is 30.4% and decreases to 5% for advanced stage disease [2]. Accurate baseline staging is essential in order to decide for the most appropriate treatment strategy [3]. Clinical staging of GAC has greatly improved in the recent years with endoscopic ultrasonography (EUS), positron emission tomography (PET)/computed tomography (CT), and laparoscopy [4–6]. Without appropriate staging, it is not surprising to diagnose peritoneal carcinomatosis (PC) in some patients who are being treated with a curative intent [7].

Laparoscopic staging can detect radiologically occult PC and is recommended for all ≥T1b GACs [3]. In a large study reported by investigators at the Memorial Sloan Kettering Cancer Center, 23% of 657 patients with GAC were found to have M1 disease at baseline staging laparoscopy [8]. The peritoneal disease rate detected with laparoscopy was 32.1% in our institution [9]. In this study, 711 patients with radiologically occult PC were included. At laparoscopy, 148 (20.8%) patients had been found to have macroscopic PC. Among 514 patients without macroscopic PC, cytological analysis of peritoneal lavage was positive in 68 (13.2%) and was equivocal in 12 (2.3%) patients. In a smaller study from the United Kingdom, 20 of 100 patients were diagnosed with PC or distant metastases (DM) at laparoscopy [10].

Gross peritoneal carcinomatosis (GPC) and positive peritoneal cytology (+PCyt) represent M1 GAC and patients with these features have a poor overall survival (OS) [11–13]. The development of PC has a poor prognosis and quality of life. In a recent study by Ikoma et al. [14], of 292 patients who received preoperative therapy 36 patients developed subsequent PC as the common recurrence site (49% of all recurrences). Baseline laparoscopy information in this study is vaguely stated and was not done in every patient. Despite the development of new drugs and new methods to apply these drugs, there is no effective therapy for PC. The outcome of patients with PC differs according to the burden of disease [15]. If the +PCyt can be converted to −PCyt, patients tend to live longer [12, 16]. This

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

suggests that early detection of PC may be useful to develop novel therapeutic interventions. To best of our knowledge, ours is the first analysis looking at subsequent development of PC when baseline laparoscopy was negative.

In this study, we aimed to characterize the natural history of patients with a −PCyt at diagnosis.

Patients and Methods

Patients

We identified 238 patients with localized GAC who had baseline staging laparoscopy and had −PCyt, between January 2002 and December 2014. Patients who had unresectable GAC or did not undergo a staging laparoscopy were excluded. Data were prospectively collected in an approved database in the Department of Gastrointestinal Medical Oncology at The University of Texas MD Anderson Cancer Center.

Staging, treatment and follow-up

All patients had baseline imaging studies (CT or PET/CT scan), EUS, and laparoscopy [9]. All patients were discussed in the multidisciplinary conference and were assigned trimodality therapy (induction systemic chemotherapy, chemoradiation and surgery). All patients received a fluoropyrimidine with a platinum compound or a taxane as induction chemotherapy and concurrently with radiation. The median dose of radiation was 45 Gy (range, 34.2 to 50.4 Gy) with either a 3D or IMRT technique.

Prior to surgery, after recovery from chemoradiation, all patients had preoperative staging with CT or PET/CT and endoscopy with biopsies. A decision to proceed with surgery was based on the most updated staging information, comorbidities, performance status, and personal preferences. Surgical pathology of each patient was reviewed in multidisciplinary conference with a pathologist who made the determination whether or not an R0 resection was accomplished.

For this analysis, clinical variables included age, sex, date of diagnosis, location of the primary tumor, length of tumor, clinical T and N stages, tumor histologic phenotype, and tumor grade. After the completion of therapy, patients were followed up at 3- to 6-month intervals in the first 2 years and then less frequently. In patients with suspicious peritoneal disease found in physical examination (ascites) or imaging methods, laparoscopic biopsies and washings were done to confirm the diagnosis.

The OS follow-up was carried out through electronic health records, tumor registry, or the Social Security Database.

Statistical Analysis

Summary statistics were used to describe the overall population and patients that developed PC. OS was calculated as the number of months from the date of diagnosis to death or lost to follow-up. Patients who were lost to follow-up were censored on that date. The Kaplan-Meier product limit method [17] was used to estimate the median OS. Univariate Cox

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

proportional hazards regression was used to identify any association with each of the variables and OS [18]. For each factor, medians, HRs, their 95% confidence intervals (CI), and proportional hazards regression p-values were determined. Recurrence-free survival (RFS) was calculated as the number of months from the date of diagnosis to recurrence or death. Patients who were lost to follow-up were censored on that date. Similar analysis was performed for RFS. Time to occurrence of PC was calculated as the number of months from the date of diagnosis to developing PC. Patients who did not develop PC were censored on that date.

Statistical analysis was performed using STATA/SE version 14.1 statistical software (Stata Corp. LP, College Station, TX).

Results

Of 238 patients, 46 did not undergo surgery (patient preference, n = 14, comorbidities and poor performance status, n = 15, and evidence of metastases at restaging, n = 17 [8 of whom had PC]) (Figure 1). The other 192 patients went to surgery. At surgery, 14 out of 192 patients (7.3 %) were found to have M1 GAC (13 patients with PC and 1 with liver metastases). Of 178 patients with completed surgery, 14 had an R1 and 164 had an R0 resection. We evaluated the clinical course of these 164 patients with R0 resection (Figure 1).

Patient Characteristics

Table 1 shows the clinical characteristics of 164 patients with R0 surgery. The median age of patients at diagnosis was 61 (range, 26–86) years, patients were primarily men (62.2%). The primary tumor was predominantly confined to the stomach (62.8%) and the median tumor length was 4 (range, 1–18) cm. Most patients had poorly differentiated tumor (80.5%), 46.8% had intestinal type tumor and 44.5% of patients had signet ring cell features on histology. The EUS T stages were mainly T3 and occasional T4 (88.4%), 52.4% of patients were N-positive. Pathologic complete response was noted in 13.4%. Residual GAC of ≥ 50% was detected in surgical specimens of 63 patients (38.4%).

Overall Survival

The median follow-up time was 3.4 years (range, 0.6–18 years). Sixty-one (37.2%) of 164 patients had died and 103 (62.8%) were alive at the time of last analysis.

Twenty-two (13.4%) of 164 patients developed PC, whereas 24 (14.6%) developed other distant metastases and 2 (1.2%) developed local recurrence. Half of these 22 patients that developed PC had obvious findings of PC at imaging, the other half had suspicious findings and PC confirmed by laparoscopic cytology or biopsy. The median time to the diagnosis of PC was 15.6 months (range, 8.5–81.7 months) (Figure 1). The median OS after PC was 7.1 months (range, 0.4–17.9 months). There was a significant difference in OS between patients who had PC compared to those who did not (median 1.9 years *vs* 10.2 years, hazard ratio 7.26 [95% Confidence Interval (CI) 4.07–12.95]; $p < 0.001$) (Figure 2). The clinical course was worse for those who had PC compared to those who had other types of relapses (Figure 3). The 2-year OS rates were 95% (95% CI 0.88–0.98), 64% (95% CI 0.42–0.79), 50%

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

(95% CI 0.28–0.68) and 5-year OS rates were 87% (95% CI 0.77–0.92), 23% (95% CI 0.07–0.45), and 5% (95% CI 0–0.21) for patients with no recurrence, other organ recurrences, and PC, respectively.

Of all 238 patients with −PCyt at staging, 56 (23.5%) developed PC at follow-up. Among the 29 patients with baseline −PCyt treated with chemoradiation who did not go surgery due to poor performance status, comorbidities or patient preference, the PC rate was 20.7%. The PC rate was 50% for 14 patients with an R1 resection (Figure 1).

Variables associated with PC recurrence after neoadjuvant therapy and subsequent R0 surgery

The results of the uni- and multi-variate analyses associated with PC are summarized in Table 2. Female gender was significantly associated with PC after R0 resection in uni- ($p<0.001$) and multi-variate ($p=0.009$) analyses. The PC rate was 25.8% for females and 5.9% for males. Gastric (non-GEJ) location, signet ring cell histology, poor differentiation, and diffuse histology were significantly associated with PC in uni-variate but not multi-variate analysis.

Discussion

We report that in patients with localized GAC, even if the baseline assessment is −PCyt, the development of PC is ~25% (with about 7% within 5 months of therapy) and the clinical variables associated with PC are not different than previously reported, however, in this setting, there has not been a report published [19–21].

Lorenzen et al. [22] evaluated the effect of neoadjuvant chemotherapy on peritoneal cytology in 61 patients with locally advanced gastric cancer. Of 61 patients, 19 (31%) had +PCyt and 42 had −PCyt at initial staging. During preoperative therapy, 24% (n=10) of those 42 developed +PCyt. Although, this cohort is very small and the conversion rate is low, there may be a benefit of performing another laparoscopic staging just prior to surgery. In our cohort, a total of 21 out of 238 patients (8.8%) were diagnosed with PC at surgery (that is immediately after preoperative therapy). Since the median OS of these patients was only 7 months, an argument can be made that a second laparoscopic staging could be considered prior to surgery in all patients. In Japanese Gastric Cancer Treatment Guidelines, laparoscopic staging is recommended just before surgery [23].

We report an overall 23.5% PC rate for patients with −PCyt at initial staging. Even for the best subgroup that had preoperative therapy followed by R0 resection, the PC rate was 13.4%. The reason for PC after an R0 surgery remains unclear. In two studies from Japan, surgical manipulation was identified as the cause for PC [24, 25].

In the present study, we noted a significantly lower OS rate for patients with PC compared to patients with other organ relapses or those without any relapse. These OS rates are in concordance with that in other studies [26, 27]. Female gender, gastric primary, presence of signet ring cell histology, poor differentiation of tumor, and diffuse histology were associated with PC. In their study, D'Angelica et al. [21] also showed an association

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

between PC and female gender, advanced T-stage, distal and diffuse type tumor. The high PC rate in female gender can be explained by the high frequency of diffuse type gastric cancer in females [28].

To the best of our knowledge, our study is the first study to document the natural history of GAC patients with −PCyt at staging and have an R0 resection. Our data should be interpreted with caution since it is a retrospective series from a single institution. However, our patient cohort is large and homogenously treated. These data will allow us to design new prospective studies that can help to predict the occurrence of PC.

In conclusion, with baseline −PCyt subsequent development of peritoneal recurrence is ~25% for localized GAC patients and even ~15% for the favorable group that had preoperative therapy and R0 surgery. Patients who do not develop peritoneal recurrence have an excellent OS rate. Further research is warranted to identify patients at high risk of subsequent peritoneal recurrence.

Acknowledgments

Our paper was supported in part by the Grants from NCI, Department of Defense and MDACC (CA129906, CA129926, CA138671, CA1727741, CA150334.01 and CA160445) and Cancer Center Support Grant (NCI Grant P30 CA016672).

References

1. Torre LA, Bray F, Siegel RL, et al. Global cancer statistics, 2012. CA Cancer J Clin. 2015; 65:87–108. [PubMed: 25651787]
2. SEER Stat Fact Sheets: Stomach Cancer. seer.cancer.gov/statfacts/html/stomach.html
3. Ajani JA, D'Amico TA, Almhanna K, et al. Gastric Cancer, Version 3.2016, NCCN Clinical Practice Guidelines in Oncology. J Natl Compr Canc Netw. 2016; 14:1286–1312. [PubMed: 27697982]
4. Abdalla EK, Pisters PW. Staging and preoperative evaluation of upper gastrointestinal malignancies. Semin Oncol. 2004; 31:513–529. [PubMed: 15297943]
5. Weber WA, Ott K. Imaging of esophageal and gastric cancer. Semin Oncol. 2004; 31:530–541. [PubMed: 15297944]
6. Kwee RM, Kwee TC. Imaging in local staging of gastric cancer: a systematic review. J Clin Oncol. 2007; 25:2107–2116. [PubMed: 17513817]
7. Burke EC, Karpeh MS, Conlon KC, Brennan MF. Laparoscopy in the management of gastric adenocarcinoma. Ann Surg. 1997; 225:262–267. [PubMed: 9060581]
8. Sarela AI, Lefkowitz R, Brennan MF, Karpeh MS. Selection of patients with gastric adenocarcinoma for laparoscopic staging. Am J Surg. 2006; 191:134–138. [PubMed: 16399124]
9. Ikoma N, Blum M, Chiang YJ, et al. Yield of Staging Laparoscopy and Lavage Cytology for Radiologically Occult Peritoneal Carcinomatosis of Gastric Cancer. Ann Surg Oncol. 2016
10. Blackshaw GR, Barry JD, Edwards P, et al. Laparoscopy significantly improves the perceived preoperative stage of gastric cancer. Gastric Cancer. 2003; 6:225–229. [PubMed: 14716516]
11. Bentrem D, Wilton A, Mazumdar M, et al. The value of peritoneal cytology as a preoperative predictor in patients with gastric carcinoma undergoing a curative resection. Ann Surg Oncol. 2005; 12:347–353. [PubMed: 15915368]
12. Mezhir JJ, Shah MA, Jacks LM, et al. Positive peritoneal cytology in patients with gastric cancer: natural history and outcome of 291 patients. Ann Surg Oncol. 2010; 17:3173–3180. [PubMed: 20585870]
13. Lee SD, Ryu KW, Eom BW, et al. Prognostic significance of peritoneal washing cytology in patients with gastric cancer. Br J Surg. 2012; 99:397–403. [PubMed: 22101572]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

14. Ikoma N, Chen HC, Wang X, et al. Patterns of Initial Recurrence in Gastric Adenocarcinoma in the Era of Preoperative Therapy. Ann Surg Oncol. 2017
15. Shiozaki H, Elimova E, Slack RS, et al. Prognosis of gastric adenocarcinoma patients with various burdens of peritoneal metastases. J Surg Oncol. 2016; 113:29–35. [PubMed: 26603684]
16. Badgwell B, Cormier JN, Krishnan S, et al. Does neoadjuvant treatment for gastric cancer patients with positive peritoneal cytology at staging laparoscopy improve survival? Ann Surg Oncol. 2008; 15:2684–2691. [PubMed: 18649106]
17. Kaplan EL, Meier P. Nonparametric estimation from incomplete observations. Journal of the American Statistical Association. 1958; 53:457–481.
18. Cox DR. Regression models and life tables (with discussion). Journal of the Royal Statistical Society B. 1972; 34:187–220.
19. Honore C, Goere D, Messager M, et al. Risk factors of peritoneal recurrence in eso-gastric signet ring cell adenocarcinoma: results of a multicentre retrospective study. Eur J Surg Oncol. 2013; 39:235–241. [PubMed: 23313257]
20. La Torre M, Ferri M, Giovagnoli MR, et al. Peritoneal wash cytology in gastric carcinoma. Prognostic significance and therapeutic consequences. Eur J Surg Oncol. 2010; 36:982–986. [PubMed: 20591604]
21. D'Angelica M, Gonen M, Brennan MF, et al. Patterns of initial recurrence in completely resected gastric adenocarcinoma. Ann Surg. 2004; 240:808–816. [PubMed: 15492562]
22. Lorenzen S, Panzram B, Rosenberg R, et al. Prognostic significance of free peritoneal tumor cells in the peritoneal cavity before and after neoadjuvant chemotherapy in patients with gastric carcinoma undergoing potentially curative resection. Ann Surg Oncol. 2010; 17:2733–2739. [PubMed: 20490698]
23. Japanese Gastric Cancer A. Japanese gastric cancer treatment guidelines 2014 (ver. 4). Gastric Cancer. 2017; 20:1–19.
24. Takebayashi K, Murata S, Yamamoto H, et al. Surgery-induced peritoneal cancer cells in patients who have undergone curative gastrectomy for gastric cancer. Ann Surg Oncol. 2014; 21:1991–1997. [PubMed: 24499832]
25. Murata S, Yamamoto H, Yamaguchi T, et al. Viable Cancer Cells in the Remnant Stomach are a Potential Source of Peritoneal Metastasis after Curative Distal Gastrectomy for Gastric Cancer. Ann Surg Oncol. 2016; 23:2920–2927. [PubMed: 27052647]
26. Burke EC, Karpeh MS Jr, Conlon KC, Brennan MF. Peritoneal lavage cytology in gastric cancer: an independent predictor of outcome. Ann Surg Oncol. 1998; 5:411–415. [PubMed: 9718170]
27. Bando E, Yonemura Y, Takeshita Y, et al. Intraoperative lavage for cytological examination in 1,297 patients with gastric carcinoma. Am J Surg. 1999; 178:256–262. [PubMed: 10527450]
28. Henson DE, Dittus C, Younes M, et al. Differential trends in the intestinal and diffuse types of gastric carcinoma in the United States, 1973–2000: increase in the signet ring cell type. Arch Pathol Lab Med. 2004; 128:765–770. [PubMed: 15214826]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Synopsis

Laparoscopic staging to detect peritoneal carcinomatosis (PC) is recommended for all ≥T1b gastric adenocarcinoma. Even with baseline negative cytology, ~25% of patients develop PC following multimodality therapy. Further research is warranted to detect PC at baseline by the use of biomarkers.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

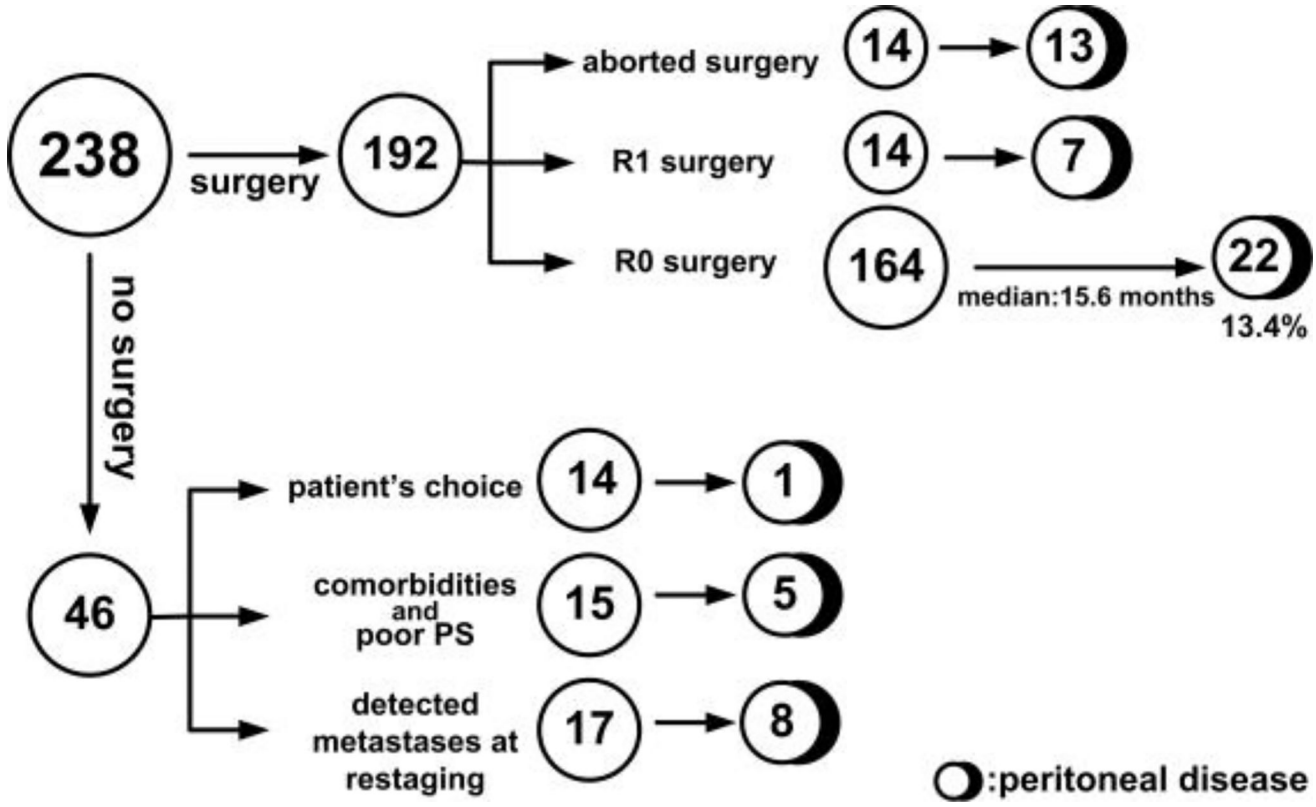

Figure 1.
Risk of peritoneal recurrence in potentially resectable gastric adenocarcinoma patients with negative peritoneal cytology at staging

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

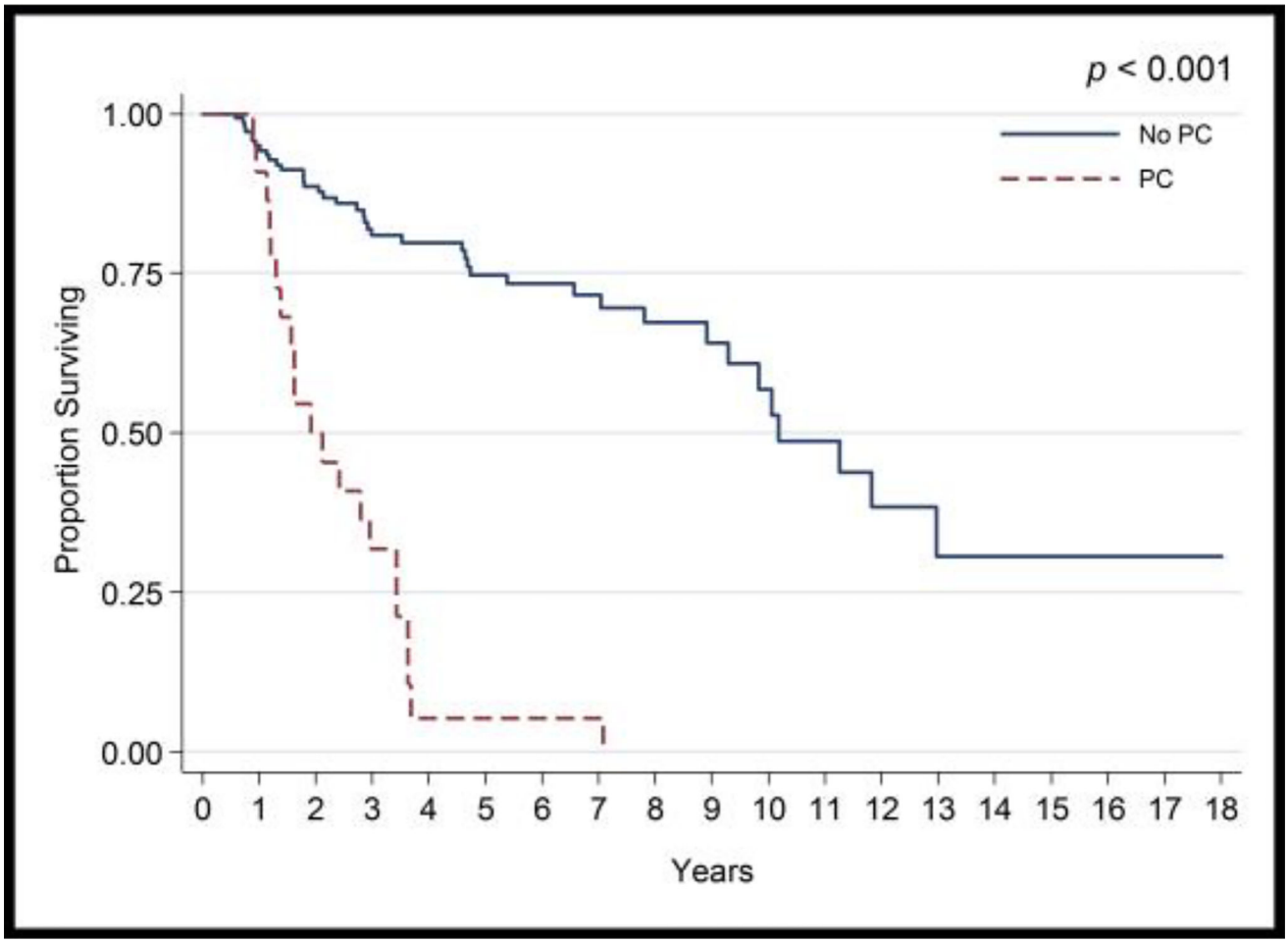

Figure 2.
Kaplan-Meier estimates of overall survival by having peritoneal recurrence or not (patients with negative peritoneal staging at diagnosis and had an R0 surgery, n=164)

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

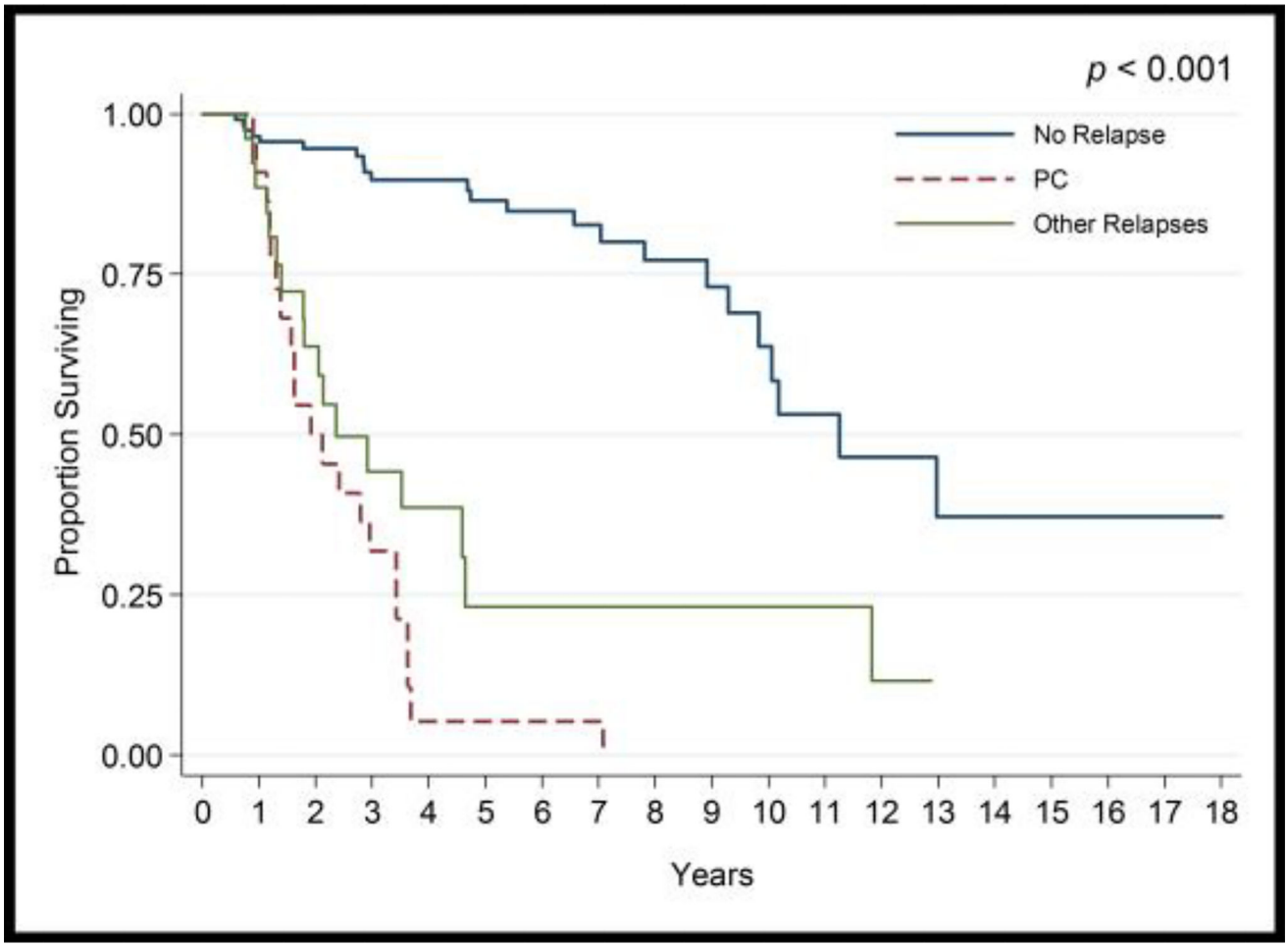

Figure 3.

Kaplan-Meier estimates of overall survival by having peritoneal recurrence (PC), other organ recurrences and patients with no recurrence (patients with negative peritoneal staging at diagnosis and had an R0 surgery, n=164)

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Table 1

Clinical and demographic characteristics of patients with negative laparoscopic staging at diagnosis and had R0 resection after preoperative therapy (n=164)

Characteristics	Number of patients	Percentage (%)
Age		
≥60	90	54.9
<60	74	45.1
Gender		
female	62	37.8
male	102	62.2
Primary tumor location		
gastroesophageal junction	61	37.2
gastric	103	62.8
EUS T stage		
T1–T2	19	11.6
T3–T4	145	88.4
EUS N status		
node negative	78	47.6
node positive	86	52.4
Adenocarcinoma subtype		
signet ring cell	73	44.5
others	91	55.5
Tumor grade		
moderately differentiated	32	19.5
poorly differentiated	132	80.5
Lauren classification		
diffuse	82	53.2
intestinal	72	46.8
ypT stage		
T0–T1–T2	86	52.5
T3–T4	78	47.5
ypN status		
node negative	99	60.4
node positive	65	39.6
yp Stage		
pathologic complete remission	22	13.4
stage-I	48	29.3

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Characteristics	Number of patients	Percentage (%)
stage-II	67	40.8
stage-III	27	16.5
Viable tumor in resected specimen		
<50%	101	61.5
≥50%	63	38.5
Lymphovascular invasion		
negative	81	57.9
positive	59	42.1

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Table 2

Univariate and multivariate analysis of clinical and pathologic factors associated with the peritoneal recurrence for patients with negative peritoneal cytology at staging laparoscopy and had an R0 resection (n=164)

Factor	Peritoneal recurrence (%)	Univariate p	Multivariate p
Age			
≥60	10/90 (11.1%)	0.34	-
<60	12/74 (16.2%)		
Gender			
female	16/62 (25.8%)	**<0.001**	**0.009**
male	6/102 (5.9%)		
Primary tumor location			
gastroesophageal junction	4/61 (6.6%)	**0.029**	0.536
gastric	18/103 (17.5%)		
EUS T stage			
T1–T2	1/19 (5.3%)	0.465	-
T3–T4	21/145 (14.5%)		
EUS N status			
node negative	10/78 (12.8%)	0.832	-
node positive	12/86 (14.0%)		
Adenocarcinoma subtype			
signet ring cell	14/73 (19.2%)	**0.034**	0.681
others	8/91 (8.8%)		
Tumor grade			
moderately differentiated	0/32 (0%)	**0.008**	-
poorly differentiated	22/132 (16.7%)		
Lauren classification			
diffuse	17/82 (20.7%)	**0.019**	0.3
intestinal	5/72 (6.9%)		
ypT stage			
T1–T2	8/86 (9.3%)	0.181	-
T3–T4	14/78 (17.9%)		
ypN status			
node negative	11/99 (11.1%)	0.285	-
node positive	11/65 (16.9%)		
yp Stage			
pathologic complete remission	1/22 (4.5%)		

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Factor	Peritoneal recurrence (%)	Univariate p	Multivariate p
stage-I	5/48 (10.4%)	0.311	-
stage-II	10/67 (14.9%)		
stage-III	6/27 (22.2%)		
Viable tumor in resected specimen			
<50%	12/101 (11.9%)	0.233	-
≥50%	10/63 (15.9%)		
Lymphovascular invasion			
negative	6/81 (7.4%)	0.08	-
positive	10/59 (16.9%)		