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The impact of the COVID-19 pandemic on the diagnosis and surgical treatment processes of gastric cancer

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ABSTRACT

Objective: This study aimed to evaluate the effects of the coronavirus disease-2019 (COVID-19) pandemic on the diagnostic and surgical treatment processes of gastric cancer. Three-year periods before and after the pandemic were compared to examine differences in the diagnostic process, disease stage, surgical extent, and survival.

Material and Methods: A retrospective analysis was conducted on 395 patients who underwent resection surgery for gastric cancer between March 11, 2017, and March 11, 2023. Patients with incomplete data regarding the diagnostic and treatment processes, those deemed inoperable following exploratory surgery and subsequently referred for alternative treatment, and patients operated on at external centers were excluded. A total of 197 patients were analyzed and divided into two groups: pre-pandemic (PP, n=137) and post-pandemic (PS, n=60).

Results: A significant decrease in the number of surgeries was observed in the PS group compared to the PP group. Significant differences were found between the two groups regarding locally advanced disease at diagnosis (T4/N+), the application rate of cytoreductive surgery+hyperthermic intraperitoneal chemotherapy, and follow-up mortality (p=0.031, p=0.028, and p=0.005). The overall mean survival was 50.02±2.78 months in the PP group and 32.52±2.24 months in the PS group (p=0.765). No significant differences were observed between the groups regarding the diagnostic process and pathological stages.

Conclusion: The COVID-19 pandemic may have reduced both the referral rates for surgery and the extent of surgical interventions for advanced-stage gastric cancer. It is believed that both surgeons and patients adopted more conservative approaches during the pandemic.

Keywords: Gastric adenocarcinoma, gastric cancer surgery, COVID-19, pandemic

INTRODUCTION

Gastric cancer continues to represent a major global health concern due to its high incidence and cancer-related mortality rates. Based on data from the Global Cancer Observatory, nearly 1 million new cases of gastric cancer were recorded in 2020, resulting in over 770,000 deaths attributed to the disease (1). While the prevalence is particularly high in East Asian countries, gastric cancer remains a leading cause of morbidity and mortality in many developing regions as well. The disease typically progresses insidiously, and the absence of prominent clinical symptoms in the early stages often leads to delayed diagnosis. Consequently, a significant proportion of patients are identified at either locally advanced or metastatic stages (2).

The contemporary management of gastric cancer typically incorporates a multimodal strategy, combining surgical intervention with systemic therapies based on the tumour stage. For early-stage disease, therapeutic options may include endoscopic resection or minimally invasive laparoscopic surgery. In contrast, patients with locally advanced tumors generally undergo extensive resections following neoadjuvant chemotherapy, which serves as the foundation of curative treatment (3). Total or subtotal gastrectomy accompanied by D2 lymphadenectomy is widely accepted as the surgical standard in oncologic practice. In more complex cases, such as those involving peritoneal dissemination or adjacent organ invasion, advanced procedures like cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC) have been adopted as potential treatment modalities (4). Nevertheless, due to the elevated risk of postoperative complications, meticulous patient selection remains crucial.

The coronavirus disease-2019 (COVID-19) pandemic, which was officially recognised on March 11, 2020, has had a profound and widespread influence on global

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healthcare delivery (5). With health systems primarily directed toward managing acute respiratory infections, there was a substantial disruption in routine medical services, including delays in elective surgeries, limitations in diagnostic workflows, and interruptions in oncologic care (6). Particularly concerning was the restriction of aerosol-generating procedures such as upper gastrointestinal endoscopy, which hindered the timely diagnosis of cancers like gastric cancer that often present with subtle or non-specific symptoms. As a result, many patients presented at more advanced disease stages, limiting opportunities for curative interventions (7).

Beyond diagnostic delays, the pandemic also led to significant modifications in surgical decision-making and treatment planning. Due to constraints such as limited availability of intensive care resources, surgical teams and multidisciplinary cancer boards increasingly adopted conservative treatment strategies, reserving high-risk procedures for select cases. In this context, neoadjuvant treatment protocols gained traction for locally advanced gastric cancer, while definitive surgeries were frequently delayed or omitted (7). Additionally, the use of high-morbidity procedures such as CRS and HIPEC for peritoneal carcinomatosis became more selective, highlighting a shift in clinical decision-making that accounted not only for oncological criteria but also for health system limitations.

Although comprehensive data remain scarce, early reports indicate a trend toward more advanced disease presentation at diagnosis, reduced surgical intervention rates, and compromised oncological outcomes in gastric cancer patients during the pandemic period (8). The magnitude of these effects, however, has varied depending on regional healthcare capacities and pandemic management strategies. Institutions with resilient infrastructure were generally able to sustain oncologic services, whereas facilities with limited resources experienced considerable disruptions in both diagnostic and therapeutic pathways (9).

This retrospective study was conducted to assess the effects of the COVID-19 pandemic on the diagnostic and therapeutic pathways of patients undergoing surgical resection for gastric cancer at our institution. We systematically compared several parameters between the pre-pandemic (PP) and pandemic periods, including stage at diagnosis, time from diagnosis to treatment, surgical extent, frequency of neoadjuvant therapy, and survival outcomes. The objective was to clarify how the pandemic influenced surgical care in gastric cancer and to inform future planning and response strategies in the face of comparable global health emergencies.

MATERIAL and METHODS

This retrospective analysis included patients diagnosed with gastric cancer who underwent surgical resection within the Department of General Surgery at Ege University Faculty of Medicine Hospital. Ethical approval for the study was obtained by the Ege University Local Medical Research Ethics Committee on May 9, 2024 (approval no: 24-5T/11).

Patients who were diagnosed with gastric cancer and underwent resection surgery at our institution between March 11, 2017, and March 11, 2023, were evaluated for inclusion in the study. Eligible cases included those with a confirmed histopathological diagnosis of gastric adenocarcinoma, established through endoscopic biopsy or exploratory surgery, with clearly identifiable dates of diagnosis and, where applicable, initiation of neoadjuvant therapy. Only patients who received definitive surgical treatment in our department, including appropriate lymphadenectomy and, when indicated, additional resective procedures such as adjacent organ resection, CRS, or HIPEC, were considered for analysis.

Patients with incomplete information regarding diagnostic or treatment procedures, those deemed inoperable during exploratory surgery and subsequently referred for non-surgical treatment, individuals who underwent definitive surgery at external centers and were referred to our institution only for additional procedures, or patients receiving solely palliative care were excluded from the analysis. Finally, 197 out of 395 patients were included in the final cohort.

All clinical and pathological data were retrospectively collected from the hospital's electronic medical records, including patient history, discharge summaries, endoscopic and radiologic reports, operative notes, and pathology findings.

The study cohort was stratified into two groups based on the timeline relative to the onset of the COVID-19 pandemic: The PP and post-pandemic (PS) periods. Patients treated between March 11, 2017 and March 10, 2020 were categorized as the PP group, while those managed between March 11, 2020 and March 11, 2023 comprised the PS group. The groups were compared across multiple parameters, including demographic characteristics (age, sex), the time interval from symptom onset to diagnosis (in months), the interval between diagnosis and initiation of first-line therapy (neoadjuvant treatment or surgery, in days), radiological evidence of locally advanced disease (cT4, cN+) or peritoneal spread, intraoperative findings such as adjacent organ invasion (cT4B) or peritoneal carcinomatosis, type of gastric resection performed, implementation of CRS and HIPEC, and postoperative pathological staging (pTNM classification and prognostic stage).

Statistical Analysis

Categorical variables were presented as frequencies and percentages, while continuous variables were reported as means with standard deviations. The normality of continuous data was assessed using the Shapiro-Wilk and Kolmogorov-Smirnov

tests. Group comparisons were conducted using the chi-square test for categorical variables, the Student's t-test for normally distributed continuous variables, and the Mann-Whitney U test for non-normally distributed variables. It could be better to add the place labeled yellow in statistical analysis "Survival analyses utilized the Kaplan-Meier method to generate and compare the survival curves between the pre-pandemic and post-pandemic groups. Furthermore, Cox Regression Analysis was performed to identify independent prognostic factors affecting mortality". A p-value less than 0.05 was considered statistically significant, and all analyses were performed using SPSS version 23.0 (IBM Corp., Chicago, IL, USA).

RESULTS

A total of 197 patients who fulfilled the inclusion criteria and had complete data regarding diagnostic and therapeutic processes were enrolled in the study. Of these, 136 (69.0%) were male and 61 (31.0%) were female, with a mean age of 62.53±11.39 years. An overview of the patients' demographic characteristics and clinical parameters is provided in Table 1.

Of the 197 patients included in the study, 137 (69.5%) were treated during the PP period, while 60 (30.5%) received treatment during the PS period. There were no statistically significant differences between the two groups regarding baseline demographic variables such as gender and age, or temporal metrics including symptom duration and time to initiation of treatment (p>0.05).

However, the proportion of patients diagnosed with locally advanced disease (cT4 and/or cN+) was significantly higher in the PP group compared to the PS group (48.2% vs. 31.7%; p=0.031). Similarly, the use of CRS combined with HIPEC significantly declined during the pandemic period (PP: 10.9% vs. PS: 1.7%; p=0.028). Follow-up data also revealed a higher mortality rate in the PP group (53.3%) compared to the PS group (31.7%), a difference that reached statistical significance (p=0.005). Further details are presented in Table 2.

The mean overall survival for the entire cohort was calculated as 50.36±2.45 months. The 1-year and 3-year survival rates were 63.6% and 57.7%, respectively. When analyzed by pandemic period, the mean overall survival was 50.02±2.78 months for the PP group and 32.52±2.24 months for the PS group; however, this difference was not statistically significant (p=0.765) (Figures 1, 2).

In the multivariate analysis conducted using Cox regression, the only factor found to have a significant impact on mortality was the pathological stage (p<0.001). No significant effects of other variables on mortality were observed (p>0.05) (Table 3).

DISCUSSION

This study aimed to investigate the effects of the COVID-19 pandemic on the diagnostic and surgical treatment processes of gastric cancer by retrospectively analyzing patients who

Table 1. Descriptive and clinical statistics

Descriptive statistics	
Age	64.97±11.59
Gender male/female	136 (69.0%)/61 (31.0%)
Symptom onset (month)	5.08±9.16
Interval between diagnosis and treatment (day)	45.31±52.73
Peritoneal carcinomatosis findings at diagnosis	16 (8.1%)
Locally advanced disease findings at diagnosis	85 (43.1%)
Neoadjuvant therapy	53 (26.9%)
Resection type-total	100 (50.8%)
Resection type-subtotal	73 (37.1%)
Resection type-proksimal	24 (12.2%)
Peritoneal carcinomatosis findings at the operation	11 (5.6%)
Adjacent organ invasion findings at the operation	19 (9.6%)
CRS + HIPEC	16 (8.1%)
pT grade-T0	8 (4.1%)
pT grade-T1	28 (14.2%)
pT grade-T2	22 (11.2%)
pT grade-T3	44 (22.3%)
pT grade-T4a	80 (40.6%)
pT grade-T4b	13 (6.6%)
pN grade-N0	67 (34.0%)
pN grade-N1	36 (18.3%)
pN grade-N2	29 (14.7%)
pN grade-N3a	41 (20.8%)
pN grade-N3b	24 (12.2%)
pM grade-M0	187 (94.9%)
pM grade-M1	10 (5.1%)
Grade-0	10 (5.1%)
Grade-1A	25 (12.7%)
Grade-1B	15 (7.6%)
Grade-2A	17 (8.6%)
Grade-2B	25 (12.7%)
Grade-3A	34 (17.3%)
Grade-3B	37 (18.8%)
Grade-3C	24 (12.2%)
Grade-4	10 (5.1%)
Overall survival	50.36±2.45 year
1-year overall survival	63.6%
3-year overall survival	57.7%

HIPEC: Hyperthermic intraperitoneal chemotherapy, CRS: Cytoreductive surgery.

Table 2. Comparison of parameters between the PP and PS groups

	PP	PS	p
Age	64.27±12.44	66.56±9.25	0.385
Gender (male/female)	92 (67.2%)/45 (32.8%)	44 (73.3%)/16 (26.7%)	
Symptom onset (month)	5.28±8.83	4.66±9.91	0.098
Interval between diagnosis and treatment (day)	43.93±56.08	48.71±47.02	0.305
Peritoneal carcinomatosis findings at diagnosis	12 (8.8%)	4 (6.7%)	0.623
Locally advanced disease findings at diagnosis	66 (48.2%)	19 (31.7%)	0.031
Neoadjuvant therapy	34 (24.8%)	19 (31.7%)	0.318
Resection type-total	65 (47.4%)	35 (58.3%)	
Resection type-subtotal	53 (38.7%)	20 (33.3%)	
Resection type-proksimal	19 (13.9%)	5 (8.3%)	
Peritoneal carcinomatosis findings at the operation	8 (5.8%)	3 (5.0%)	0.814
Adjacent organ invasion findings at the operation	13 (9.5%)	6 (10.0%)	0.911
CRS + HIPEC	15 (10.9%)	1 (1.7%)	0.028
pT grade-Tis	2 (1.5%)	0 (%)	
pT grade-T0	6 (4.4%)	2 (3.3%)	
pT grade-T1	21 (15.3%)	7 (11.7%)	
pT grade-T2	12 (8.8%)	10 (16.7%)	
pT grade-T3	32 (23.4%)	12 (20.0%)	
pT grade-T4a	54 (39.4%)	26 (43.3%)	
pT grade-T4b	10 (7.3%)	3 (5.0%)	
pN grade-N0	46 (33.6%)	21 (35.0%)	
pN grade-N1	25 (18.2%)	11 (18.3%)	
pN grade-N2	16 (11.7%)	13 (21.75)	
pN grade-N3a	34 (24.8%)	7 (11.7%)	
pN grade-N3b	16 (11.7%)	8 (13.3%)	
pM grade-M0	129 (94.2%)	58 (96.7%)	0.569
pM grade-M1	8 (5.8%)	2 (3.3%)	0.463
Grade-0	8 (5.8%)	2 (3.3%)	
Grade-1A	19 (13.9%)	6 (10.0%)	
Grade-1B	8 (5.8%)	7 (11.7%)	
Grade-2A	13 (9.5%)	4 (6.7%)	
Grade-2B	13 (9.5%)	12 (20.0%)	
Grade-3A	21 (15.3%)	13 (21.7%)	
Grade-3B	21 (15.3%)	7 (11.7%)	
Grade-3C	30 (21.9%)	7 (11.7%)	
Grade-4	17 (12.4%)	2 (3.3%)	
Exitus	73 (53.3%)	19 (31.7%)	0.005
Overall survival	50.02±2.78	32.52±2.24	0.765
1-year overall survival	83.2%	84.8%	
3-year overall survival	57.5%	65.7%	

PP: Pre pandemic, PS: Post pandemic, HIPEC: Hyperthermic intraperitoneal chemotherapy, CRS: Cytoreductive surgery.

underwent surgery before and after the pandemic. Our findings indicate that during the pandemic period, there was a significant reduction in the number of patients undergoing surgery, a decline in the rate of locally advanced disease at diagnosis, and a significant decrease in the frequency of advanced surgical interventions such as CRS+HIPEC. These results not only reflect

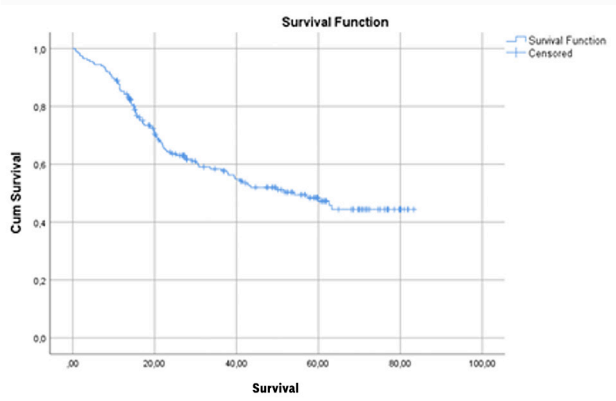

Figure 1. Overall survival curve.

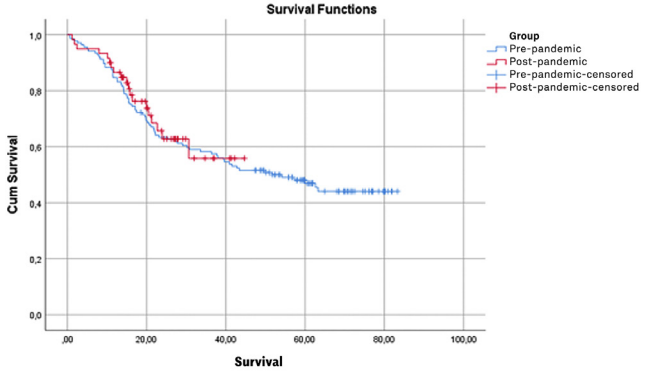

Figure 2. Survival comparison between the PP and PS groups.
PP: Pre pandemic, PS: Post pandemic

the burden placed on healthcare systems during the pandemic but also highlight its impact on surgical decision-making processes.

The reduction in surgical cases observed during the pandemic is in line with data reported from various countries. In nations such as China, Italy, Spain, and the United States, marked declines in surgical rates for gastrointestinal cancers have been documented. This trend is attributed both to a decrease in patient referrals and to the reallocation of hospital resources (e.g., intensive care beds, personnel, and equipment) to the management of COVID-19 patients (10). In our study, 30.5% fewer patients received surgical treatment during the pandemic period compared to the PP period, suggesting that the number of gastric cancer patients who were either undiagnosed or unable to access surgery may be even higher.

The lower rate of locally advanced disease at diagnosis in the PS period appears to contradict some findings in the literature. For instance, a study conducted in the United Kingdom reported an increased rate of advanced-stage disease among gastrointestinal cancer patients during the pandemic (11). However, our study included only patients eligible for surgery—a selected patient population—which may explain this discrepancy. It is possible that patients with more advanced diseases were either directed to non-surgical treatment modalities or deemed inoperable during the pandemic. Moreover, the relatively maintained access to diagnosis and treatment at our centre, owing to its robust healthcare infrastructure, might have contributed to these findings.

The marked reduction in high-morbidity procedures such as CRS+HIPEC during the pandemic aligns with current international guidelines. Authorities such as European Society For Medical Oncology and National Comprehensive Cancer Network recommended a more selective approach to these high-risk procedures during the pandemic (12). Our findings suggest that this recommendation was reflected in clinical practice, with surgeons adopting more conservative management strategies, particularly for patients with peritoneal disease driven by both clinical and logistical concerns.

Although the survival analysis revealed a lower mean overall survival for patients operated on during the pandemic, this difference was not statistically significant. This observation may be explained by the relatively short follow-up period, the selected nature of the patient population, and the exclusion of patients who did not undergo surgery during the pandemic. Additionally, the Cox regression analysis identified only the pathological stage as an independent predictor of survival, underscoring the critical role of tumour staging in treatment outcomes (13).

One of the strengths of this study is the use of patient data covering six years from a single centre, where patients were treated by a homogeneous surgical team. This minimizes heterogeneity in surgical techniques and follow-up protocols. Furthermore, by including data from a three-year pandemic period, our study allows for an evaluation of both the immediate and longer-term effects of the COVID-19 crisis.

Study Limitations

Nonetheless, our study has several limitations. As a retrospective analysis, it is subject to methodological constraints such as selection bias and potential inaccuracies in record-keeping. Patients who were directed to non-surgical treatment modalities or who succumbed to their disease without accessing surgery were not included, which may lead to an underestimation of the true impact of the pandemic. Moreover, the incomplete long-term survival data limits a comprehensive prognostic evaluation.

CONCLUSION

The COVID-19 pandemic has profoundly affected not only the management of infectious diseases but also the diagnostic and treatment pathways for oncological conditions. This study

Table 3. Cox regression analysis results of factors affecting survival

	B	SE	Wald	df	Sig.	Exp(B)	95% CI lower	95% CI upper
Locally advanced disease findings at diagnosis	0.121	0.262	0.213	1	0.644	0.886	0.53	1.481
HIPEC	0.076	0.614	0.015	1	0.902	0.927	0.278	3.086
Grade			33.116	8	0.0			
Grade-1A	0.764	1.025	0.556	1	0.456	0.466	0.062	3.472
Grade-1B	0.711	0.89	0.638	1	0.424	2.036	0.356	11.652
Grade-2A	1.097	0.837	1.715	1	0.19	2.994	0.381	15.455
Grade-2B	1.247	0.794	2.467	1	0.116	3.481	0.734	16.557
Grade-3A	1.317	0.792	2.761	1	0.097	3.731	0.789	17.631
Grade-3B	1.978	0.785	6.353	1	0.012	7.227	1.553	33.645
Grade-3C	2.312	0.798	8.403	1	0.004	10.096	2.114	48.203
Grade-4	3.226	0.913	12.482	1	0.0	25.185	4.206	150.816
Age	0.006	0.01	0.332	1	0.565	1.006	0.96	1.054
Gender	0.194	0.236	0.676	1	0.411	1.214	0.765	1.927
Pandemic	0.027	0.105	0.071	1	0.791	0.974	0.801	1.186
Peritoneal carcinomatosis findings at diagnosis	0.702	0.523	1.803	1	0.179	0.496	0.178	1.381
Neoadjuvant therapy	0.344	0.395	0.756	1	0.385	1.41	0.65	3.063
Total gastrectomy	1.569	0.456	11.855	2	0.456	4.804	1.726	13.366
Subtotal gastrectomy	0.317	0.256	1.533	1	0.216	0.728	0.44	1.203
Proksimal gastrectomy	0.074	0.388	0.036	1	0.849	0.929	0.434	1.987
Peritoneal carcinomatosis findings at the operation	0.313	0.487	0.412	1	0.521	1.367	0.526	3.553
Adjacent organ invasion findings at the operation	0.099	0.348	0.082	1	0.775	0.905	0.458	1.789

CI: Confidence interval, SE: Standard error, HIPEC: Hyperthermic intraperitoneal chemotherapy.

demonstrates that the pandemic resulted in a significant reduction in the number of patients referred for surgery, a hesitancy to perform advanced surgical interventions, and potential variations in tumour staging at diagnosis among gastric cancer patients. Although no statistically significant difference in overall survival was observed between the PP and PS periods, the exclusion of patients who did not undergo surgery suggests that the true impact of the pandemic may be even more substantial.

These findings underscore the necessity of enhancing the resilience of healthcare systems to ensure the continuity of oncological care during global crises. In anticipation of future health emergencies, it is imperative to develop flexible health policies and dynamic resource management strategies, particularly for high-mortality malignancies.

Ethics

Ethics Committee Approval: Ethical approval for the study was obtained by the Ege University Local Medical Research Ethics Committee on May 9, 2024 (approval no: 24-5T/11).

Informed Consent: Retrospective study.

Footnotes

Author Contributions

Surgical and Medical Practices - E.U., V.S., B.Ç., M.S.E., T.Ö.S.; Concept - E.U., V.S.; Design - E.U., Ö.F.; Data Collection or Processing - S.T., B.E.B., Ö.F.; Analysis or Interpretation - S.T., B.E.B., B.Ç.; Literature Search - E.U., V.S., Ö.F.; Writing - E.U., V.S., B.Ç.

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