Received: 10 October 2024 | Revised: 3 November 2024 | Accepted: 10 November 2024

DOI: 10.1002/ags3.12891

AGSurg Annals of Gastroenterological Surgery Open Access WILEY

ORIGINAL ARTICLE

Analysis of surgical volume and short-term outcomes for upper gastrointestinal cancer post-COVID-19: Evidence from a nationwide Japanese database

Masashi Takeuchi[1] | Hideki Endo[2] | Taizo Hibi[3] | Ryo Seishima[1] | Yusuke Takemura[1] | Hiroyuki Yamamoto[2] | Hiromichi Maeda[4] | Akinobu Taketomi[5] | Yoshihiro Kakeji[6,7] | Yasuyuki Seto[8] | Hideki Ueno[6,9] | Masaki Mori[10] | Ken Shirabe[11,12] | Yuko Kitagawa[1,12]

[1]Department of Surgery, Keio University School of Medicine, Tokyo, Japan

[2]Department of Healthcare Quality Assessment, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan

[3]Department of Pediatric Surgery and Transplantation, Kumamoto University Graduate School of Medical Sciences, Kumamoto, Japan

[4]Department of Surgery, Kochi Medical School, Kochi, Japan

[5]Department of Gastroenterological Surgery I, Hokkaido University Hospital, Hokkaido, Japan

[6]Database Committee, The Japanese Society of Gastroenterological Surgery, Tokyo, Japan

[7]Division of Gastrointestinal Surgery, Department of Surgery, Graduate School of Medicine, Kobe University, Kobe, Japan

[8]National Cancer Center Hospital, Tokyo, Japan

[9]Department of Surgery, National Defense Medical College, Tokorozawa, Japan

[10]Tokai University, Tokyo, Japan

[11]Department of General Surgical Science, Gunma University Graduate School of Medicine, Gunma, Japan

[12]The Japanese Society of Gastroenterological Surgery, Tokyo, Japan

Correspondence
Taizo Hibi, Department of Pediatric Surgery and Transplantation, Kumamoto University Graduate School of Medical Sciences, 1-1-1 Honjo, Chuoku, Kumamoto 860-8582, Japan.
Email: taizohibi@gmail.com

Funding information
MHLW Research on Emerging and Re-emerging Infectious Diseases and Immunization, Grant/Award Number: JPMH23HA2011 and JPMH24HA2015

Abstract

Aim: Previous studies indicated that short-term outcomes for gastroenterological surgeries did not worsen during the COVID-19 pandemic. However, it remains unclear whether surgical volumes and medical resource use have recovered postpandemic. This study examines pre- and postpandemic trends in upper gastrointestinal surgeries, including esophagectomy and gastrectomy, and their short-term outcomes.

Methods: Data from the Japan's National Clinical Database (NCD) were analyzed for patients who underwent esophagectomy for esophageal cancer and gastrectomy for gastric cancer between January 2018 and December 2023. We evaluated changes in surgical volume, intensive care unit (ICU) use, morbidity, mortality rates, and the standardized morbidity and mortality ratio (SMR)—a comparison of observed versus expected outcomes using an NCD-established risk calculator. Key metrics included 30d mortality, surgical mortality, and four major morbidities like pneumonia and anastomotic leakage.

Results: Esophagectomy volumes remained stable from 2018 to 2023, while gastrectomy volumes decreased notably over the past 6 y. The proportion of patients over 70 increased significantly in both surgery types. Morbidity and mortality rates showed no significant deterioration postpandemic, as indicated by SMR values.
Conclusions: This study analyzed changes in surgical volume and short-term outcomes for upper gastrointestinal cancer in the post-COVID-19 era using a Japanese nationwide database. It found that surgical treatments for gastrectomy and esophagectomy remained safe even after the pandemic.

KEYWORDS
COVID-19, esophageal cancer, esophagectomy, gastrectomy, gastric cancer

1 | INTRODUCTION

The coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first identified in Wuhan, China, in December 2019.[1] The virus quickly spread worldwide, resulting in a global pandemic. This pandemic has significantly altered daily life, including the adoption of face masks, social distancing, and changes in lifestyles, work routines, and communication methods.[2] The impact of the pandemic extended to cancer screening, diagnosis, and treatment.[3–5] Reduced endoscopic screenings led to a rise in advanced-stage cancer diagnoses during the pandemic.[6] To manage medical resources for COVID-19 and reduce hospital infections, the Japanese Surgical Society, which includes 10 major surgical societies in Japan, recommended surgical triage based on illness severity on April 1, 2020. They advised postponing nonurgent surgeries for benign conditions. Consequently, there was a decrease in surgeries, with a nationwide analysis showing about a 15% reduction in gastrointestinal surgeries during the pandemic.[6]

To assess the impact of the COVID-19 pandemic on cancer treatment in Japan, our group examined surgical outcomes before and after the pandemic using a nationwide database across various malignancies, including esophageal, stomach, colorectal, pancreatic, and liver cancers.[7–11] We found that short-term outcomes did not significantly worsen during the pandemic, despite constrained medical resources, due to the concerted efforts of Japan's entire surgical community. However, there was a decline in the number of surgeries and intensive care unit (ICU) admissions, particularly for gastric cancer, during the pandemic. It is important to determine whether surgical volumes and medical resource utilization are recovering postpandemic.

This study aims to analyze trends in the number of patients undergoing upper gastrointestinal surgeries, such as esophagectomy and gastrectomy, which are among the most invasive procedures for gastrointestinal cancer.

2 | METHODS

2.1 | Patients

This analysis used data from the National Clinical Database (NCD), a comprehensive web-based surgical registration system in Japan, focusing on patients who underwent esophagectomy for esophageal cancer from January 2018 to December 2023. We also included data on gastrectomy for gastric cancer. The NCD has recorded over 14 million procedures, covering more than 90% of all surgeries performed nationwide, with detailed patient information and short-term outcomes from ~5000 hospitals. This database has been used to report numerous significant findings for various surgical types.[6,12–14] For this study, we collected data from the NCD on the number of surgeries, ICU utilization rates (defined as the hospital ward providing the most intensive medical care), and monthly mortality and morbidity rates. We excluded patients with benign tumors, tumors in other organs, those under 18 y of age, emergency surgery cases, patients with T0 or Tis esophageal or gastric tumors, and cases with missing data (Figure 1). Four morbidities were assessed: pneumonia, sepsis, unplanned intubation, and anastomotic leakage, along with 30d mortality and operative mortality for esophagectomy, and pneumonia, sepsis, cardiac complications, and anastomotic leakage, as well as 30d and operative mortality for gastrectomy. Pneumonia was diagnosed through postoperative chest X-rays, chest computed tomography (CT) scans showing abnormal shadows, or a positive sputum culture. Unplanned intubation was defined as any unscheduled reintubation within 30 d after initial extubation. Cardiac complications included cardiac arrest or myocardial infarction requiring resuscitation. Operative mortality was defined as death within 30 d or in-hospital death within 90 d. Cancer stage was determined using the TNM classification.[15] The study protocol was reviewed and approved by the Japanese Society of Gastroenterological Surgery Committee and the Institutional Review Board of Kochi Medical School, which waived the need for individual written informed consent (ID: 2023-108).

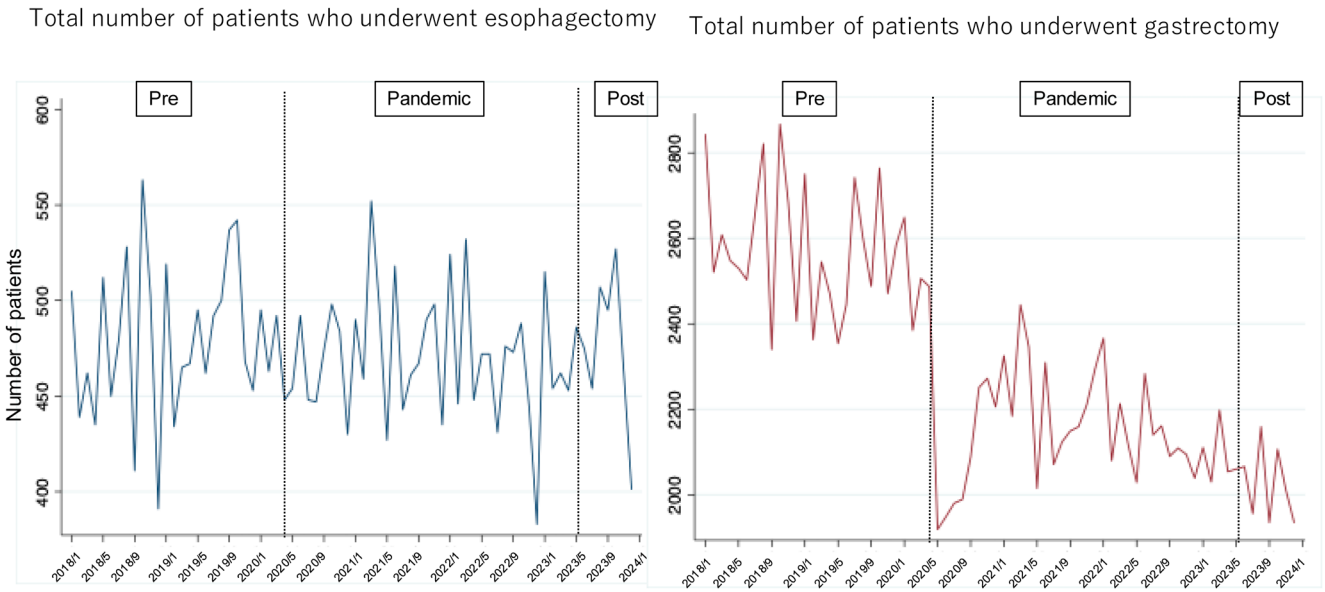

FIGURE 1 Trends in the number of patients undergoing esophagectomy and gastrectomy. The blue and red solid lines represent patients who had esophagectomy and those who had gastrectomy, respectively.

2.2 | Statistical analysis

Time-series charts were created using Stata/BE 17 for Mac (StataCorp, College Station, TX, USA), and all statistical analyses were conducted with R v. 4.1.2 (2021; R Foundation for Statistical Computing, Vienna, Austria). The analysis categorized data into three infectious periods: prepandemic, pandemic, and postpandemic. The pandemic start date was set as April 1, 2020, when the Japanese Surgical Society (comprising 10 major surgical societies in Japan) highlighted the need for surgical triage based on illness severity. The end date was set as May 8, 2023, when the Ministry of Health, Labour and Welfare downgraded the disease from category II to V under the Infectious Diseases Control Law. After this date, the government no longer required daily reporting of infectious cases, but shifted to weekly announcements based on reports from fixed-point medical facilities.

The standardized mortality and morbidity ratio (SMR) was calculated monthly to assess trends in risk-adjusted outcomes. This ratio is obtained by dividing the observed number of complications by the expected number, using a risk calculator. Developed by the NCD, the risk calculator estimates mortality and morbidity risks based on logistic regression analysis.[12,16] A previous study created a risk model for predicting 30d mortality, operative mortality, pneumonia, anastomotic leakage, unplanned intubation, and sepsis after esophagectomy. This model considers factors such as patient age, preoperative daily activities, cerebrovascular disease history, weight loss, uncontrolled ascites, high American Society of Anesthesiologists (ASA) scores, comorbidities, and abnormal hematologic findings. A similar risk model was used for calculating the SMR for gastrectomy.[13,14]

The interpretation of the SMR is as follows: An SMR greater than 1 means the observed number of patients exceeds the expected number based on the risk calculator. An SMR less than 1 indicates that the observed number is lower than expected. An SMR of 1 indicates that the observed number matches the expected number. A statistically significant difference between observed and expected numbers is indicated if the 95% confidence interval does not include 1.0.

3 | RESULTS

3.1 | Trends in the number of patients undergoing esophagectomy and gastrectomy

Out of 37002 patients who underwent esophagectomy between 2018 and 2023, data from 34158 patients were analyzed based on inclusion and exclusion criteria (Figure S1). The annual number of esophagectomies remained fairly stable over the 6y: 5679 in 2018, 5834 in 2019, 5625 in 2020, 5738 in 2021, 5590 in 2022, and 5692 in 2023 (Table 1). This trend did not show significant changes during the COVID-19 pandemic (Figure 1). In contrast, among 165558 patients who underwent gastrectomy, the number of surgeries decreased over the 6y: 31329 in 2018, 30578 in 2019, 26681 in 2020, 26631 in 2021, 25720 in 2022, and 24619 in 2023 (Figure 1). A similar trend was observed at ICU usage after surgery (Figure S2). The study also examined trends in esophagectomy patients by age, T stage, and lymph node status. The proportion of patients over 70y old increased significantly during and after the pandemic compared to the prepandemic period, for both esophagectomy and gastrectomy. The percentages were 46.2%, 48.5%, 49.1%, 50.5%, 51.1%, and 52.6% for esophagectomy in 2018 through 2023 and 61.6%, 64.5%, 66.8%, 68.6%, 70.6%, and 71.6% for gastrectomy over the same years (Figure 2).

TABLE 1 The number of patients who underwent esophagectomy and gastrectomy for primary cancers.

		Month											
Year	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Esophagectomy													
2018	5679	505	439	462	435	512	450	480	528	411	563	503	391
2019	5834	519	434	465	467	495	462	492	500	537	542	468	453
2020	5625	495	463	492	448	454	492	448	447	474	498	484	430
2021	5738	490	459	552	498	427	518	443	461	467	490	498	435
2022	5590	524	446	532	448	472	472	431	476	473	488	445	383
2023	5692	515	454	462	453	486	475	454	507	495	527	463	401
Gastrectomy													
2018	31329	2844	2521	2608	2548	2530	2503	2658	2821	2340	2867	2683	2406
2019	30578	2750	2363	2545	2471	2354	2445	2742	2601	2488	2764	2471	2584
2020	26681	2649	2385	2506	2487	1919	1948	1980	1989	2089	2251	2272	2206
2021	26631	2325	2184	2444	2346	2015	2309	2071	2123	2149	2159	2211	2295
2022	25720	2366	2080	2213	2116	2029	2283	2140	2161	2090	2109	2094	2039
2023	24619	2110	2030	2198	2054	2060	2066	1956	2159	1935	2106	2011	1934

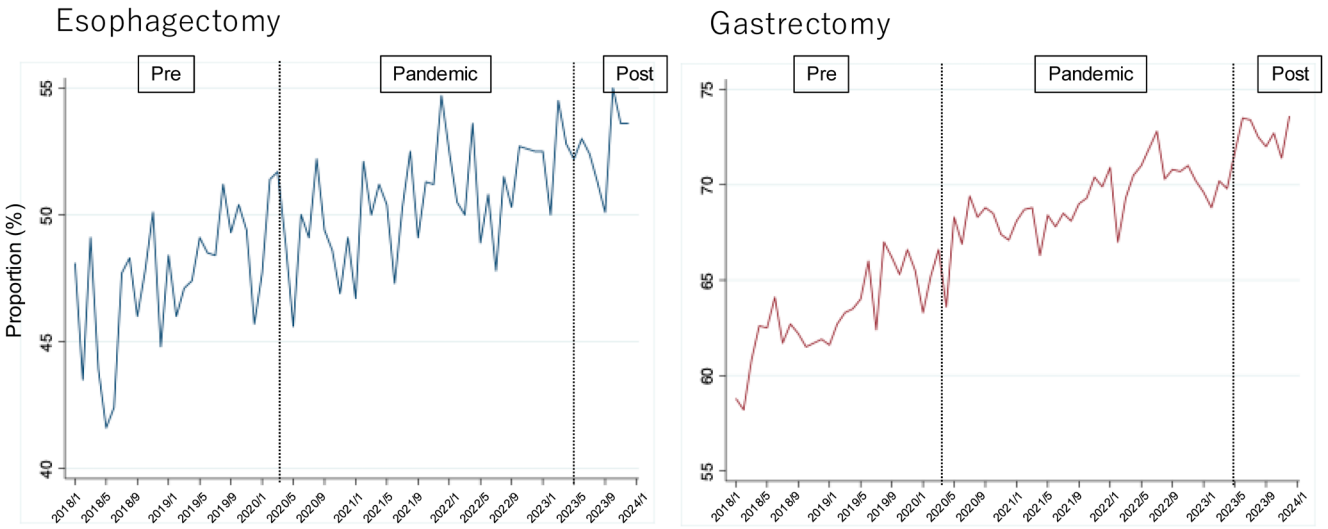

FIGURE 2 Trends in the number of patients over 70y old undergoing esophagectomy and gastrectomy. The blue and red solid lines indicate patients who underwent esophagectomy and those who had gastrectomy, respectively.

3.2 | The standardized mortality and morbidity ratio

For patients who underwent esophagectomy, the average operative morality rates were 1.4%, 1.6%, 1.1%, 1.1%, 1.3%, and 1.1% in 2018 through 2023, respectively (Table S1). No significant changes in the SMR were observed during or after the pandemic compared to the prepandemic period. This trend was also noted for other complications, including 30d mortality, pneumonia, sepsis, unplanned intubation, and anastomotic leakage.

For patients who underwent gastrectomy, the average operative morality rates were 0.8%, 0.9%, 1.0%, 0.9%, 1.0%, and 1.0% from 2018 to 2023, respectively (Table S2). There were no significant changes in the SMR over the years. Detailed SMR values and 95% confidence intervals for mortalities and morbidities are shown in Figures 3 and 4.

4 | DISCUSSION

This study examined changes in surgical volume and short-term outcomes for upper gastrointestinal cancer in the post-COVID-19 period using a nationwide Japanese database. We found that surgical treatments, including gastrectomy and esophagectomy—both invasive procedures in the gastrointestinal field—continued to be performed safely after the COVID-19 pandemic.

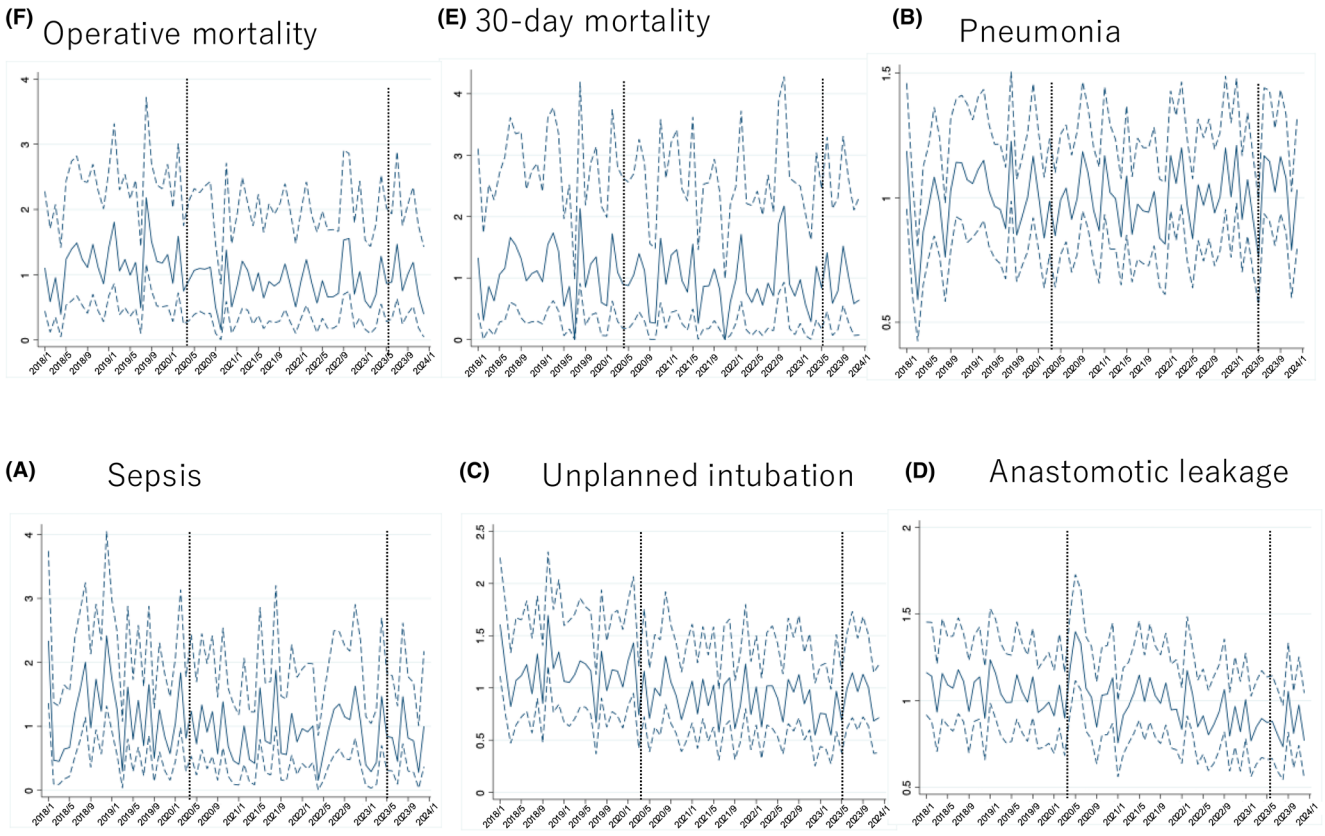

FIGURE 3 Monthly standardized morbidity and mortality ratio (SMR) for (A) sepsis, (B) pneumonia, (C) unplanned intubation, (D) anastomotic leakage, (E) 30d mortality, and (F) operative mortality across the 47 prefectures.

Numerous studies, including ours, have examined the impact of COVID-19 pandemic on surgical treatment. The pandemic caused delays and cancellations of surgeries due to the reallocation of limited medical resources, such as surgical staff and ICU beds, for COVID-19 care. Ikeda et al used nationwide data to demonstrate a decrease in most surgical procedures in 2020 due to the pandemic.[6] Furthermore, one study found that the pandemic led to an increase in advanced-stage cancer diagnoses because of a reduction in cancer screenings, such as esophagogastroduodenoscopy. It has also been reported that the total number of endoscopic procedures decreased by 44% during the pandemic due to its classification as an aerosol-generating procedure.[17–19] However, there have been no reports on the impact of the COVID-19 pandemic on surgical complications in Japan. Therefore, our group investigated short-term outcomes for esophageal, gastric, rectal, liver, and pancreatic cancer by comparing prepandemic to pandemic periods.[7–11] Our findings indicate that surgeries for these cancers were performed safely without increasing mortality rates during the pandemic, even in areas heavily affected by the epidemic in Japan. This was determined by calculating the SMR, a risk-adjusted metric for both prepandemic and pandemic periods. We concluded that surgical management was effectively maintained through the coordinated efforts of the entire surgical department, even with limited medical resources and staff. This study also reviews and summarizes surgical outcomes for esophageal and gastric cancer in the post-COVID-19 period, providing additional analysis to previous studies. Furthermore, we found that surgical treatment for esophageal and gastric cancer remains safe and effective, consistent with the period during the pandemic.

In this study, no significant changes in the number of esophagectomy procedures were observed even after the COVID-19 pandemic ended, while a decreasing trend in gastrectomy continued postpandemic. The notable changes in gastric cancer incidence, which are well-documented, suggest that factors such as *Helicobacter pylori* infection, lifestyle, and environmental factors may play a significant role, rather than genetics alone. Specifically, the reduction in gastric cancer incidence may be largely attributed to decreased *H. pylori* infection, as studies have shown a decline in gastric cancer incidence in Asia coinciding with reduced *H. pylori* infections.[20–22] Thus, the declining trend in Japan persisted even after the COVID-19 pandemic subsided.

One significant change observed in this study was an increase in the proportion of elderly patients. A possible explanation is that the COVID-19 pandemic may have delayed cancer screenings for some individuals, leading to an increase in elderly patients. However, this is unlikely, as a similar trend was noted before the pandemic and there was little change in clinical cancer stages. It is more probable that the overall patient population is aging due to an aging society, and this trend is expected to continue.

Several studies reported the impact of COVID-19 on upper gastrointestinal cancer treatment. Doeve et al found that in the

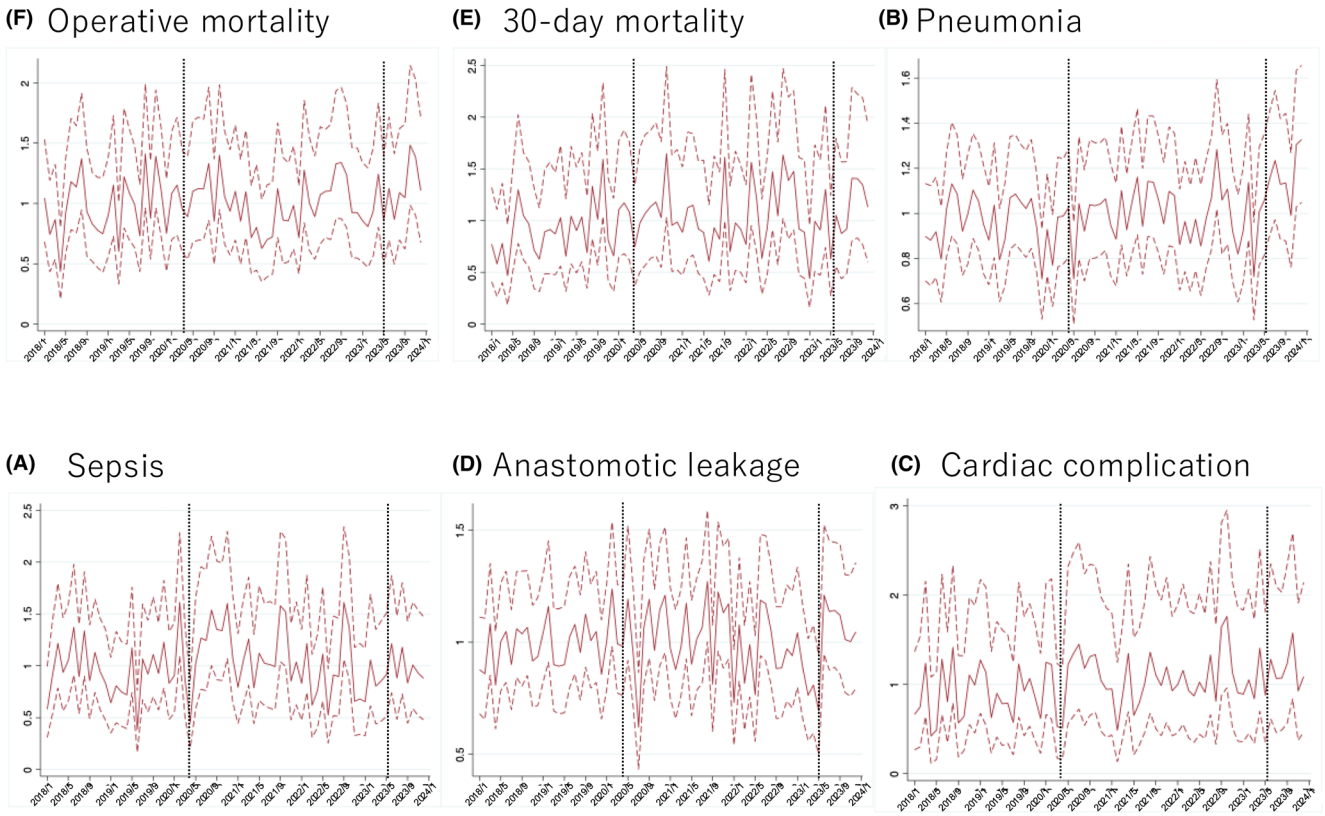

FIGURE 4 Monthly standardized morbidity and mortality ratio (SMR) for (A) sepsis, (B) pneumonia, (C) unplanned intubation, (D) anastomotic leakage, (E) 30d mortality, and (F) operative mortality in epidemic areas.

first 2 mo of the COVID-19 pandemic, there was a decrease in the number of esophagogastric cancer diagnoses in the Netherlands, along with an increase in the percentage of patients diagnosed with incurable disease.[23] Similarly, Baxter et al reported that esophagogastric cancer patients in Scotland were more likely to present with advanced disease, leading to a shift towards non-curative treatment, which negatively impacted overall survival rates.[24] Additionally, Solaini et al observed a rise in advanced or metastatic esophagogastric cancer cases following the spread of COVID-19 in Italy.[25] Although we demonstrated that the surgical quality of both gastrectomy and esophagectomy were well maintained in the post-COVID-19 period in Japan, whether the overall prognoses remained equivalent to the pre-COVID-19 period warrants further investigation.

This study has several limitations. It does not address changes in nonsurgical treatments, such as endoscopic procedures, chemotherapy, or chemoradiotherapy, which are now commonly used for cancer patients. Additionally, like previous studies, it does not include long-term prognosis, and the assessment of medical resources was limited to ICU admission rates, which is a significant limitation.

In conclusion, this study examined changes in surgical volume and short-term outcomes for upper gastrointestinal cancer in the post-COVID-19 period using a nationwide Japanese database. We found that surgical treatments for gastrectomy and esophagectomy, both invasive procedures in the gastrointestinal field, continued to be performed safely even after the COVID-19 pandemic. These findings offer valuable insights for surgical practice in Japan during a pandemic and will aid in planning for appropriate staffing and facilities in future pandemic situations.

AUTHOR CONTRIBUTIONS

Masashi Takeuchi: Conceptualization; investigation; methodology; project administration; visualization; writing – original draft. **Hideki Endo:** Conceptualization; data curation; supervision; writing – review and editing. **Taizo Hibi:** Conceptualization; funding acquisition; methodology; project administration; resources; writing – review and editing. **Ryo Seishima:** Conceptualization; investigation; writing – review and editing. **Yusuke Takemura:** Conceptualization; investigation; writing – review and editing. **Hiroyuki Yamamoto:** Conceptualization; data curation; investigation; software; writing – review and editing. **Hiromichi Maeda:** Conceptualization; investigation; writing – review and editing. **Akinobu Taketomi:** Methodology; supervision; writing – review and editing. **Yoshihiro Kakeji:** Methodology; supervision; writing – review and editing. **Yasuyuki Seto:** Investigation; supervision; writing – review and editing. **Hideki Ueno:** Methodology; supervision; writing – review and editing. **Masaki Mori:** Methodology; supervision; writing – review and editing. **Ken Shirabe:** Methodology; supervision; writing – review and editing. **Yuko Kitagawa:** Funding

acquisition; methodology; supervision; writing – review and editing.

FUNDING INFORMATION

This work was supported by MHLW Research on Emerging and Re-emerging Infectious Diseases and Immunization (Program Grant Number JPMH23HA2011 and JPMH24HA2015).

CONFLICT OF INTEREST STATEMENT

Yuko Kitagawa has received grants and personal fees from Asahi Kasei Pharma Corporation; grants, personal fees, and other support from Ono Pharmaceutical Co., Ltd.; grants and personal fees from Otsuka Pharmaceutical Factory, Inc.; grants and personal fees from Nippon Covidien Inc.; grants, personal fees, and additional support from Taiho Pharmaceutical Co., Ltd.; grants, personal fees, and other support from Chugai Pharmaceutical Co., Ltd.; grants and personal fees from Kaken Pharmaceutical Co., Ltd.; personal fees from AstraZeneca K.K.; personal fees from Ethicon Inc.; personal fees from Olympus Corporation; personal fees from Shionogi & Co., Ltd.; personal fees and additional support from Bristol-Myers Squibb K.K.; personal fees from MSD K.K.; personal fees from Smith & Nephew K.K.; personal fees from ASKA Pharmaceutical Co., Ltd.; personal fees from Miyarisan Pharmaceutical Co., Ltd.; personal fees from Toray Industries, Inc.; personal fees from Daiichi Sankyo Co., Ltd.; personal fees from Chugai Foundation for Innovative Drug Discovery Science; personal fees from Nippon Kayaku Co., Ltd.; grants from Yakult Honsha Co. Ltd.; grants from Otsuka Pharmaceutical Co., Ltd.; grants from Tsumura & Co.; grants from Sumitomo Pharma Co., Ltd.; grants and personal fees from EA Pharma Co., Ltd.; grants from Eisai Co., Ltd.; grants from Kyowa Kirin Co., Ltd.; grants from Medicon Inc.; grants from Takeda Pharmaceutical Co., Ltd.; grants from Teijin Limited; and personal fees from Intuitive Surgical G.K., all outside the submitted work. Hideki Endo and Hiroyuki Yamamoto are affiliated with the Department of Healthcare Quality Assessment at the University of Tokyo. This department receives support from the National Clinical Database, Johnson & Johnson K.K., Nipro Corporation, and Intuitive Surgical Sàrl. Yuko Kitagawa is a Chief Editor of the *Annals of Gastroenterological Surgery*. Masaki Mori is Emeritus Editor-in-Chief of the *Annals of Gastroenterological Surgery*. Yasuyuki Seto, Yoshihiro Kakeji, and Hideki Ueno are Associate Editors of the *Annals of Gastroenterological Surgery*.

ETHICS STATEMENT

Approval of the research protocol by an Institutional Reviewer Board: The protocol of this study was reviewed and adopted by the Japanese Society of Gastrointestinal Surgery Committee and approved by the Institutional Review Board of Kochi Medical School with exemption of individual written informed consent owing to the retrospective study design (ID: 2023–108).

Informed Consent: N/A.

Registry and the Registration No. of the study/trial: N/A.

Animal Studies: N/A.

ORCID

Masashi Takeuchi https://orcid.org/0000-0003-3797-432X
Hideki Endo https://orcid.org/0000-0003-0052-0332
Taizo Hibi https://orcid.org/0000-0002-6867-228X
Ryo Seishima https://orcid.org/0000-0002-8892-4173
Yusuke Takemura https://orcid.org/0000-0003-3791-9902
Hiromichi Maeda https://orcid.org/0000-0001-7694-8082
Yoshihiro Kakeji https://orcid.org/0000-0002-2727-0241
Yasuyuki Seto https://orcid.org/0000-0002-6953-8752
Hideki Ueno https://orcid.org/0000-0002-8600-1199

REFERENCES

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020;382(8):727–33.
2. Ministry of Health, Labour and Welfare. Domestic outbreak situation of COVID-19. Accessed 31 August 2024. Available from: https://www.mhlw.go.jp/stf/covid-19/kokunainohasseijoukyou.html.
3. Maeda H, Endo H, Yamamoto H, Miyata H, Munekage M, Taketomi A, et al. Effects of the COVID-19 pandemic on gastroenterological surgeries in 2020: a study using the National Clinical Database of Japan. Ann Gastroenterol Surg. 2023;7(3):407–18.
4. Driessen MLS, Sturms LM, Bloemers FW, Duis HJ, Edwards MJR, den Hartog D, et al. The detrimental impact of the COVID-19 pandemic on major trauma outcomes in The Netherlands: a comprehensive nationwide study. Ann Surg. 2022;275(2):252–8.
5. COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. Br J Surg. 2020;107(11):1440–9.
6. Ikeda N, Yamamoto H, Taketomi A, Hibi T, Ono M, Niikura N, et al. The impact of COVID-19 on surgical procedures in Japan: analysis of data from the National Clinical Database. Surg Today. 2022;52(1):22–35.
7. Takemura Y, Endo H, Hibi T, Nakano Y, Seishima R, Takeuchi M, et al. Impact of the COVID-19 pandemic on the number and short-term outcomes in hepatectomy for hepatocellular carcinoma: results from the Japanese National Clinical Database, 2018–2021. Hepatol Res. 2024;54:685–94. https://doi.org/10.1111/hepr.14014
8. Seishima R, Endo H, Hibi T, Takeuchi M, Nakano Y, Yamamoto H, et al. Impact of COVID-19 pandemic on short-term outcomes after low anterior resection in patients with rectal cancer: analysis of data from the Japanese National Clinical Database. Ann Gastroenterol Surg. 2024;8(1):107–13.
9. Takeuchi M, Endo H, Hibi T, Seishima R, Nakano Y, Yamamoto H, et al. Analysis of the short-term outcomes after esophagectomy for esophageal cancer during the COVID-19 pandemic using data from a nationwide Japanese database. Esophagus. 2023;20(4):617–25.
10. Takeuchi M, Endo H, Hibi T, Seishima R, Nakano Y, Yamamoto H, et al. The impact of COVID-19 for postoperative outcomes using a nationwide Japanese database of patients undergoing distal gastrectomy for gastric cancer. Ann Gastroenterol Surg. 2023;7(6):887–95.
11. Takemura Y, Endo H, Hibi T, Nakano Y, Seishima R, Takeuchi M, et al. Impact of the COVID-19 pandemic on short-term outcomes after pancreaticoduodenectomy for pancreatic cancer: a retrospective study from the Japanese National Clinical Database, 2018–2021. Ann Gastroenterol Surg. 2024;8:877–87. https://doi.org/10.1002/ags3.12798
12. Takeuchi H, Miyata H, Gotoh M, Kitagawa Y, Baba H, Kimura W, et al. A risk model for esophagectomy using data of 5354 patients

included in a Japanese nationwide web-based database. Ann Surg. 2014;260(2):259–66.
13. Kunisaki C, Makino H, Takagawa R. Predictive factors for surgical complications of laparoscopy-assisted distal gastrectomy for gastric cancer. Surg Endosc. 2009;23(9):2085–93.
14. Kurita N, Miyata H, Gotoh M, Shimada M, Imura S, Kimura W, et al. Risk model for distal gastrectomy when treating gastric cancer on the basis of data from 33,917 Japanese patients collected using a nationwide web-based data entry system. Ann Surg. 2015;262(2):295–303.
15. Rice TW, Patil DT, Blackstone EH. 8th edition AJCC/UICC staging of cancers of the esophagus and esophagogastric junction: application to clinical practice. Ann Cardiothorac Surg. 2017;6(2):119–30.
16. Ohkura Y, Miyata H, Konno H, Udagawa H, Ueno M, Shindoh J, et al. Development of a model predicting the risk of eight major postoperative complications after esophagectomy based on 10,826 cases in the Japan National Clinical Database. J Surg Oncol. 2020;121(2):313–21.
17. Akahane T, Nakanishi Y, Yoshiji H, Akahane M. Esophagogastroduodenoscopy Screening Intentions During the COVID-19 Pandemic in Japan: Web-Based Survey. JMIR Cancer. 2022;8(4):e40600.
18. Sagami R, Nishikiori H, Sato T, Tsuji H, Ono M, Togo K, et al. Aerosols produced by upper gastrointestinal endoscopy: a quantitative evaluation. Am J Gastroenterol. 2021;116(2):202–5.
19. Maruyama H, Hosomi S, Nebiki H, Fukuda T, Nakagawa K, Okazaki H, et al. Gastrointestinal endoscopic practice during COVID-19 pandemic: a multi-institutional survey. Rom J Intern Med. 2021;59(3):166–73.
20. Fock KM, Ang TL. Epidemiology of *Helicobacter pylori* infection and gastric cancer in Asia. J Gastroenterol Hepatol. 2010;25(3):479–86.
21. Wong MCS, Huang J, Chan PSF, Choi P, Lao XQ, Chan SM, et al. Global incidence and mortality of gastric cancer, 1980–2018. JAMA Netw Open. 2021;4(7):e2118457.
22. Ahmed N. 23 y of the discovery of *Helicobacter pylori*: is the debate over? Ann Clin Microbiol Antimicrob. 2005;4:17.
23. Doeve BH, Bakx JAC, Siersema PD, Rosman C, van Grieken NCT, van Berge Henegouwen MI, et al. The impact of the COVID-19 pandemic on the diagnosis, stage, and treatment of esophagogastric cancer. J Gastroenterol. 2023;58(10):965–77. https://doi.org/10.1007/s00535-023-02009-3
24. Baxter MA, Khan KS, Gall LS, Samuelson C, McCollum C, Chuntamongkol R, et al. Diagnosis, treatment, and outcome of patients with oesophagogastric cancer during the COVID-19 pandemic: national study. Br J Surg. 2023;110(4):456–61. https://doi.org/10.1093/bjs/znad003
25. Solaini L, Bencivenga M, Rosa F, D'ignazio A, Marino E, Ministrini S, et al. Consequences of the COVID-19 pandemic on the diagnosis and treatment of gastric cancer in referral centers in Italy. Tumori. 2023;109(1):121–8. https://doi.org/10.1177/03008916211072586

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Takeuchi M, Endo H, Hibi T, Seishima R, Takemura Y, Yamamoto H, et al. Analysis of surgical volume and short-term outcomes for upper gastrointestinal cancer post-COVID-19: Evidence from a nationwide Japanese database. Ann Gastroenterol Surg. 2025;9:448–455. https://doi.org/10.1002/ags3.12891