

Management of Hepato-biliary-pancreatic Surgery during the COVID-19 Pandemic

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ABSTRACT

Purpose : We examined the effect of COVID-19 on diseases treated with hepato-biliary-pancreatic surgery from the experience of nosocomial infection at our hospital.

Methods : We examined the treatment of 106 patients admitted by the Division of Hepato-Biliary-Pancreatic Surgery to The Jikei University Hospital for elective surgery from January through May 2020.

Results : Of the 106 operations, 90 (85%) were performed as scheduled and did not include COVID-19-positive patients. Operations for 16 patients (15%) were postponed, but 5 (31%) of these operations were urgent or quasiurgent and were performed during the study period. Of 95 patients who underwent surgery, 50 (53%) had a malignant tumor, 3 (3%) had a borderline malignant tumor, and 42 (44%) had a benign lesion, of which 41 were gallstones or gallbladder polyps and 1 was an intraductal papillary mucinous neoplasm that caused pancreatitis. Surgery for the latter tumor was postponed while conservative treatment improved conditions, but pancreatitis recurred 2 weeks after discharge, leading to a quasiurgent surgery.

Conclusion : Owing to COVID-19, 15% of the scheduled elective hepato-biliary-pancreatic operations were postponed. Even lesions considered benign or not requiring emergency surgery should be treated promptly. Thus, the timing of treatment should be determined so that the risks of exacerbation and COVID-19 can be balanced.

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Key words : Hepato-biliary-pancreatic surgery, COVID-19, SARS-CoV-2, nosocomial infection, management of surgery

INTRIDUCTION

The first case of a novel coronavirus infection, reported by the Chinese government on December 8, 2019, is believed to have been a death of unknown cause in the city of Wuhan, China, which has a population of more 10 million¹. The pathogen was identified as severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2)², which rapidly

spread through China to the rest of the world³. The World Health Organization named the disease caused by this virus Coronavirus disease 2019 (COVID-19)⁴.

In Japan, the first case of COVID-19 was reported on January 15, 2020, after which the number of cases steadily increased⁵. From February 3, 2020, a cruise ship with approximately 700 SARS-CoV-2-positive patients was quarantined at a port in Yokohama for 2 weeks^{6,7}. These patients

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were transported to nearby medical facilities, but with such a rapid increase in the number of patients, medical facilities in Kanagawa Prefecture could not cope, leading to patients being transferred to facilities in Tokyo Prefecture⁶. The Jikei University Hospital in Tokyo began accepting patients with COVID-19 on February 11, 2020. The number of patients in Tokyo steadily increased, and by the end of March 2020 the number of new infections per day exceeded 100 and led the prime minister to declare a state of emergency on April 7⁸. Owing to the rapid increase in the number of patients, some medical supplies were of limited availability at medical facilities⁹.

Although The Jikei University Hospital accepted patients with COVID-19 at an early stage of the pandemic, we continued to provide regular medical care in January through March 2020. However, on April 3, an asymptomatic patient with COVID-19, who had been hospitalized for other conditions, spread nosocomial infections to 2 patients, 3 nurses, and 1 physician and led to a state of emergency being declared for the hospital. For this reason, all departments stopped accepting new outpatients and new patients requiring hospitalization and either cancelled or postponed nonemergency examinations and operations. As of April 20, 2020, all admitted patients were routinely tested with the real-time reverse-transcriptase polymerase chain reaction (RT-PCR) via nasopharyngeal swabs and underwent computed tomography of the chest. In combination with strict zoning of the wards, new cases of nosocomial infection of COVID-19 were avoided. In our department, we have been cancelling or postponing operations since late March 2020 to prepare for the COVID-19 pandemic.

In the present study, the effect of COVID-19 on hepato-biliary-pancreatic operations was examined in the transition from January 2020, when COVID-19 was first reported in Japan, to May 2020, when infection control was taken temporarily.

METHODS

The participants of this study were 106 patients who had been scheduled to undergo elective hepato-biliary-pancreatic surgical operations at our hospital from January through May 2020. To assess the effect of COVID-19 on such operations, we compared these patients to patients who had undergone hepato-biliary-pancreatic operations

during the same 4-month period from 2015 through 2019.

The study protocol was approved by the ethics committee of The Jikei University School of Medicine (27-177(8062)), and the written informed consent was obtained from each patient.

RESULTS

During the study period of January through May 2020, elective operations were performed for 90 (85%) of 106 patients for whom surgery had been scheduled and were postponed for 16 patients (15%). Including 5 patients who underwent urgent or quasiurgent operations after first being postponed, a total of 95 patients underwent surgery.

The lesions in the 95 patients who underwent surgery were malignant in 50 (53%), borderline malignant in 3 (3%), and benign in 42 (44%). Of patients with malignant lesions, 28 underwent hepatectomy and 19 underwent pancreatectomy (including hepatopancreaticoduodenectomy). Of the 42 operations performed for benign lesions, 41 were laparoscopic cholecystectomy for gallstones or gallbladder polyps and 1 was a distal pancreatectomy for an intraductal papillary mucinous neoplasm (IPMN) that had caused pancreatitis; most of these operations were performed in January or February 2020. In addition, operations performed for 1 patient each were palliative bile duct resection for unsuitable general conditions associated with a cholangiocarcinoma, radiofrequency ablation for recurrence of a hepatocellular carcinoma (HCC) with poor hepatic reserve, extended cholecystectomy for gallbladder cancer, and flow diversion surgery for congenital biliary dilatation (Table 1).

Of the 16 operations that had been postponed, 13 (81%) were for benign lesions. Quasiurgent operations were required by the end of May 2020 for 3 benign lesions and 2 malignant tumors. A patient for whom surgery for a benign lesion had been postponed had suddenly worsening symptoms and was hospitalized for surgery in May. Eleven of the 16 postponed operations were for patients with symptomatic cholelithiasis. Of these 11 patients, 1 wished to undergo surgery and was transferred to a hospital that did not accept patients with COVID-19, and 10 patients had their operations indefinitely postponed. Two operations had been postponed for patients with symptomatic cholelithiasis but were eventually performed owing to a quasiurgent state. Surgery had been postponed for a patient with recur-

Table 1. All hepato-biliary-pancreatic operations from January through May 2020

Surgery	Diagnosis (n)	Classification	Patients	Month (n)
Laparoscopic cholecystectomy	gallstone (32), gallbladder polyps (9)	benign	41	Jan (11), Feb (18), Mar (9), Apr (2), May (2)
Extended cholecystectomy	gallbladder cancer	malignant	1	Mar (1)
Bile duct resection	cholangiocarcinoma	malignant	1	Apr (1)
Flow diversion surgery	congenital biliary dilation	borderline	1	Jan (1)
Radiofrequency ablation	hepatocellular carcinoma	malignant	1 [†]	Mar (1)
Hepatectomy	hepatocellular carcinoma (1), intrahepatic cholangiocarcinoma (2), metastatic liver cancer (8)	malignant	28	Jan (11), Feb (18), Mar (9), Apr (2), May (2)
Pancreatico- duodenectomy	pancreatic cancer (4), cholangiocarcinoma (1), neuroendocrine tumor (3), IPMC (1), cancer of the papilla of Vater (2)	malignant	11	Jan (3), Feb (2), Mar (3), Apr (2), May (1)
Hepatopancreatico-duodenectomy	hilar cholangiocarcinoma	malignant	1	Mar (1)
Distal pancreatectomy	pancreatic cancer (6), IPMN (1), mucinous cystic neoplasm (1), metastatic cancer (1), pancreatitis (1)	malignant (7), borderline (2), benign (1)	10	Jan (2), Feb (2), Mar (4), May (1)

IPMC, intraductal papillary mucinous carcinoma ; IPMN, intraductal papillary mucinous neoplasm ; Jan, January ; Feb, February ; Mar, March ; Apr, April

Table 2. Postponed operations

Diagnosis	Classification	Patients	Outcome	Date of surgery (2020)
Symptomatic cholelithiasis	benign	11	1 transferred, 8 waiting, 2 semiurgent operations	4/3 → 5/19, 4/17 → 5/19
Pancreatitis caused by IPMN	benign	1	semiurgent operation	4/10 → 5/15
idiopathic thrombocytopenic purpura	benign	1	semiurgent operation	4/24 → 6/1
IPNB	borderline	1	waiting	4/27 → 6/15
Suspected IPMC	malignant	1	waiting (1 month)	4/6 → 5/18
Hepatocellular carcinoma	malignant	1	waiting (1 month)	4/13 → 5/27

IPMN, intraductal papillary mucinous neoplasm ; IPNB, intraductal papillary neoplasm of the bile duct ; IPMC, intraductal papillary mucinous carcinoma

ring pancreatitis caused by mucus from an IPMN after conservative treatment had improved the patient's condition ; the patient was discharged but was readmitted for surgery 2 weeks later when the pancreatitis had recurred. Splenectomy for idiopathic thrombocytopenic purpura (ITP) had been scheduled in April but was postponed ; however, because the illness rapidly progressed in late May, the patient was readmitted and underwent a quasiurgent operation on June 1. A patient with HCC and a patient with intraductal papillary mucinous carcinoma (IPMC) underwent surgery shortly after having negative results for nosocomial infection confirmed in mid-May (Table 2). One patient for whom pancreaticoduodenectomy to treat IPMC had been postponed later underwent the surgery and had the postoperative complication of an intra-abdominal abscess ; after successfully being treated

with antibiotics, the patient was discharged. Among patients whose operations were postponed, no increase in postoperative complications was observed. Patients with HCC or IPMC for whom operations had been postponed later underwent surgery but had no disease recurrence after 3 months (as of July 2020).

The numbers of hepatectomy and pancreatectomy operations had been consistent since 2015 until increasing in 2019, whereas the number of cholecystectomy operations, a majority of which were for benign lesions, greatly decreased in 2020 (Fig. 1). The number of operations for benign, borderline malignant (i.e., potentially malignant), and malignant tumors fluctuated from 2015 through 2020, but the number of operations for benign lesions showed a clear decrease in only 2020 (Fig. 2). Operations for malignant and borderline malignant tumors did not show a notable change

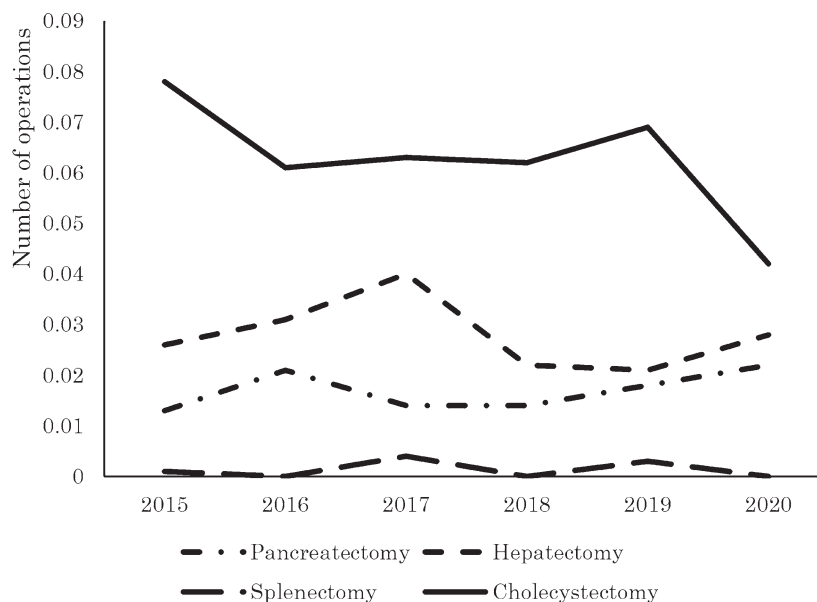


Fig. 1. Annual changes in the number of elective hepato-biliary-pancreatic operations by the type of surgery (January through May in 2015 through 2020). The number of hepatectomy and pancreatectomy operations remained largely constant and then started to increase. In contrast, the number of cholecystectomy operations decreased in 2020.

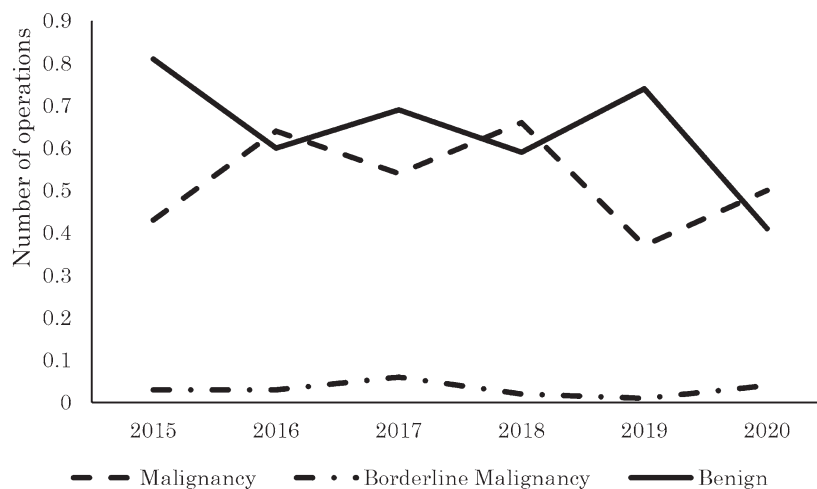


Fig. 2. Annual changes in the number of elective hepato-biliary-pancreatic surgeries by the type of disease (January through May in 2015-2020). There was no change for malignant and borderline malignant lesions, whereas benign lesions showed a decrease in 2020.

between years. In fact, the numbers of operations increased in 2019.

The average number of operations for malignant and borderline malignant tumors performed each month from January through May varied little from 2015 through 2019 (Fig. 3), but in 2020 the numbers of operations in January through March were greater than in previous years and the numbers in April and May were lower. In contrast, the number of operations for benign lesions in 2020 showed no no-

table difference from 2015 through 2019 in January and February but markedly decreased in March, April, and May (Fig. 4).

DISCUSSION

Owing to the COVID-19 pandemic, international societies for anesthesiology, oncology, and surgery have published policies for postponing and adapting operations¹⁰⁻¹².

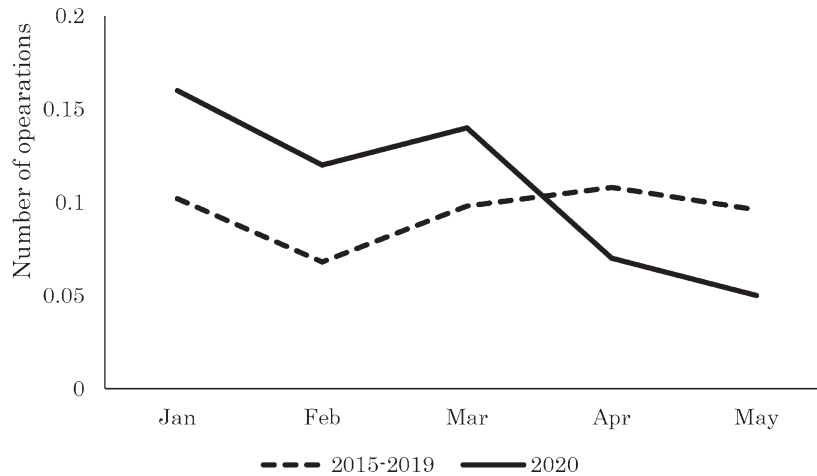


Fig. 3. Monthly changes in the number of malignant and borderline malignant hepato-biliary-pancreatic operations from January through May (average for 2015 through 2019 vs. 2020). The number of operations exceeded the mean from January through March but then began to decrease to below average in April.

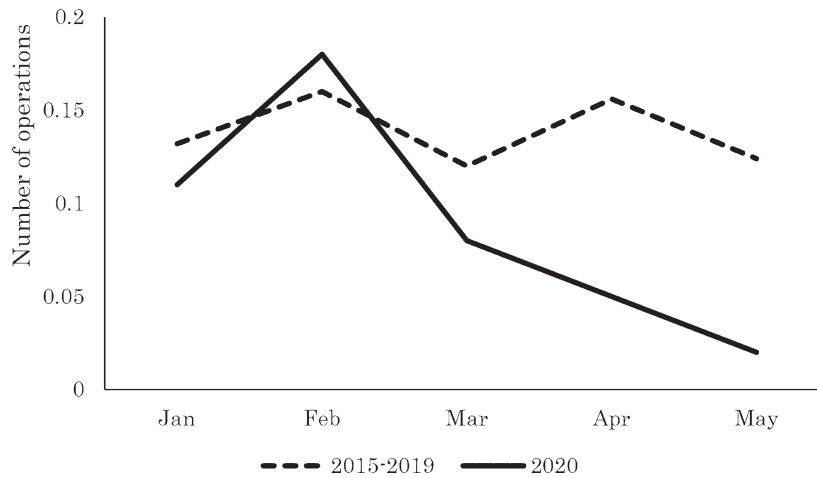


Fig. 4. Monthly changes in the number of benign hepato-biliary-pancreatic surgeries from January through May (average for 2015 through 2019 vs. 2020). The number of operations was similar to that in other years in January and February but decreased from March.

Considering the risk of infection in operating rooms¹³, the Department of Surgery of The Jikei University Hospital, on its own volition, began postponing nonurgent operations in early March 2020, before a state of emergency had been declared by the Japanese government. However, because a nosocomial infection had been confirmed at our hospital on April 3, we began operating under a strict system. On the basis of their COVID-19 infection status, patients were separated into wards in different buildings, with strict and thorough zoning. Since April 20, RT-PCR tests and computed tomographic examinations of the chest were routinely performed for all hospitalized patients. We designated

separate pathways and wards to be for patients who were COVID-19-positive, COVID-19-negative, COVID-19-tested (highly suspected), or COVID-19-tested (not likely). Through this evaluation system and the strict use of personal protective equipment by a team of physicians specializing in internal medicine and infectious disease, we believed that the number of patients with COVID-19 was under control after the first wave of the pandemic. To ensure that nosocomial infections were prevented, some ward beds, intensive care unit (ICU) beds, and ventilators were designated to secure the number available and maintain the morale of the hospital’s medical staff. However, to secure

the availability of beds and ventilators, the hospitalization and operations for patients were postponed. The number of ICU beds and ventilators is limited, and securing their availability was important, assuming that the number of patients severely affected by COVID-19 or with other severe conditions would increase^{14,15}. To that end, we avoided nonessential yet high-risk tests and operations.

In late March 2020 our Division of Hepato-Biliary-Pancreatic Surgery began postponing operations for benign lesions but still performed operations for malignant tumors as scheduled or even earlier. Operations for borderline malignant tumors (i.e., potentially malignant tumors) were performed if progression was likely but were otherwise postponed. As a result of this postponement, the number of operations for malignant tumors increased in March and decreased in April and May (Fig.4 and 5). Since March 2020, operations for benign tumors were postponed if possible. In the field of hepato-biliary-pancreatic surgery, such conditions as pancreatic cancer and massive hepatic tumors with a poor prognosis should quickly be operated on¹⁶; however, because patients with COVID-19 were being admitted to our hospital, few new patients, for whom surgery had not been postponed, were admitted. New patients with such conditions were not found in April and the following months due to hospitalization restrictions because of the COVID-19 pandemic

At our hospital, surgery had been the preferred treatment of resectable cases of pancreatic cancer. However, because of a recent report that neoadjuvant chemotherapy is effective for resectable cases of pancreatic cancer¹⁷, our policy is to perform chemotherapy if a new patient was admitted to the hospital. Cases of cholangiocarcinoma and borderline malignant tumors that progressed less rapidly than pancreatic cancer were treated with surgery before the number of patients increased or else the operation was postponed. However, because long-term observation is not desirable, a patient with an illness that could not be managed with the hospital system was transferred, with informed consent, to the University affiliated hospitals.

The numbers of new COVID-19 infections and related deaths in Japan peaked in late April 2020; on May 14 the state of emergency was lifted in most areas of the country, and on May 25 the state of emergency was lifted nationwide. At The Jikei University Hospital, thanks to the early response and measures taken, COVID-19 came under con-

trol, and malignant and borderline malignant tumors for which operations had been postponed could quickly be surgically treated. In addition, hepato-biliary-pancreatic surgeries are long and invasive; before the COVID-19 pandemic, patients who had undergone pancreaticoduodenectomy or hepatectomy were routinely admitted to the ICU and observed. In contrast, we avoided nonurgent hepato-biliary-pancreatic operations and limited the use of the ICU for observation after surgery, and, in principle, we monitored patients via frequent visits by nurses in a general ward or on-call visits by an attending physician. A burden was placed on attending physicians, forcing them to stay in wards late into the night to manage their patients. However, early postoperative complications developed in none of our patients, and all were discharged without any complications.

Of the present patients whose scheduled surgery had been postponed, 2 with cholelithiasis underwent quasiurgent laparoscopic cholecystectomy. One patient had schizophrenia that could not be psychiatrically controlled owing to many gallstones having developed, and the other patient had acute cholecystitis that could not be managed with antibacterial treatment and percutaneous transhepatic gallbladder drainage (PTGBD). The probability of symptomatic cholelithiasis developing into cholecystitis is 1% to 3%, and, therefore, postponing the operation had been considered acceptable. However, because of the risk of cholecystitis, measures were prepared for an emergency that precedes informed consent being obtained, antibiotics, and PTGBD.

Operations were also postponed for patients with pancreatitis or ITP, which are benign conditions. However, because pancreatitis recurred and ITP progressed, quasiurgent operations were performed. The case of pancreatitis associated with IPMN was assumed to have been caused by mucus, which was not unexpected. Although ITP is resistant to corticosteroid therapy, the platelet count of the patient with ITP remained at approximately 30,000/ μ L and no bleeding occurred. Thus, the surgery was postponed. However, when the patient complained of subcutaneous bleeding and had a reduced platelet count of 1,500/ μ L, intravenous immunoglobulin therapy was administered upon admission, and quasiurgent surgery was performed. Considering the appropriate management of the disease, surgery should be performed as scheduled, but because COVID-19 is poorly understood and uncontrolled, surgery during the pandemic was considered unsafe. Our hospital

responded early in the pandemic, and we were able to perform quasiurgent surgery. The priorities of treatment should be determined on the basis of the conditions and the status of either each patient or the hospital with respect to COVID-19 and should be carefully explained to patients to obtain consent for how the disease was managed.

The patient of this study with HCC had a single 2.5-cm S8 tumor, and a postponing surgery for 1 to 2 months was considered to have little effect on the prognosis; thus, the surgery was scheduled. A patient with suspected IPMC had a nodular lesion in the cyst, and although malignancy was not definitively indicated, the regional lymph nodes were swollen. Thus, surgery was performed as soon as the nosocomial infection was temporarily under control in mid-May. The tumor was diagnosed as a stage 1 IPMC without metastasis to the lymph nodes.

The COVID-19 pandemic peaked earlier in Japan than in the United States and Europe. Yet, many persons with infections in Japan have been asymptomatic¹⁸, and without herd immunity or vaccines (as of July 2020), another wave of infections is possible. However, considering the policies at our hospital—strict zoning, secure medical supplies, secure beds, ICU beds and ventilators, and adjustments to the timing of operations to allow for COVID-19 treatment, surgery, and life-saving efforts in parallel—we are striving to reduce the possibility of another wave of infections. Unless clear measures and solutions for preventing and treating COVID-19 are established, possible countermeasures must be taken in response to the presence of patients with COVID-19 and the risk of infection, and a safe and sustainable medical system must be provided to patients with other diseases.

CONCLUSIONS

The COVID-19 pandemic forced 16% of elective hepato-biliary-pancreatic operations in our hospital to be postponed. An early response by the hospital allowed the COVID-19 situation to be controlled and created an environment in which operations could be safely performed.

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Authors have no conflicts of interest.

Author contributions

Hironori Shiozaki collected and analyzed data and wrote the manuscript; Fumiaki Yano, Yoshihiro Shirai, Jungo Yasuda, Kenei Furukawa, Shinji Onda, and Takeshi Gochi supervised the study; Toru Ikegami and Takao Ohki supervised the study and critically revised the manuscript.

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