



Lockdown period during SARS COVID-19 endemic outbreak in Taiwan did not cause an increase of the complications nor mortality of patients received endoscopic retrograde cholangiopancreatography: A single-center retrospective study

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Abstract

Background: Coronavirus disease 2019, known as a widespread, aerosol spreading disease, has affected >549 000 000 people since 2019. During the lockdown period, dramatic reduction of elective endoscopic procedures, including endoscopic retrograde cholangiopancreatography, had been reported worldwide, leading to delayed diagnosis and treatment. Nevertheless, whether patients' hospital stays and complication rate of endoscopic retrograde cholangiopancreatography (ERCP) during the lockdown period were influenced by the pandemic still remains controversial.

Methods: Patients who diagnosed with obstructive jaundice and acute cholangitis in the lockdown period, May 16 to July 26, 2021, were compared to the same pre-pandemic period in 2019.

Results: A total of 204 patients in 2019 and 168 patients in 2021 were diagnosed with acute biliary cholangitis or obstructive jaundice, and 82 of the patients in 2019 and 77 patients in 2021 underwent ERCP ($p = 0.274$). Patients whose quick Sequential Organ Failure Assessment (qSOFA) score was ≥ 2 occurred more during the lockdown period than during the normal period (24/77, 31.1% vs 12/82, 14.6%; $p = 0.013$). The initial laboratory data, including, total bilirubin (4.12 in 2021 vs 3.08 mg/dL in 2019; $p = 0.014$), gamma-glutamyl transferase (378 in 2021 vs 261 U/L in 2019; $p = 0.009$), and alkaline phosphatase (254 in 2021 vs 174 U/L in 2019; $p = 0.002$) were higher during the lockdown period compared to 2019. Hospital stay was statistically significant longer in the lockdown period (11 days [7.00–22.00] in 2021 vs 8 days in 2019 [6.00–12.00]; p value = 0.02). Multivariate analysis showed that qSOFA ≥ 2 (hazard ratio [HR] = 3.837, 95% confidence interval [CI] = 1.471–10.003; $p = 0.006$), and malignant etiology (HR = 2.932, 95% CI = 1.271–6.765; $p = 0.012$) were the statistically significant factors for a prolonged hospital stay, which was defined as hospital stay >21 days. ERCP-related complications and mortality rate were not statistically different between the two periods.

Conclusion: Patients from May 16 to July 26, 2021, the lockdown period, had longer hospital stays and higher biliary tract enzyme levels, which indicated more severe disease. Nevertheless, ERCP could be safely and successfully performed even during the medical level 3 alert lockdown period without causing an increase in procedure-related complications and mortality.

Keywords: Coronavirus disease 2019; Endoscopic retrograde cholangiopancreatography; Endoscopic papillotomy; Quick Sequential Organ Failure Assessment

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1. INTRODUCTION

Since late 2019 to July 2022, the coronavirus disease 2019 has affected >549 000 000 people and devastated approximately >6 000 000 people's lives. The ravaging disease has changed people's lives and behaviors in many aspects in addition to affecting the way clinical practice is being conducted. Invasive and high-risk procedures, such as endoscopic procedures that may spread aerosol droplets containing the coronavirus 2019 (COVID-19), have raised a great deal of concern about avoiding viral transmission during the pandemic.¹⁻³ Elective procedures, such as esophagogastroduodenoscopy, colonoscopy, and endoscopic ultrasound, were reduced dramatically during the pandemic, particularly during the lockdown.²⁻⁶

Unlike other endoscopic procedures, endoscopic retrograde cholangiopancreatography (ERCP), which is considered an advanced endoscopic procedure that is used to treat biliary tract obstruction, is a relatively emergent intervention. Previous studies had been reported that ERCP cases reduced during the lockdown period. A delay in performing procedures may have occurred during lockdown periods.^{6–12} Whether patients' hospital stays and complication rate of ERCP during the lockdown period were influenced by the pandemic, which still remains controversial.

Taiwan, unlike most other countries, had undertaken strict control of the spreading of this disease. Daily clinical practice was maintained until May 2021. An outbreak of COVID-19 was reported. A national level 3 alert^{13–16} was announced on May 16, 2021. Elective or scheduled medical service were scaled back because of the COVID-19 outbreak, and the alert was implemented nationwide under the command of National Health Command Center. Fortunately, the COVID-19 outbreak was controlled, and on July 26, 2021, the national level 3 alert was downgraded to level 2. The endoscopic center of Taipei Veterans General Hospital restored normal endoscopic service capacity as pre-COVID-19 era under a strict check of COVID-19 reverse-transcriptase polymerase chain reaction (RT-PCR) test before the procedures.

This study is aimed to study patients' hospital stay and complication rates associated with ERCP during the lockdown period in Taiwan.

2. METHODS

2.1. Study population and design

This study was a single Taiwanese tertiary center, retrospective, and cohort study. Patients with whose ages were ≥ 20 years and who had indications, including acute biliary cholangitis and obstructive jaundice, for undergoing ERCPs from May to July 26, 2021, were compared to the same pre-pandemic period in 2019 (Fig. 1). These specific intervals were chosen because that the Taiwanese government had announced national level

3 alert since May 16 to July 26, 2021. The pre-COVID era in 2019 was defined as the control group. This study was approved by the Institutional Review Board of Taipei Veterans General Hospital. Informed consent was waived because this study was retrospective.

The initial clinical presentations were assessed using the quick Sequential Organ Failure Assessment (qSOFA) score. Laboratory test data including white blood cell (WBC) and neutrophil counts, hemoglobin (Hb) levels, platelet count, alanine transaminase (ALT), aspartate transaminase (AST), total and direct bilirubin levels, alkaline phosphatase (ALKP), gamma-glutamyl transferase (GGT), and C-reactive protein (CRP) were analyzed when patient initially presented to our hospital and before he/she was discharged. Besides, hospital stays of the patients undergoing ERCP and the procedure-related complications during normal period, 2019, and the lockdown period, 2021, were compared.

2.2. ERCP procedures

Before undergoing ERCP, all patients were sedated with Midazolam (1–5 mg), Tramadol 100 mg, Fentanyl (0.025–0.1 mg) was administered by doctors intravenously in a select population of those who were ≤ 80 years old, had a stable respiratory pattern, and stable vital signs. All ERCP procedures were performed with side viewing endoscopes (JF-260V or TJF-260V Olympus Optical Corporation).

2.3. Protective equipment

In 2019, before the COVID-19 pandemic, ERCPs were performed by endoscopists equipped with surgical masks, surgical gloves, and waterproof gowns. During the outbreak period in 2021, N95 masks, waterproof shoe covers, and facial shields were added to the list.

2.4. PCR test for COVID

All patients undergoing ERCPs were admitted for the procedure and further management. During the COVID-19 outbreak, the patient would undergo nasal swab test of COVID-19 for

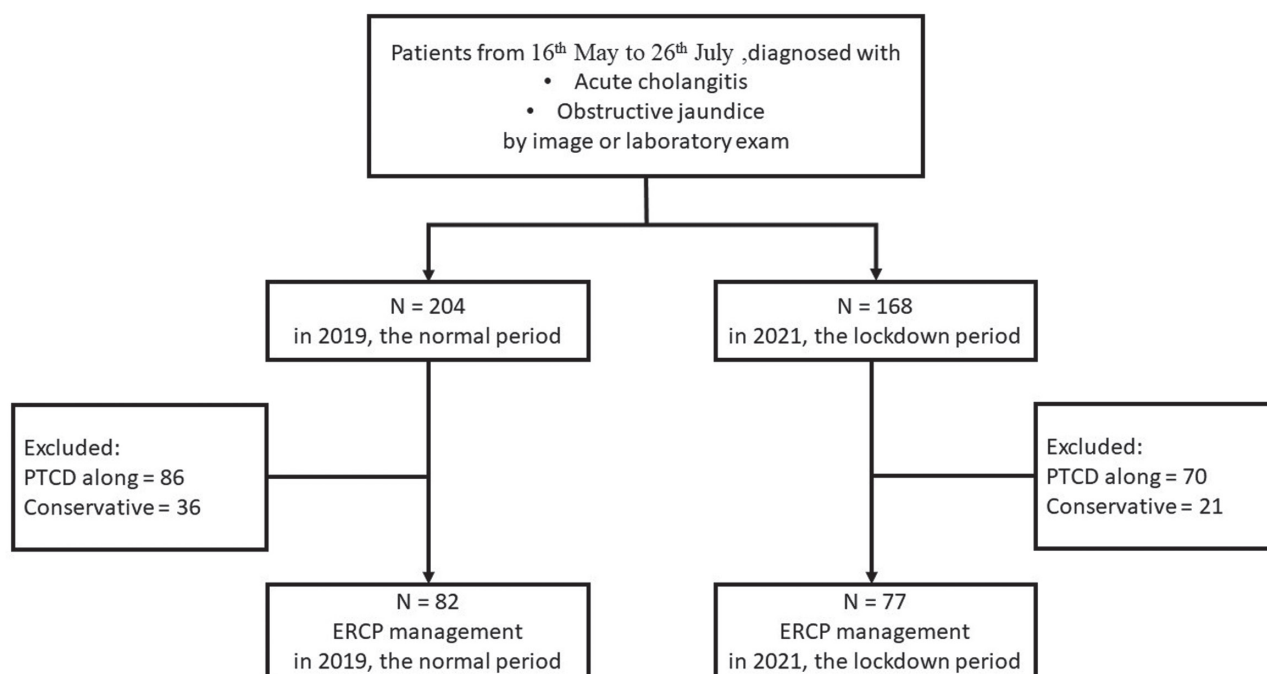


Fig. 1 Patient selection flowchart.

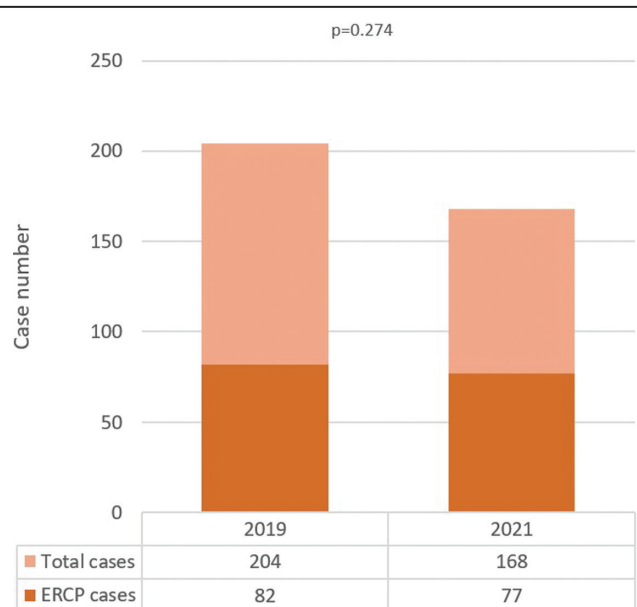


Fig. 2 Total case number and ERCP case number during the normal period and lockdown period. ERCP = endoscopic retrograde cholangiopancreatography.

reverse-transcriptase polymerase chain reaction (RT-PCR). Once a result was negative, a patient was then allowed to have the endoscopic procedure at Taipei Veterans General Hospital. The COVID-19 RT-PCR test would take around 6 hours to yield the results. From May 16 to July 26, 2021, no patient nor ERCP staffs were diagnosed with COVID-19.

2.5. Statistical analyses

The case numbers, initial presentations, pre- and post-ERCP laboratory data, post-ERCP complications, time to ERCP, and hospital stays were analyzed. To compare the variables between 2019 and 2021, the Mann–Whitney U test and the chi-squared test were used to compare continuous and categorical variables, respectively. Cox regression was used to analyze the variable that may influence the Inpatient days in 2021. A Kruskal–Wallis test was used to compare lab data between different patient origins in 2021. A p value <0.05 indicated statistical significance. Statistical analysis was conducted using IBM SPSS version 25.0.

3. RESULTS

A total of 204 patients in 2019 and 168 patients in 2021 were diagnosed with acute biliary cholangitis or obstructive jaundice, and 82 of the patients in 2019 and 77 patients in 2021 underwent ERCP ($p = 0.274$, Fig. 2). Comparison of age, gender, and malignant etiologies between the two groups showed no statistically significant differences. More patients referred from other hospitals was found, eight patients (9.8%) in 2019 and 20 (26%) in 2021 ($p = 0.022$). The rest of baseline characteristics are listed in Table 1.

The initial lab data, including blood urea nitrogen ([BUN] 15.00 in 2021 vs 11.5 mg/dL in 2019; $p = 0.029$), total bilirubin (4.12 in 2021 vs 3.08 mg/dL in 2019; $p = 0.014$), GGT (378 in 2021 vs 261 U/L in 2019; $p = 0.009$), and ALKP (254 in 2021 vs 174 U/L in 2019; $p = 0.002$) were higher during lockdown compared to the normal period in 2019. Patients whose qSOFA score was ≥ 2 occurred more during the lockdown period than during the normal period (24 patients [31.1%] in the lockdown periods versus 12 patients [14.6 %] in the normal period; $p = 0.013$). The detailed information is listed in Table 2.

Table 1

Demographic data of patient undergoing ERCP during the normal and lockdown periods

	2019 (the normal period) (n = 82)	2021 (the lockdown period) (n = 77)	p
Male (%)	44 (53.7)	42 (54.5)	1
Age, y (median [IQR])	67.50 (60.25, 77.00)	69.00 (59.00, 82.00)	0.492
Charlson comorbidity index ≥ 2 (%)	67 (81.7)	64 (83.1)	0.816
Malignancy (%)	9 (11.0)	14 (18.2)	0.287
Diabetes mellitus (%)	18 (22.0)	23 (29.9)	0.337
Hypertension (%)	35 (42.7)	33 (42.9)	1
History of biliary stone (%)	27 (32.9)	29 (37.7)	0.646
Congestive heart failure (%)	14 (17.1)	16 (20.8)	0.693
COPD (%)	2 (2.4)	4 (5.2)	0.621
Chronic kidney disease (%)	10 (12.2)	7 (9.1)	0.707
Chronic liver disease (%)	9 (11.0)	8 (10.4)	1
Indications of ERCP			0.573
Biliary stone-related cholangitis	68 (62.5)	52 (67.5)	
Malignant obstructive jaundice	8 (9.8)	15 (19.5)	
Benign obstructive jaundice	6 (7.3)	10 (13.0)	
Procedure during ERCP			0.153
EPT (%)	20 (24.4)	27 (35.0)	
EPBD/EPLBD (%)	36 (43.9)	24 (31.2)	
Stent (%)	12 (14.6)	15 (19.5)	
Cannulation method			0.569
Selective catheter cannulation	77 (93.9)	74 (96.1)	
Guidewire-assisted	1 (1.2)	1 (1.2)	
Precut papillotomy	4 (4.8)	2 (2.6)	
Patient origin (%)			0.022
Emergent room	56 (68.3)	46 (59.7)	
Out-patient department	18 (22.0)	11 (14.3)	
Referral	8 (9.8)	20 (26.0)	

COPD = chronic obstructive pulmonary disease; EPT = endoscopic papillotomy; EPLBD = endoscopic papillary large balloon dilation; ERCP = endoscopic retrograde cholangiopancreatography; IQR = inter-quartile range.

Table 2**Laboratory data and clinical presentation of patients undergoing ERCP during 2019 (the normal period) and 2021 (the lockdown period)**

	2019 (the normal period) (n = 82)	2021 (the lockdown period) (n = 77)	<i>p</i>
WBC (/μL) (median [IQR])	9200.00 [6140.00, 13 775.00]	10 100.00 [7100.00, 14 000.00]	0.227
Hb (g/dL) (median [IQR])	13.10 [11.90, 14.67]	13.10 [11.90, 14.20]	0.461
Plt (/μL) (median [IQR])	204 500.00 [159 250.00, 258 000.00]	220 000.00 [164 000.00, 264 000.00]	0.881
BUN (mg/dL) (median [IQR])	11.50 [9.00, 14.00]	15.00 [9.00, 23.00]	0.029
Cr (mg/dL) (median [IQR])	0.94 [0.77, 1.15]	0.86 [0.65, 1.15]	0.184
ALT (U/L) (median [IQR])	167.50 [60.00, 365.50]	186.00 [98.00, 358.00]	0.376
AST (U/L) (median [IQR])	139.00 [49.00, 307.00]	156.50 [73.25, 288.50]	0.531
Tbil (mg/dL) (median [IQR])	3.08 [1.23, 4.49]	4.12 [2.17, 7.24]	0.014
GGT (U/L) (median [IQR])	261.00 [116.50, 467.75]	378.00 [248.00, 595.00]	0.009
ALKP (U/L) (median [IQR])	174.00 [131.00, 301.00]	254.00 [168.50, 393.00]	0.002
Lipase (median [IQR])	434.28 (1433.04)	496.64 (1577.64)	0.807
CRP (mg/dL) (median [IQR])	4.77 [1.54, 8.50]	6.16 [1.93, 13.07]	0.055
Acute kidney injury (%)	15 (18.3)	17 (22.1)	0.691
PTCD/PTGBD (%)	12 (14.6)	15 (19.5)	0.547
Pancreatitis (%)	17 (20.7)	17 (22.1)	0.989
qSOFA ≥ 2 (%)	12 (14.6)	24 (31.1)	0.013

ALKP = alkaline phosphatase; ALT = alanine aminotransferase; AST = aspartate aminotransferase; BUN = blood urea nitrogen; CRP = C-reactive protein; ERCP = endoscopic retrograde cholangiopancreatography; Hb = hemoglobin; PTCD = percutaneous transhepatic cholangiography and drainage; PTGBD = percutaneous transhepatic gallbladder drainage; qSOFA = quick Sequential Organ Failure Assessment; Tbil = total bilirubin; WBC = white blood cell count.

Table 3**Time intervals during the clinical course of patients undergoing ERCP during the normal period (2019) and lockdown period (2021)**

	2019 (the normal period) (n = 82)	2021 (the lockdown period) (n = 77)	<i>p</i>
Symptom onset to ER (median [IQR])	1.00 [0.00, 6.25]	2.00 [0.00, 6.00]	0.298
ER registration to image evaluation (median [IQR])	0.50 [0.00, 2.00]	0.00 [0.00, 1.00]	0.15
Image diagnosis to ERCP (median [IQR])	5.00 [4.00, 7.75]	6.00 [3.00, 11.00]	0.351
Hospital admission to ERCP (median [IQR])	4.00 [3.00, 6.00]	4.00 [3.00, 8.00]	0.341
Hospital stays (median [IQR])	8.00 [6.00, 12.00]	11.00 [7.00, 22.00]	0.002

ER = emergency room; ERCP = endoscopic retrograde cholangiopancreatography; IQR = interquartile range.

Time interval including from symptom onset to discharge was analyzed, Table 3. Only hospital stay showed statistically significant longer values in the lockdown period than in the normal period (11 days [7.00–22.00] vs 8 days [6.00–12.00]; $p = 0.02$, Fig. 3A). Cumulative incidence of discharge of patients during lockdown, stratified by qSOFA ≥ 2 showed at Fig. 3B, while the normal period was shown in Fig. 3C. Both periods showed the statistical significance of hospital stay when stratified by qSOFA score, $p < 0.001$.

Multivariate analysis showed that qSOFA ≥ 2 (hazard ratio [HR] = 3.837, 95% confidence interval [CI] = 1.471–10.003; $p = 0.006$) and malignant etiology (HR = 2.932, 95% CI = 1.271–6.765; $p = 0.012$) were the statistically significant factors for a

prolonged hospital stay, which is defined as hospital stay >21 days according to the local Health Ministry's operational definition (Table 4).

Further analysis was conducted based on patients' origin during the lockdown period in 2021. A total of 77 patients in 2021 were stratified into three groups: (1) patients admitted from the emergency room (ER), (2) those from the out-patient department (OPD), and (3) those referred from other hospitals. Forty-six patients (59.7%) were admitted from ER, 11 patients from OPD (14.3%), while 20 patients (26.0%) were referred from other hospitals. Patients referred from the OPD had longer hospital stay although it was not statistically different. More patients had a medical history of hepatobiliary tract

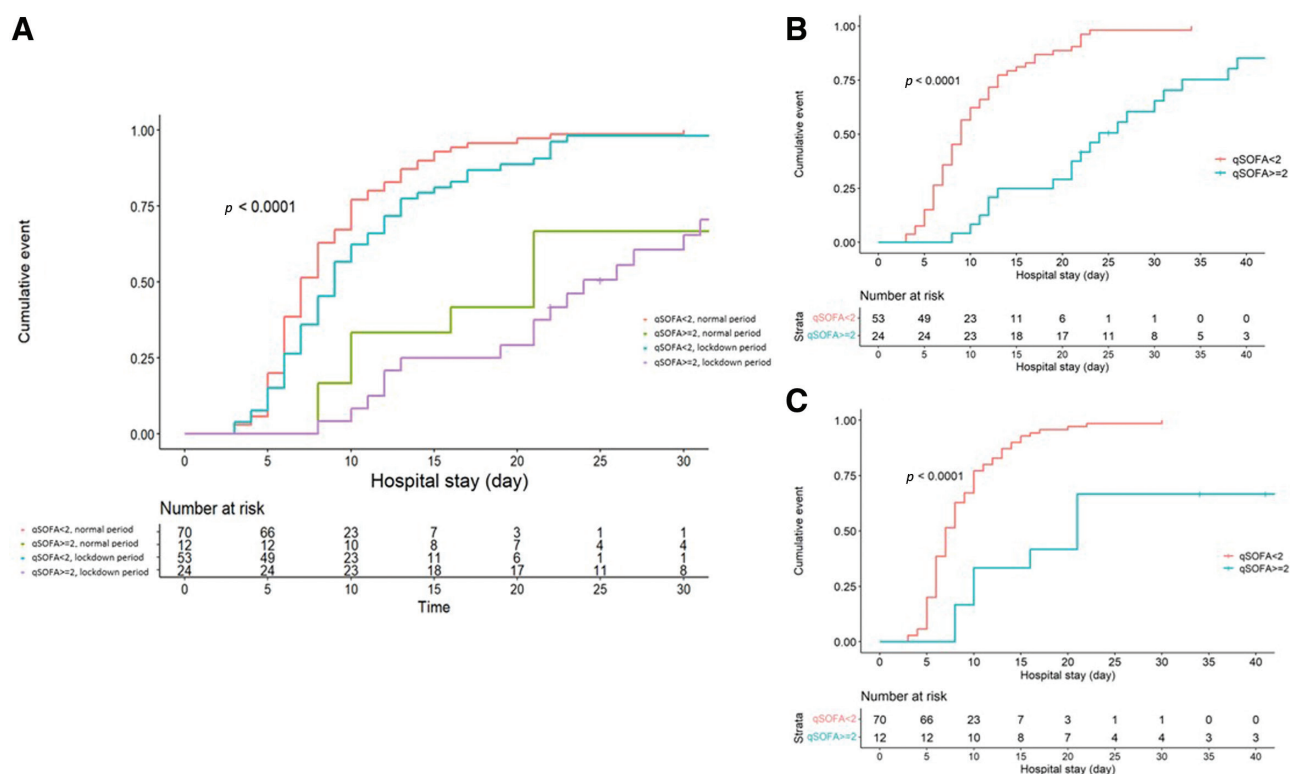


Fig. 3 A, Cumulative incidence of discharge of the patient received ERCP during the normal and lockdown period, stratified by qSOFA ≥ 2. B, During 2019, the lockdown period. C, During 2021, the normal period. ERCP = endoscopic retrograde cholangiopancreatography; qSOFA = quick Sequential Organ Failure Assessment.

Table 4

Risk factors of prolonged hospital stay, defined as >21 days hospital stay

Variable	N	Univariate analysis		Multivariate analysis	
		Hazard ratio	p	Hazard ratio	p
Lockdown period	77/82	0.697 (0.304–1.599)	0.395		
Y/N					
Gender	86/73	1.298 (0.164–10.288)	0.805		
M/F					
Referral	28/131	0.824 (0.149–4.548)	0.824		
Y/N					
Malignant etiology	23/136	35.109 (2.017–611.034)	0.015	2.932 (1.271–6.765)	0.012
Y/N					
qSOFA	36/123	21.484 (3.557–129.751)	0.001	3.837 (1.471–10.003)	0.006
≥2/<2					
Post-EPT bleeding	5/154	0.172 (0.026–1.160)	0.071		
Y/N					
Post-ERCP pancreatitis	14/145	8.935 (0.134–593.675)	0.306		
Y/N					
Charlson Comorbidity index ≥2/<2	131/28	67.284 (0.100–45192.978)	0.205		
WBC (/10 ⁹ L ⁻¹)		1.031 (0.989–1.075)	0.155		
BUN (mg/dL)		1.011 (0.941–1.087)	0.761		
Total bilirubin (mg/dL)		0.839 (0.733–0.960)	0.010	0.946 (0.895–1.000)	0.051
GGT (mg/dL)		1.003 (1.000–1.005)	0.036		
ALKP (mg/dL)		1.003 (0.999–1.007)	0.156		
CRP (mg/dL)		0.964 (0.883–1.054)	0.422		

BUN = blood urea nitrogen; ALKP = alkaline phosphatase; CRP = C-reactive protein; EPT = endoscopic papillotomy; ERCP = endoscopic retrograde cholangiopancreatography; GGT = gamma-glutamyl transferase; qSOFA = quick Sequential Organ Failure Assessment; WBC = white blood cell.

malignancy compared patients referred from OPD to those who were admitted from ER or referred from other hospitals (90.90%, 17.39%, and 25%, respectively; $p = 0.003$). On the contrary, these patients had lower WBC and CRP level ($p =$

0.015 and $p = 0.006$, respectively). The detailed data are listed in Table 5.

Post-ERCP complications including post-EPT bleeding, perforation, and post-ERCP pancreatitis were compared between

Table 5**Comparison of laboratory data according to patients' origin during the lockdown period in 2021**

	ER (n = 46)	OPD (n = 11)	Referral (n = 20)	<i>p</i>
Malignant etiology (%)	8 (17.39)	10 (90.90)	5 (25)	0.003
EPT (%)	17 (36.9)	3 (27.2)	7 (35.0)	0.833
WBC (/ μ L) (median [IQR])	10 550.00 [7767.50, 14 000.00]	5900.00 [4700.00, 8785.00]	11 100.00 [7175.00, 15 850.00]	0.015
Tbil (mg/dL) (median [IQR])	3.63 [2.13, 6.11]	8.58 [2.42, 13.58]	4.65 [2.49, 8.02]	0.177
ALT (U/L) (median [IQR])	188.00 [105.50, 359.25]	235.00 [76.00, 422.50]	181.00 [74.50, 339.25]	0.976
GGT (U/L) (median [IQR])	347.50 [248.25, 566.75]	581.00 [281.50, 807.50]	384.00 [230.25, 572.75]	0.463
ALKP (U/L) (median [IQR])	258.00 [186.00, 376.00]	442.00 [142.50, 531.00]	188.00 [150.75, 284.00]	0.263
CRP (mg/dL) (median [IQR])	7.15 [4.63, 13.41]	1.76 [0.47, 2.29]	9.42 [2.01, 16.28]	0.006
qSOFA \geq 2 (%)	14 (30.4)	3 (27.2)	7 (35.0)	0.226
Hospital stays (d) (median [IQR])	10.50 [7.00, 19.50]	17.00 [8.00, 33.000]	12.00 [8.25, 26.00]	0.103

BUN = blood urea nitrogen; ALKP = alkaline phosphatase; CRP = C-reactive protein; EPT = endoscopic papillotomy; ERCP = endoscopic retrograde cholangiopancreatography; GGT = gamma-glutamyl transferase; IQR = interquartile range; qSOFA = quick Sequential Organ Failure Assessment; WBC = white blood cell.

Table 6**Comparison of post-ERCP complications and cannulation failure rates between the normal period (2019) and lockdown period (2021)**

	2019 (the normal period) (n = 82)	2021 (the lockdown period) (n = 77)	<i>p</i>
Post-EPT bleeding (%)	3 (3.7)	2 (2.6)	1
Post-ERCP pancreatitis (%)	5 (6.1)	9 (11.7)	0.335
Perforation (%)	0 (0)	0 (0)	1
Cannulation failure rate (%)	6 (7.3)	3 (3.9)	0.556

EPT = endoscopic papillotomy; ERCP = endoscopic retrograde cholangiopancreatography.

2019 and 2021. No statistical significance was revealed between these two periods in our study (Table 6).

Post-treatment lab data before discharge showed no statistical difference between 2019 and 2021, except for ALKP, which was higher in 2021 rather than 2019 (144 vs 128 U/L; $p = 0.043$, Supplementary Table 1, <http://links.lww.com/JCMA/A171>). Biomarkers representing biliary tract and liver function improved after the treatment. The improvement in the total bilirubin level (1.94 mg/dL in 2019 vs 2.76 mg/dL in 2021; $p = 0.018$) was significantly higher in 2021 than that in 2019 (Fig. 4). Detailed data are listed in Supplementary Table 2, <http://links.lww.com/JCMA/A171>.

4. DISCUSSION

During the pandemic era, especially the lockdown period, many previous studies reported a reduction in cases of endoscopic procedure including upper gastrointestinal endoscopy, colonoscopy, and endoscopic ultrasound. The reduction of elective endoscopic procedures was found to have led to the reduction in the malignancy detection rates,^{17,18} which may have delayed diagnosis and treatment.

Whether ERCP procedure would be delayed during the lockdown period seems to be controversial. One Italian study reported urgent EGD was significantly higher during the pandemic than before.³ Another retrospective study in Korea reported a significant reduction in ERCP during the pandemic.⁶ A similar result was obtained in a study from Ireland. However, another single-center retrospective study in Spain implied that no significant ERCP reduction during the pandemic had occurred,

and the procedure could be performed safely even during the pandemic.¹¹ Our study revealed no significant reduction in both patients diagnosed with acute cholangitis or obstructive jaundice and the patients receiving ERCP during the lockdown period, compatible with the previous study in Spain.

Time from symptom onset to hospital visit, hospital registration to image evaluation, and admission date to date of ERCP showed no differences between 2019 and 2021. The results implied that the medical evaluation and ERCP intervention were not delayed during the lockdown period. However, the hospital stay was longer in the lockdown period than in 2019, which might have indicated a more severe disease condition. The much higher total bilirubin, GGT, and ALKP level during the lockdown period could reflect this finding. More patients, whose qSOFA score ≥ 2 , were noticed in the lockdown period than in the normal period in our study. Multivariate analysis also showed that qSOFA ≥ 2 and malignant etiology were statistically significant factors for a prolonged hospital stay, which was defined as hospital stay >21 days.

Although prolonged hospital stay was found in the lockdown period in our study, the complication and mortality rates were not different during the lockdown period.

Previous studies have been reported the incidences of ERCP complications. The incidence of post-ERCP pancreatitis is ranging from 2% to 16%.¹⁹⁻²¹ Post-EPT bleeding and perforation varied from 0.02% to 11% and 0.06% to 0.72%, respectively.²¹⁻²³ Finally, the failure rate of cannulation is reported as ranging from 16% to 24%.²⁴⁻²⁶ The performance indicators, including cannulation and complication rates, were similar between 2019 and 2021 and compatible with the previous

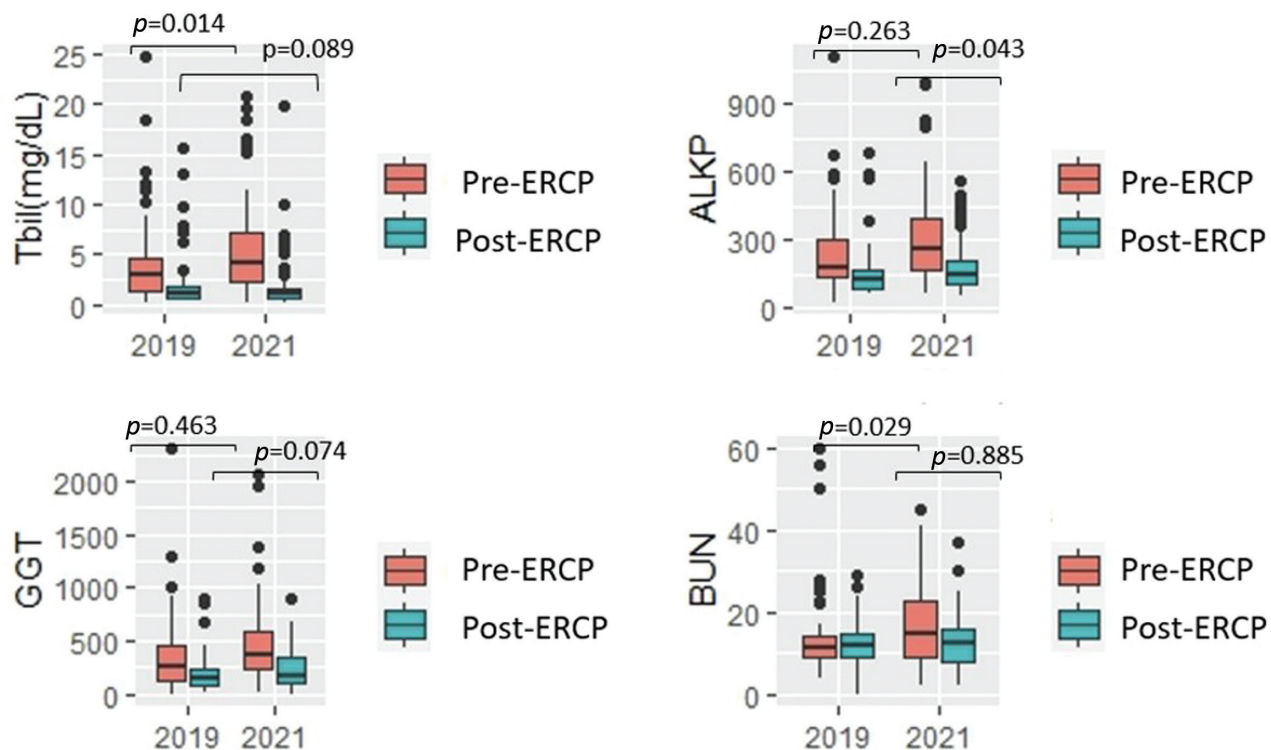


Fig. 4 The improvement of laboratory examinations before and after ERCP during the lockdown and normal period. ERCP = endoscopic retrograde cholangiopancreatography.

studies. In fact, in Taipei Veteran General Hospital, the preventive strategy of post-ERCP pancreatitis was not different during normal and lockdown periods. During both periods, preprocedure rectal indomethacin administration and pancreatic stenting were applied for the prevention of post-ERCP pancreatitis, especially for those who had risk factors of post-ERCP pancreatitis, including recurrent pancreatitis, difficult cannulation, or precut papillotomy. The fact implies that the procedure could be safely performed during the lockdown period. The result was concordant with the previous studies.^{6,14} Also, a more severe reduction of total bilirubin and CRP level in 2021 indicates that the procedure could efficiently manage the patients with the indications of ERCP during the lockdown period.

Further analysis based on patients' origin was conducted. Our study found that patients who were referred from OPD tended to have malignant etiology and longer hospital stays than patients referred from ER or other hospitals. The patients from the OPD tended to have higher total bilirubin and biliary tract enzyme levels although this difference was not statistically significant. The patients from the OPD had more insidious and ambiguous symptoms, which may not be obvious enough to urge the patient to seek for medical help immediately. This finding was compatible with the previous study, which reported higher total bilirubin and biliary tract enzyme in patients with obstructive jaundice induced by malignant etiology.^{27,28} On the other hand, patients from the ER or those referred from other hospital had higher qSOFA scores and inflammatory markers upon admission. These patients, having abrupt abdominal pain, fever, or gastrointestinal upset, would have sought medical help in a timely manner even during the lockdown period, leading to shorter hospital stays.

Several studies and guidelines have offered the endoscopist safe and efficient self-protection methods to performed endoscopic procedure.^{29,30} The more serious the clinical condition

before the procedure and the more improvements of laboratory data after the procedure during the lockdown era suggests that the ERCP should not be delayed even during the medical lockdown period. Early referral to hospital equipped with ERCP equipment and timely ERCP intervention are highly suggested based on our analysis.

Our study has some limitations. First, small case numbers were a limitation since this study is a single-center observational study. For more case numbers, nationwide information is necessary. Second, although our analysis reports were no significant reduction in urgent ERCP case numbers, the real reduction in elective ERCP, since there was no document nor registration if patients canceled the procedure or doctors did not order the ERCP procedure during the lockdown period. The effects of reduction or delay of elective ERCP need more time to evaluate.

In conclusion, patients from May 16 to July 26, 2021, had longer hospital stays and higher biliary tract enzyme levels, which indicated more severe disease. Nevertheless, ERCP could be safely and successfully performed even during the medical level 3 alert lockdown period without causing an increase in procedure-related complications.

APPENDIX A. SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <http://links.lww.com/JCMA/A171>.

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