Hospital Trends of Acute Pancreatitis During the Coronavirus Disease 2019 Pandemic

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Objective: The coronavirus disease 2019 pandemic led to changes in individuals' behaviors and healthcare delivery. We examined the impact of these changes on the rates and clinical course of acute pancreatitis (AP).

Methods: Hospitalizations for AP from March 1 through August 31 in 2019 (baseline group) and the same period in 2020 (pandemic group) were retrospectively reviewed. Univariate and multivariate analyses were used for demographics and outcomes.

Results: Two hundred eighty subjects (315 admissions) were identified in 2019 and 237 subjects (264 admissions) in 2020. Subjects in the pandemic group were more likely to have systemic inflammatory response syndrome (40% vs 25%, $P < 0.01$), pancreatic necrosis (14% vs 10%, $P = 0.03$), and persistent organ failure (17% vs 9%, $P = 0.01$) compared with prepandemic. There was no difference in etiology of AP. A multivariable model indicates that increased comorbidities, prior pancreatitis, pancreatic necrosis, and prescription of opiates at discharge were associated with 30-day readmissions during the pandemic.

Conclusions: Fewer patients were admitted for AP during the pandemic, suggesting that patients with milder symptoms avoided hospital interaction. Practices followed during the pandemic, especially avoidance of hospitalization and improved efficiency of hospital management, may reduce the burden of pancreatitis care in the future.

Key Words: coronavirus disease 2019, COVID-19, SARS-CoV-2, pancreatitis, alcohol abuse, healthcare resource utilization

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The coronavirus disease 2019 (COVID-19) pandemic impacted human health in many ways, including morbidity and mortality directly related to infection by the causative virus, alterations to healthcare delivery, and increases in symptoms of anxiety and depression related to social isolation. Decreased access to outpatient substance abuse treatment[1] and increased stressors led to an increase in alcohol use for one third of survey respondents.[2–5] The negative effects of alcohol use during the COVID-19 pandemic have been predicted to cause a "shadow pandemic" of alcohol-related illnesses after the viral pandemic has ended,[6] but only limited evidence of increased alcohol-related health problems during the pandemic has been shown.[7]

Alcohol-related gastrointestinal diseases include acute and chronic pancreatitis (CP), alcoholic hepatitis, and alcohol-related cirrhosis.[8] Among these, acute pancreatitis (AP) is the most common, making it the most suitable for study.[9] In addition, many studies have assessed the burden of healthcare utilization related to AP and identified factors contributing to hospital outcomes and readmission rates.[10,11] One potential drawback to studying AP during the pandemic is that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been hypothesized to cause AP due to the presence of angiotensin converting enzyme receptors in the pancreas,[12,13] although this continues to be debated.[14–16]

We hypothesized that changes in alcohol use behavior during the COVID-19 pandemic would influence the epidemiology of AP and that healthcare resource utilization would be different. The primary outcome was percentage of AP admissions attributed to alcohol use. Additional outcomes of interest included measures of healthcare resource utilization such as length of stay and readmission rates.

MATERIALS AND METHODS

A retrospective chart review was performed at The Ohio State University Wexner Medical Center, a large tertiary academic center. The institutional review board approved this study (protocol: 2020H0430). The electronic medical record was used to identify all patients hospitalized with a diagnosis of AP. March 1 to August 31, 2020, was selected as the pandemic group study period, corresponding with times when stay-at-home orders were in full effect. Hospitalizations from the same period in the year before (2019) were selected as the control population. Acute pancreatitis diagnoses and severity assessment were identified by the *International Classification of Diseases*, *Tenth Revision*, code K85.X and were validated by manual chart review using the revised Atlanta classification criteria.[17] Organ failure was defined by modified Marshall scores greater than 2 for respiratory (intubation), renal (creatinine >1.8 or dialysis), and cardiovascular (shock unresponsive to fluids or vasopressor use) systems.[17]

The etiology of AP was adjudicated based on the impression of the consulting gastroenterologist during the index admission or from the admitting service when no gastroenterology consultation was obtained. Systemic inflammatory response syndrome (SIRS) criteria were recorded from the first set of vital signs and laboratory results in the emergency ward. Chronic pancreatitis (CP) was defined by the presence of pancreatic calcifications or by a combination of morphologic features and functional deficiencies.[18] Subjects were considered to have COVID-19 if a polymerase chain reaction test identified the virus during the hospitalization. Opiate use at discharge was measured in oral morphine equivalents based on dosages listed in the hospital discharge summary.

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Charlson Comorbidity Index was calculated based on the known comorbidities during the hospitalization.[19] Readmissions were assessed irrespective of the indication.

Data analysis was performed using SAS (version 9.4; Cary, NC).

All statistical testing was performed by an expert biostatistician and included χ^2 tests (or Fisher exact test, when appropriate) for categorical variables and *t* tests for continuous variables. Wilcoxon rank sum tests were used to compare medians. Univariate logistic regression models were used to identify factors that affected 30-day readmissions, and multivariable logistic regression models were created that included factors with a significant difference ($P < 0.05$) on univariate analysis and clinical relevance. The multivariable models ultimately included 6 items: presence of pancreatic necrosis, prior AP, comorbid CP, current alcohol use, discharge with narcotics, and Charlson Comorbidity Index. Severity was not included as a variable in the multivariable models because there was no difference in univariate comparison. All authors had access to the study data and reviewed and approved the final manuscript.

RESULTS

Study Population

There were 280 subjects in the baseline group compared with 237 subjects in the pandemic group (Table 1). Subjects admitted during the pandemic were younger (52.2 vs 55.2 years, $P = 0.03$), less likely to be married (35% vs 44%, $P = 0.03$), and more likely to be of a non-White race (35% vs 27%, $P = 0.05$). There was no difference in sex, median Charlson Comorbidity Index, body mass index, smoking status, or history of prior AP or CP between groups. Alcohol use was different between groups when categorized as current (40.8% vs 34.9%), former (30.9% vs 44.2%), or never (28.3% vs 20.9%; overall $P < 0.01$). When dichotomized as current versus no current use, a higher portion of AP patients were active drinkers during the pandemic; however, this difference did not reach statistical significance (Table 1).

Acute Pancreatitis Characteristics

There were 315 AP admissions in the baseline group and 264 admissions in the pandemic group (Table 2). There was no difference in etiology between groups ($P = 0.11$), including alcohol-related AP (28.5% vs 23.8%). Subjects in the pandemic group were more likely to present with SIRS (40% vs 25%, $P < 0.01$) and develop pancreatic necrosis (14% vs 10%, $P = 0.03$) compared with the prepandemic group. The distribution of severity was different between groups, with more severe cases during the pandemic (17.4% vs 8.6%; $P = 0.01$) despite a lower proportion of subjects admitted as a hospital transfer during this time period (28% vs 44%, $P < 0.01$). Development of cardiac failure (9.5% vs 5.1%, $P = 0.06$) and renal failure (18.6% vs 10.8%, $P = 0.01$) were more common in the pandemic group than the prepandemic group, but there was no difference in respiratory failure (8.3% vs 10.2%, $P = 0.50$; Table 2).

Subgroup analysis of subjects with positive inpatient tests for SARS-CoV-2 was not performed because only 5 subjects had positive inpatient tests for SARS-CoV-2 in the pandemic cohort. Of these 5 subjects, 2 had gallstone AP and 3 had idiopathic AP. Three subjects (60%) developed severe AP (based on persistent respiratory and renal failure) with a median length of stay of 14 days (range, 7–30 days). There was no hospital mortality: one subject died within 30 days of discharge, and the cause of death was unrelated to AP. There were no readmissions within 90 days in the remaining four COVID-19–positive patients.

Subset analyses were completed for subjects with alcohol-related AP and gallstone-related AP. Alcohol use characteristics, history of prior AP, and comorbid CP were similar among the patients in each cohort (Table 3). In the prepandemic cohort, 54 subjects were eligible for same-admission cholecystectomy and 34 (63%) underwent surgery during the index admission. In the pandemic cohort, 51 subjects were eligible for same-admission cholecystectomy and 25 (49%) underwent surgery (Supplemental Table 1, http://links.lww.com/MPA/A947). Subjects who underwent same-admission cholecystectomy were less likely to be readmitted within 30 or 90 days in the prepandemic group and within 90 days in the pandemic group, but 30-day readmissions, although lower (16% vs 32%), did not reach statistical significance in the pandemic group (Supplemental Table 2, http://links.lww.com/MPA/A947).

TABLE 1. Demographics of the Subjects Hospitalized With AP From March 1 to August 31, 2019, and March 1 to August 31, 2020

	Control Group 2019 (n = 280)	Pandemic Group 2020 (n = 237)	*P*
Sex, male	159 (56.8)	128 (54.0)	0.59
Age, mean (SD), y	55.23 (15.54)	52.19 (15.94)	0.03
Marital status			0.03
Married	124 (44.3)	82 (34.6)	
Single, divorced, or widowed	156 (45.7)	155 (65.4)	
Charlson Comorbidity Index, median (range)	1 (0–8)	1 (0–9)	0.91
Race			0.05
White	205 (73.2)	155 (65.4)	
Non-White	75 (26.8)	82 (34.6)	
Black/African American	59 (21.1)	68 (28.7)	
Asian	2 (0.7)	2 (0.8)	
Other	9 (3.2)	9 (3.7)	
Data not available	5 (1.8)	4 (1.6)	
Body mass index category			0.53
Normal/healthy	79 (28.4)	57 (24.2)	
Obese	112 (40.3)	105 (44.5)	
Overweight	75 (27.0)	60 (25.4)	
Underweight	12 (4.3)	14 (5.9)	
History of CP	43 (15.5)	38 (16.2)	0.92
Prior AP	119 (42.5)	100 (42.6)	1.00
Smoking status			0.39
Current	79 (28.4)	80 (34.0)	
Former	95 (34.2)	74 (31.5)	
Never	104 (37.4)	81 (34.5)	
Smoking status (dichotomized)			0.17
Current	79 (28.4)	80 (34.0)	
Without current use	201 (71.6)	157 (66.0)	
Alcohol use status			<0.01
Current	97 (34.9)	95 (40.8)	
Former	123 (44.2)	72 (30.9)	
Never	58 (20.9)	66 (28.3)	
Alcohol use status (dichotomized)			0.20
Current	97 (34.9)	95 (40.8)	
Without current use	181 (65.1)	138 (59.2)	
Current alcoholic drinks per day, mean (SD)	6.33 (7.85)	7.16 (8.45)	0.49

Data are presented as n (%), unless otherwise noted.

SD indicates standard deviation.

TABLE 2. Characteristics of AP Hospitalizations From March 1 to August 31, 2019, and March 1 to August 31, 2020

	Control Group 2019 (n = 315)	Pandemic Group 2020 (n = 264)	*P*
SIRS on admission	80 (25.4)	106 (40.2)	<0.01
Hospital transfer	139 (44.1)	75 (28.4)	<0.01
Abdominal ultrasound obtained	146 (46.3)	115 (43.7)	0.58
Interstitial or necrotizing			0.03
Interstitial	249 (79.0)	184 (69.7)	
Necrosis	32 (10.2)	36 (13.6)	
Unknown*	34 (10.8)	44 (16.7)	
Organ failure			
Respiratory failure	26 (8.3)	27 (10.2)	0.50
Cardiac failure	16 (5.1)	25 (9.5)	0.06
Renal failure	34 (10.8)	49 (18.6)	0.01
Acute pancreatitis severity			0.01
Mild	270 (85.7)	203 (76.9)	
Moderately severe	18 (5.7)	15 (5.7)	
Severe	27 (8.6)	46 (17.4)	
Etiology			0.11
Alcohol	75 (23.8)	75 (28.5)	
Gallstone	66 (21.0)	60 (22.7)	
Idiopathic	88 (27.9)	81 (30.8)	
Other	78 (24.8)	42 (16.0)	
Pancreatic cancer	8 (2.5)	5 (1.9)	
Length of stay, overall, median (range), d	5.0 (0–114)	5.0 (1–65)	0.36
Length of stay, mild	5.0 (0–41)	4.0 (1–33)	0.12
Length of stay, moderately severe	11.0 (1–114)	4.0 (2–30)	<0.01
Length of stay, severe	15.0 (2–76)	12.50 (2–65)	0.57
Discharged with narcotics	140 (45.3)	123 (47.1)	0.73
OME at discharge, mean (SD), mg	46.46 (61.76)	41.97 (33.78)	0.48
Duration of narcotics, mean (SD), d	5.25 (3.34)	4.70 (3.18)	0.20
Mortality			
Admission	9 (2.9)	7 (2.7)	1.00
30-d	4 (1.3)	6 (2.3)	0.55
90-d	6 (2.0)	3 (1.2)	0.68
Readmission			
30-d	83 (26.3)	73 (27.7)	0.80
90-d	122 (38.7)	80 (30.3)	0.04

Data are presented as n (%), unless otherwise noted.

*Unknown indicates that cross sectional imaging was not completed during hospitalization.

OME indicates oral morphine equivalent.

Acute Pancreatitis Outcomes

Regarding AP outcomes, mortality was not different between groups (Table 2). Readmissions within 30 days were not different, but there were fewer 90-day readmissions in the pandemic group compared with the prepandemic group (30% vs 39%, $P = 0.04$). Overall length of stay was similar between groups, with a median length of stay of 5 days ($P = 0.36$), but was significantly shorter for moderately severe AP during the pandemic ($P < 0.01$; Table 2). A similar proportion of patients were discharged with narcotics, and similar dose and duration were prescribed.

When controlling for the 6 variables included in the multivariable model, presence of necrosis, prior AP, Charlson Comorbidity Index, and discharge with narcotics were associated with increased 30-day readmissions (Table 4). Comorbid CP and current alcohol use were not independent predictors of 30-day readmission (Table 4).

DISCUSSION

Our study shows that during the initial surge of the COVID-19 pandemic in the United States, there were overall fewer AP hospitalizations compared with the same period in 2019. Inpatient pancreatitis during the pandemic was more likely to have severe features, but the etiology and clinical outcomes were not different. Overall, this suggests that patients with milder AP were not hospitalized during the pandemic and moderately severe cases were expediently discharged. Despite these alterations, readmission and mortality rates were similar. These findings demonstrate opportunities to improve efficiency in the approach to hospital management of AP even after the pandemic has resolved.

The COVID-19 pandemic led to myriad changes in healthcare delivery. Some changes to hospital-based care were implemented by healthcare leaders to minimize the spread of the virus, protect healthcare workers, and preserve personal protective equipment.[20] Hospital units previously used for postoperative care were converted to intensive care–capable units and elective surgical and endoscopic procedures were canceled.[21] Healthcare workers may have followed leaders' example by expediting hospital discharges to preserve hospital beds for impending volumes of patients infected with the virus. Similarly, patients may have requested expedient discharge to minimize their risk of exposure to the virus. Our study supports this hypothesis by demonstrating no difference in overall length of stay despite increased severity of AP during the pandemic cohort. Length of stay was significantly shorter for moderately severe AP, highlighting a potential opportunity for reducing overall length of stay by optimizing this group of patients. There was no difference in 30-day readmissions and were fewer 90-day readmissions during the pandemic, suggesting that expedient discharges did not increase the risk of readmission.

Outpatient care was also affected by the pandemic, where many appointments were canceled or converted to telemedicine to minimize clinician exposures.[22] The patients also made changes to their healthcare use patterns to minimize their risk of exposure. For example, a survey of patients with chronic rheumatologic conditions found a reluctance to report symptoms to providers and a preference to delay hospital presentation as long as possible because of fears of contracting the virus.[23] We speculate that similar reasons led to the decrease in overall AP hospitalizations during the pandemic period of our study. Furthermore, delayed presentation may have led to greater severity scores. Delayed presentation for severe illness during the pandemic has been demonstrated among other severe conditions, including abdominal disorders requiring emergency general surgery.[24,25] We were unable to measure the time from symptom onset to hospital presentation because this information is rarely available retrospectively. However, our data suggest that the patients with AP had delayed presentation during the pandemic as evidenced by a higher proportion of patients with SIRS at presentation and with severe AP. This underscores the importance of prompt recognition and early fluid resuscitation for subjects with AP.

Regarding alcohol use during the pandemic, we found that despite an increased proportion of active alcohol users during

TABLE 3. Alcohol Use Characteristics Among the Patients Hospitalized With Alcohol-Related AP*

	Control Group 2019 (n = 75)	Pandemic Group 2020 (n = 75)	*P*
Endorsed current alcohol use, n (%)	65 (86.7)	66 (88.0)	0.60
Reported drinks per day,* median (range)	5 (1–39)	6 (1–51)	0.63
Reported days per week,* median (range)	7 (1–7)	7 (1–7)	0.50
Days from last drink to admission,† median (range)	2 (0–106)	1.5 (0–108)	0.38
Prior AP, n (%)	48 (64.0)	50 (66.7)	0.44
Comorbid CP,‡ n (%)	22 (29.7)	19 (25.7)	0.96

*Missing data for 7 subjects in 2019 and 17 subjects in 2020.

†Missing data for 21 subjects in 2019 and 37 subjects in 2020.

‡Missing data for 1 subject in 2019 and 2020.

the pandemic, this difference was not statistically significant. Social gathering restrictions were imposed during the pandemic, which led to social deprivation—an established risk factor for increased alcohol use and subsequent AP[26]—but increased AP attributed to alcohol use was not seen in our study. One possible explanation is that alcohol use did not exceed the threshold for AP (40 g/d[27]) for the majority of people during the pandemic. Of the patients admitted with alcohol-related AP, approximately 65% had prior AP and approximately 25% were diagnosed with CP, suggesting a pattern of lifetime alcohol abuse that was not specifically related to the pandemic. Otherwise, we identified several demographic features that were overrepresented during the pandemic, which may identify a phenotype particularly vulnerable to the psychosocial stressors imposed by the pandemic. Younger, unmarried, non-White patients, active users of alcohol and tobacco were more likely to be admitted with AP during the pandemic. It is unclear whether these groups were impacted by social gathering restrictions and whether social alcohol use is more or less likely to lead to AP. Public health efforts to support this subset of the population is warranted in times of crisis to minimize AP hospitalizations.

Our findings in the multivariable models for 30-day readmissions were similar to the previous reports, with an increased risk for readmission seen for patients with necrosis, prior AP, and increased comorbidities.[28–30] In contrast to the previous reports, we found that narcotic prescription was associated with an increased risk of 30-day readmissions.[31] In a previous study, those prescribed opiates at baseline had a 4-fold increase risk in readmission compared with those who did not use opiates before admission, but there was no difference in readmission rates between subjects with new opiate prescriptions at discharge.[31] Similar narcotic doses were prescribed in our study, but we did not determine which subjects were opioid naive. Future studies on the impact of opiate prescriptions on readmission in AP are warranted and should account for baseline use. Regarding same-admission cholecystectomy among patients with gallstone pancreatitis, we suspect that more patients during the pandemic group had necrosis or comorbidities (eg, cirrhosis) that precluded operative intervention. Several cases during the pandemic were managed by endoscopic retrograde cholangiopancreatography with biliary sphincterotomy instead of cholecystectomy.

We acknowledge several limitations to our study. This was a single-center retrospective study using available medical records, so some information is not available. A high percentage of patients with alcohol-related AP had missing information in respect to the date of last drink and other measures of alcohol use (drinks per day, days per week). In addition, as expected based on societal guidelines, cross-sectional imaging was not performed in all subjects, so necrosis and local fluid collections may be underestimated. A multivariable model could not be completed for mortality, because of a low number of observations. Lastly, myriad changes occurred to healthcare delivery during the pandemic that cannot be controlled for in this retrospective study.

Despite these limitations, our study has many strengths. A major strength is the clinical outcomes, including SIRS, organ failure, severity features, and length of stay, which were evaluated for most subjects. Inclusion of a similar period in 2019 allowed for meaningful comparisons to the pandemic group, which has not been reported in pandemic-related pancreatitis literature. In addition, our tertiary academic center treated a large number of patients during these periods, which allowed for multivariate modeling and subset analyses of alcohol- and gallstone-related AP. Finally, our center performed polymerase chain reaction testing on all subjects at the time of admission/transfer, so the presence or absence of COVID-19 infection was systematically assessed in the pandemic group.

In summary, we demonstrated a reduction in overall number of AP hospitalizations during the pandemic, which may be explained by patient reluctance to seek medical attention and provider reluctance in admitting mild AP patients during the pandemic. A similar proportion of cases attributed to alcohol suggested that while some changes in alcohol use occurred, misuse of alcohol causing AP was similar during the pandemic. The predicted "shadow pandemic" of alcohol-related illnesses was not present during the first 2 waves of the pandemic in our region but may be a delayed phenomenon, so ongoing vigilance is warranted. Lastly, AP patients displayed more severe features during the pandemic, but clinical outcomes were unchanged indicating successful and expedited inpatient management despite the challenges to healthcare delivery imposed by the pandemic.

TABLE 4. Multivariable Models for 30-Day Readmissions in the 2019 and 2020 Cohorts

Predictors	Odds Ratio* (95% CI)	*P*
Necrotizing AP	2.22 (1.25–3.92)	0.01
Discharged with narcotics	1.67 (1.11–2.52)	0.01
Prior AP	1.62 (1.02–2.59)	0.04
Current alcohol use	0.88 (0.57–1.36)	0.56
Comorbid CP	1.25 (0.73–2.15)	0.42
Charlson Comorbidity Index	1.16 (1.05–1.30)	<0.01

*Odds ratio is per each point increase in composite score.

CI indicates confidence interval.

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