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Effect of the Coronavirus 2019 Pandemic on Outcomes for Patients Admitted With Gastrointestinal Bleeding in New York City

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The coronavirus disease 2019 (COVID-19) pandemic has resulted in a massive reorganization of hospital operations, with specific implications for patients hospitalized with gastrointestinal bleeding.^{1,2} Guidelines recommend minimizing high-risk aerosol-generating procedures, including upper gastrointestinal endoscopy, and reducing direct patient contact by inpatient consultation services.¹⁻³ The impact of these changes on gastrointestinal bleeding, which is the most common gastrointestinal reason for hospitalization in the United States,⁴ is unknown.

This study examined the effect of the COVID-19 pandemic on outcomes for patients admitted for gastrointestinal bleeding at 2 affiliated hospitals in New York City, the epicenter of the COVID-19 pandemic during the study period.² We sought to assess differences in hospital length of stay for gastrointestinal bleeding before and during the COVID-19 pandemic. We also assessed differences in blood product transfusion requirements and the rate of endoscopy performed during hospitalization.

Methods

This was a retrospective cohort study of all adults ≥ 18 years of age admitted with suspected gastrointestinal bleeding from February 1, 2020, to April 24, 2020, at 2 hospitals in Northern Manhattan affiliated within a single health care system (Columbia University Irving Medical Center). The primary exposure was hospital admission date, either preceding or on/after March 16, 2020. This was the date on which new COVID-19 policies were put into effect, including stoppage of elective procedures and encouragement of remote (as opposed to in-person) inpatient consultation.

Demographic data, outpatient medications, laboratory findings on admission, inpatient procedures, and outcome data were collected. The primary outcome was hospital length of stay. Secondary outcomes were transfusions (packed red blood cells, platelets, cryoprecipitate, or fresh frozen plasma) given during hospitalization and performance of inpatient endoscopy. Because of the nonnormal distribution of length of stay and to account for ongoing hospitalization at the time of this analysis, we dichotomized the primary outcome as a length of stay of < 5

days vs ≥ 5 days, corresponding to the median length of stay in the entire cohort. Multivariable logistic regression models were built to examine the association of primary and secondary outcomes with period of admission (before or during the COVID-19 pandemic). This study was approved by the institutional review board of Columbia University Irving Medical Center.

Results

We identified 211 patients admitted with gastrointestinal bleeding between February 1, 2020, and April 24, 2020, with 88 (42%) patients admitted after March 15, 2020. Characteristics of the 2 cohorts are shown in [Table 1](#). On univariable analysis, patients with gastrointestinal bleeding admitted during the pandemic presented with significantly lower hemoglobin ($P = .0188$), lower platelet count ($P = .0083$), higher international normalized ratio ($P = .0094$), and higher creatinine ($P = .0057$) compared to those admitted before the pandemic.

On multivariable logistic regression, admission during the COVID-19 pandemic was significantly associated with increased length of stay after adjusting for age, sex, admission hemoglobin, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) status, intensive care unit admission, and performance of endoscopy (adjusted odds ratio [OR], 2.46; 95% confidence interval [CI], 1.13–5.34; $P = .023$) ([Supplementary Table 1](#)). On repeat multivariable logistic regression analysis excluding patients with COVID-19, admission during the pandemic was still associated with increased length of stay (adjusted OR, 2.62; 95% CI, 1.17–5.84; $P = .019$). When treating length of stay as a continuous variable on multivariable linear regression, there was a nonsignificant trend toward longer length of

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Abbreviations used in this paper: CI, confidence interval; COVID-19, coronavirus 2019; OR, odds ratio; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

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Table 1. Descriptive Characteristics of the Study Cohort, Stratified by Admission Date

Patient characteristics	Pre-COVID pandemic (February 1, 2020 to March 15, 2020) n = 123	During COVID pandemic (March 16, 2020 to April 27, 2020) n = 88	P value
Age, median (IQR)	67.9 (59.2–80)	70.1 (60–77)	.6184
Sex, female, n (%)	52 (42.3)	32 (36.4)	.387
Race/ethnicity			.029
Non-Hispanic white	27 (22.0)	7 (7.9)	
Non-Hispanic black	22 (17.9)	19 (21.6)	
Hispanic	57 (46.3)	53 (60.2)	
Other/unknown	17 (13.8)	9 (10.2)	
Outpatient medications, n (%), n=191			
Aspirin	40 (34.2)	28 (29.2)	.721
NSAID	18 (15.4)	6 (8.1)	.059
Anticoagulant	21 (18.0)	21 (23.9)	.299
Antiplatelet	9 (7.7)	9 (10.2)	.526
Laboratory values on admission, median (IQR)			
Hemoglobin, g/dL, n=196	10.1 (7.6–12.3)	8.75 (5.8–11.35)	.0188
Platelet, count/ μ L, n=196	239 (185–325)	197 (121.5–281)	.0083
INR, n=161	1.1 (1.1–1.3)	1.25 (1.1–1.7)	.0094
PTT, s, n=160	30.95 (27.2–34.3)	32.55 (28.2–36.4)	.0537
BUN, mg/dL, n=196	19.5 (14–36)	25 (15.5–39.5)	.0454
Creatinine, mg/dL, n=196	0.93 (0.72–1.31)	1.155 (0.82–1.965)	.0057
Albumin, g/dL, n=177	3.6 (3.2–4.1)	3.4 (3–3.9)	.0977
SARS-CoV-2 detected, n (%), n=197	2 (1.6)	38 (43.2)	<.001
ICU admission during hospitalization, n (%)	18 (14.6)	14 (16.9)	.698
Hospital length of stay, median (IQR)	4 (3–7)	5.5 (3–9)	.0043
Hospital length of stay at/above median, n (%)	55 (44.72)	58 (65.9)	.002
Number of transfusion(s), median (IQR)	0 (0–2)	1 (0–3)	.0152
Any transfusions during admission, n (%)	53 (43.1)	52 (59.1)	.022
PPI received during admission, n (%)	101 (82.1)	85 (88.2)	.001
Endoscopy performed, n (%)	62 (50.4)	25 (28.4)	.001
Inpatient mortality, n (%)	11 (8.9)	9 (10.2)	.754

BUN, blood urea nitrogen; ICU, intensive care unit; INR, International Normalized Ratio; IQR, interquartile range; NSAID, nonsteroidal anti-inflammatory drug; PPI, proton pump inhibitor; PTT, partial thromboplastin time.

stay in the post-COVID time period (beta coefficient, 0.38; 95% CI, -0.70 to 1.46; $P = .489$).

After adjusting for age, sex, SARS-CoV-2 diagnosis, ICU admission, performance of endoscopy, and admission hemoglobin and platelet count, admission during the COVID-19 pandemic was significantly associated with receiving at least 1 transfusion (adjusted OR, 2.86; 95% CI, 1.25–6.55; $P = .013$) (Supplementary Table 2). Admission during the pandemic was also associated with decreased odds of receiving inpatient endoscopy after adjusting for age, sex, race/ethnicity, admission platelet count and creatinine, length of stay, transfusion requirement, receipt of a proton pump inhibitor, and SARS-CoV-2 status (adjusted OR, 0.32; 95% CI, 0.15–0.72; $P = .013$).

Discussion

This study aimed to characterize the impact of massive reorganization to hospital operations during the COVID-19 pandemic on outcomes for patients admitted with gastrointestinal bleeding at 2 hospitals in New York City. Patients

admitted with gastrointestinal bleeding during the pandemic presented with lower hemoglobin and platelet counts and higher international normalized ratio than those admitted before the pandemic. These laboratory differences persisted even when excluding patients with COVID-19 and may reflect patients' reluctance to present to the hospital during the pandemic or, perhaps, higher thresholds for hospital admission.

Patients admitted with gastrointestinal bleeding during the pandemic were 2.5 times more likely to have a length of stay ≥ 5 days, even after adjustment for SARS-CoV-2 infection, compared to patients admitted before the pandemic. We are likely underestimating length of stay in the COVID-19 cohort, because 14 patients were still admitted at the time of analysis compared to 0 patients in the pre-COVID-19 cohort. This would have a greater impact on our linear regression model than on our logistic regression model (evaluating short vs long hospitalization), because all patients had at least 5 days of follow-up. This may account for the difference in significance between the 2 models.

Patients admitted during the pandemic had a 2.86-fold higher odds of being transfused while hospitalized, even after adjustment for potential confounders such as admission hemoglobin and platelet counts. These patients also had significantly lower odds of undergoing an endoscopy relative to those admitted before the pandemic. The decrease in inpatient endoscopies, likely due to higher thresholds to perform aerosol-generating procedures, may have contributed to increased lengths of stay and transfusion requirements for these patients, given the lack of endoscopic evaluation.

Our study has limitations. Because it was a retrospective analysis, causal relationships between admission date and outcomes can only be hypothesized. There was also a short follow-up time for patients admitted during the COVID-19 pandemic, limiting our ability to measure readmissions for recurrent bleeding as an outcome.

This is the first study to evaluate the impact of the COVID-19 pandemic on gastrointestinal bleeding outcomes. Patients admitted during the pandemic, even those without COVID-19, had more concerning laboratory findings on admission, were less likely to undergo inpatient endoscopy, were more likely to receive transfusion, and had increased hospital length of stay. These findings suggest that adapting to the COVID-19 pandemic has downstream deleterious effects on gastrointestinal bleeding management.

Supplementary Material

Note: To access the supplementary material accompanying this article, visit the online version of *Gastroenterology* at www.gastrojournal.org, and at <https://doi.org/10.1053/j.gastro.2020.05.031>.

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Conflicts of interest

The authors disclose no conflicts.

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Supplementary Methods

Data Collection

Patients were included for analysis if they presented to the emergency department during the study period (February 1, 2020 through April 24, 2020) with symptoms of gastrointestinal bleeding, defined by melena, hematochezia, bright red blood per rectum, coffee ground emesis, hematochezia, or anemia likely due to gastrointestinal bleeding. Patients were also included if they had an inpatient gastrointestinal team consult for concern for gastrointestinal bleeding placed within 48 hours of their date of admission. Measured covariates included age, sex, race/ethnicity, home medications, SARS-CoV-2 status, laboratory values, inpatient proton pump inhibitor use, and admission to the intensive care unit. SARS-CoV-2 status was determined by real-time reverse-transcription polymerase chain reaction assay of nasopharyngeal swab specimens.

Statistical Analysis

Continuous variables were expressed as medians and interquartile ranges. Categorical variables were summarized as counts and percentages. Chi-squared or Fisher's exact

tests were used to compare categorical variables. The Mann-Whitney *U* test was used to compare nonnormally distributed continuous variables. On multivariable logistic regression models, variables with a *P* value of $>.2$ were removed by stepwise selection except for age, sex, and SARS-CoV-2 status, which we retained in the models a priori. An alpha of .05 was considered statistically significant. Statistical calculations were performed in STATA 16 (Stata Corp, College Station, TX).

Sensitivity Analysis

So as to further clarify whether length of stay or changes in laboratory values were being driven by SARS-CoV-2 positivity and to determine the downstream effect of the pandemic on uninfected patients with acute gastrointestinal bleeding, we repeated the multivariable logistic regression analysis for hospital length of stay, now excluding all patients who tested positive for SARS-CoV-2. In an additional sensitivity analysis, we generated a multivariable model, now using linear regression, treating hospital stay as a continuous outcome. There were 12 outlier patients admitted over 14 days who were treated as having a length of stay of 14 days for this model. For the 14 patients still admitted at the time of analysis, length of stay was defined as the current length of stay up to that point.

Supplementary Table 1. Multivariable Logistic Regression Model of Risk Factors Associated With Increased Length of Stay (≥ 5 Days)

Predictor	OR (95% CI)	<i>P</i> value
Age, y		
<60	1 (ref)	
60–69	0.89 (0.36–2.19)	.795
70–79	1.38 (0.56–3.41)	.487
≥ 80	1.18 (0.46–2.98)	.732
Sex		.829
Male	1 (ref)	
Female	0.93 (0.46–1.85)	
Hemoglobin on admission, g/dL		.006
≥ 12	1 (ref)	
<12	3.17 (1.40–7.04)	
Time period (after March 16, 2020)	2.46 (1.13–5.34)	.023
SARS-CoV-2 detected	2.30 (0.85–6.19)	.099
ICU admission during hospitalization	49.25 (6.13–395.06)	<.001
Endoscopy performed	2.52 (1.24–5.12)	.010

ICU, intensive care unit; ref, reference.

Supplementary Table 2. Multivariable Logistic Regression Model of Risk Factors Associated With Receiving Transfusions During Hospitalization

Predictor	OR (95% CI)	<i>P</i> value
Age, y		
<60	1 (ref)	
60–69	0.57 (0.22–1.47)	.248
70–79	1.56 (0.62–3.93)	.346
≥ 80	1.26 (0.47–3.36)	.644
Sex		.524
Male	1 (ref)	
Female	0.80 (0.41–1.58)	
Hemoglobin on admission, g/dL		<.001
≥ 12	1 (ref)	
<12	13.2 (4.95–35.1)	
Platelets on admission, count/ μ L		.023
$\geq 150,000$	1 (ref)	
<150,000	2.66 (1.15–6.16)	
Time period (after March 16, 2020)	2.86 (1.25–6.55)	.013
SARS-CoV-2 detected	0.65 (0.24–1.75)	.390
Endoscopy performed during hospitalization	2.66 (1.15–6.16)	.023
ICU admission during hospitalization	4.08 (1.40–11.92)	.010

ICU, intensive care unit; ref, reference.