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Outcomes for upper gastrointestinal bleeding during the first wave of the COVID-19 pandemic in the Toronto area

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Abstract

Background and Aim: Changes to endoscopy service availability during the COVID-19 pandemic may have affected management of upper gastrointestinal bleeding (UGIB). The aim of this study was to describe the impact of the pandemic on UGIB outcomes in the Toronto area in Canada.
Methods: We described all adults admitted to general medicine wards or intensive care units at six hospitals in Toronto and Mississauga, Canada, with UGIB during the first wave of the COVID-19 pandemic (March 1 to June 30, 2020) and compared them with a historical cohort (March 1 to June 30, 2018 and 2019). We compared clinical outcomes (in-hospital mortality, length of stay, 30-day readmission, intensive care utilization, receipt of endoscopy, persistent bleeding, receipt of second endoscopy, and need for angiographic or surgical intervention) using multivariable regression models, controlling for demographics, comorbidities, and severity of clinical presentation.
Results: There were 82.5 and 215.5 admissions per month for UGIB during the COVID-19 and control periods, respectively. There were no baseline differences between groups for demographic characteristics, comorbidities, or severity of bleeding. Patients in the COVID-19 group did not have significantly different unadjusted (3.9% vs 4.2%, P = 0.983) or adjusted mortality (adjusted odds ratio [OR] = 0.64, 95% confidence interval [CI] = 0.25–1.48, P = 0.322). Patients in COVID-19 group were less likely to receive endoscopy for UGIB in the unadjusted (61.8% vs 71.0%, P = 0.003) and adjusted (adjusted OR = 0.64, 95% CI = 0.49–0.84, $P < 0.01$) models. There were no differences between groups for other secondary outcomes.
Conclusions: While patients admitted for UGIB during the first wave of the pandemic were less likely to receive endoscopy, this had no impact on mortality or any secondary outcomes.

Introduction

The COVID-19 pandemic has required large-scale reorganization of hospital resources and procedures worldwide. While acute upper gastrointestinal bleeding (UGIB) remains a common emergency and carries high morbidity and mortality risk,[1–3] the pandemic has created unique challenges for management of UGIB.[4,5] The impact of the first wave of COVID-19 on UGIB care and outcomes is not well described.

As upper endoscopy is an aerosol-generating procedure,[6] several gastroenterology societies initially recommended reducing direct patient contact by inpatient services,[7] with many endoscopy units shutting down a large part of their operations.[8] Shortages of personal protective equipment may have also made physicians hesitant to perform endoscopy.[9] International studies have reported reductions in endoscopy volume during the initial stages of the pandemic.[10–14]

Endoscopic procedures performed during the pandemic have found higher than expected rates of gastrointestinal bleeding and malignancy,[15] suggesting that patients may have delayed or avoided presenting to hospital for medical issues.[16] To explore the impact of the COVID-19 pandemic on the characteristics and outcomes of patients with UGIB, we conducted a retrospective observational study across several tertiary care hospitals.

Methods

We conducted this retrospective cohort study of patients using data from six hospitals in the Greater Toronto Area in Canada (five academic hospitals in Toronto and one community-based teaching hospital in Mississauga) that participate in GEMINI.[17] In all of the included hospitals, patients with UGIB are routinely admitted

under the general internal medicine (GIM) service or to the intensive care unit (ICU).

Study population. The study population included patients over 18 years admitted with UGIB from March 1 to June 30, 2020 (approximating the timing of the first wave of the COVID-19 pandemic in Ontario), to a GIM ward or ICU from the emergency department. The historical control group included patients admitted with UGIB between March 1 to June 30, 2019, and March 1 to June 30, 2018. We identified cases of UGIB using the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision codes for the most responsible diagnosis identified in the emergency department.[18] The GEMINI database captured only patients who were admitted to or discharged from a GIM service. This captured all patients admitted with UGIB, but may have missed patients admitted with a different primary diagnosis who then developed UGIB in hospital and patients admitted for UGIB directly to ICU who either died in ICU or were transferred to a non-GIM service.

Data collection. We collected clinical and administrative data from hospital information systems through GEMINI.[19] GEMINI data have 98–100% accuracy compared with manual review of medical records.[19] We collected patient demographics, comorbidities, hospital resource use, provision of endoscopy, interventional radiology-guided or surgical treatment of bleeding, and outcomes including length of stay (LOS) and mortality as reported by the Canadian Institute for Health Information Discharge Abstract Database and the National Ambulatory Care Reporting System. We also collected data on etiology and severity of bleeding, vital signs, laboratory test results, blood transfusions, intensive care utilization, and persistent bleeding from hospital information systems.

Patient characteristics and severity of bleeding. We report patient age, sex, and prior comorbidities. We categorized comorbidities by identifying whether patients had underlying cirrhosis and their Charlson comorbidity index score.[20] To characterize the severity of the bleeding, we collected presenting heart rate, systolic blood pressure, and hemoglobin. We also calculated the pre-endoscopy Rockall score (RS), which is based on age, heart rate, blood pressure, and the presence of comorbidities with particular emphasis on renal failure, liver failure, and disseminated malignancy.[21] This ordinal scale provides a score of 0 (0.2% of pre-endoscopy mortality) to 7 (50% pre-endoscopy mortality).[21,22]

Outcomes. The primary outcome was in-hospital mortality. Secondary outcomes were hospital LOS, 30-day readmission, intensive care utilization, receipt of endoscopy, persistent bleeding, receipt of second endoscopy, and need for angiographic or surgical intervention. We defined persistent bleeding as a 20-g/L drop in hemoglobin or a 5% decrease in hematocrit in a 24-h time period, within 7 days following endoscopy. These modified criteria were adapted from consensus recommendations on UGIB trials[23] to allow for characterization of potentially persistent bleeding in the absence of data on clinical symptoms of melena and hematochezia.

Statistical analysis. We compared patient characteristics, presenting vitals, and severity of bleeding indices using standardized mean differences (SD), with SD of > 0.1 reflecting imbalance between groups.[24] We conducted unadjusted analyses to compare the COVID-19 and control groups with χ^2 tests and Student's *t*-tests (or Mann–Whitney *U*-tests) for categorical and continuous variables, respectively. We then used multivariable regression models to compare the primary and secondary outcomes, adjusting for age, sex, Charlson comorbidity index, underlying cirrhosis, etiology of bleeding (variceal *vs* non-variceal), pre-endoscopy RS, and presenting hospital. These variables were chosen a priori and are independently associated with prognosis in UGIB.[21,25,26] One site did not have reliable data on vital signs, and this site was thus removed in the adjusted models. In-hospital mortality, 30-day readmission, receipt of endoscopy, persistent bleeding, receipt of second endoscopy, and need for angiographic or surgical intervention were modeled using logistic regression, while hospital LOS was modeled using negative binomial regression.

Results

The cohort included 82.5 admissions per month for UGIB during the COVID-19 period (330 total UGIB admissions) and 215.5 admissions per month during the control period (862 total UGIB admissions). These represented 3.7% and 4.4% of all GIM patients admitted to these hospitals during the COVID-19 (1224 total GIM patients) and control (3810 total GIM patients) periods, respectively.

Patient characteristics. Patients during the COVID-19 period and control period had median ages of 70.0 (interquartile range [IQR] 56.0–82.0) and 70.0 (IQR 57.0–82.0), respectively. There were no differences between the COVID-19 group and the control group with respect to sex, Charlson index score of 2 or more, or pre-existing cirrhosis (Table 1). Severity and etiology did not differ significantly, with no differences in presenting mean hemoglobin level (in g/L), mean systolic blood pressure, presence of hypotension (systolic blood pressure of < 90 mmHg), mean heart rate, mean pre-endoscopy RS, and variceal bleeding (Table 1).

Mortality, length of stay, and readmission. For the primary outcome of in-hospital mortality, patients in the COVID-19 group did not have significantly different unadjusted (3.9% *vs* 4.2%, $P = 0.983$) or adjusted outcomes (adjusted odds ratio [OR] = 0.64, 95% confidence interval [CI] = 0.25–1.48, $P = 0.322$) compared with the control group (Tables 2,3). There was no difference between groups for hospital LOS (unadjusted median 3.76 days [IQR 2.17–6.40] *vs* 3.78 days [IQR 2.16–6.83], $P = 0.494$; adjusted rate ratio = 0.89, 95% CI = 0.79–1.01, $P = 0.062$) or 30-day readmission rates (unadjusted 13.5% *vs* 15.5%, $P = 0.454$; unadjusted OR = 1.04, 95% CI = 0.68–1.58).

Hospital resource utilization. Patients in the COVID-19 group, compared with the control group, were less likely to receive endoscopy for UGIB in the unadjusted (61.8% *vs* 71.0%, $P = 0.003$) and adjusted (adjusted OR = 0.64, 95% CI = 0.49–0.84, $P < 0.01$) models. Patients were less likely to

Table 1 Baseline characteristics

Characteristic	COVID-19 time period March 1 to July 31, 2020	Pre-COVID-19 time period March 1 to July 31, 2018 and 2019	*P*-value	SMD
Age, median [IQR]	70 [56, 82]	70 [57, 82]	0.533	0.036
Sex—male (%)	208 (63)	513 (60)	0.296	0.072
First Hb (g/L), mean (SD)	94.8 (32.8)	98.0 (31.8)	0.115	0.101
First SBP (mmHg), mean (SD)	127.3 (22.9)	125.2 (22.5)	0.203	0.092
First SBP < 90 mmHg (%)	< 5[†]	24 (3)	0.208	0.116
First heart rate (b.p.m.), mean (SD)	82 (15)	83 (18)	0.195	0.096
Cirrhosis (%)	46 (14.0)	105 (12.2)	0.472	0.052
Charlson index 2+ (%)	142 (43.0)	333 (38.6)	0.186	0.090
Variceal bleed (%)	28 (8.5)	61 (7.1)	0.481	0.053
Pre-endoscopy Rockall score, mean (SD)	1.9 (1.3)	2.0 (1.3)	0.386	0.063

[†]Cells with five or fewer observations are censored to reduce the risk of patient reidentification.
Hb, hemoglobin; IQR, interquartile range; SBP, systolic blood pressure; SD, standard deviation; SMD, standardized mean difference.

undergo a second endoscopy in the unadjusted (7.6% *vs* 12.1%, $P = 0.033$) but not in adjusted model (adjusted OR = 0.65, 95% CI = 0.39–1.05, $P = 0.087$), with no differences in persistent bleeding (unadjusted 10.0% *vs* 10.7% and adjusted OR 0.84, 95% CI = 0.51–1.36, $P = 0.496$).

There were no significant differences between groups in the unadjusted or adjusted models for the outcomes of intensive care utilization, intensive care LOS, red blood cell transfusion requirements, and need for angiographic or surgical intervention (Tables 2,3).

Discussion

We found no difference in mortality for patients admitted with UGIB during the first wave of the COVID-19 pandemic to six hospitals in the Greater Toronto Area in Canada, compared with a historical control group from 2018 and 2019. While patients admitted during the first wave were less likely to undergo endoscopy for their UGIB during their admission, they did not experience worse outcomes for mortality, LOS, readmission rate, persistent bleeding, intensive care utilization, transfusion requirements, or angiographic/surgical intervention.

Our findings are consistent with previous reports from New York City and Hong Kong with no change in mortality for UGIB during the pandemic.[27,28] Another recent report from the UK on UGIB during a COVID-19 wave found reduced 30-day survival in nine London teaching hospitals.[29] This study, however, was limited by only including patients who underwent endoscopy and thus does not represent all patients with UGIB who are admitted to hospital. As patients who underwent endoscopy during the pandemic were likely those with higher risk presentations, it is possible that the mortality difference found in the London study represents inherent differences between study groups.[29]

One notable finding was that there were fewer presentations per month for UGIB during the first wave of the pandemic compared with prior years, similar to previous studies in Xingtai City, New York City, London, and Hong Kong.[27–30] The percentage of patients with UGIB of all GIM and ICU admissions in our study was not meaningfully different between the COVID-19 and control groups. This supports the notion that patients with a variety of illnesses, including UGIB, avoided hospital presentation during the pandemic.[31,32] Our finding of patients admitted during the COVID-19 period being less likely to under endoscopy is also in keeping with prior reports.[28,30] We also found that patients in the study period were less likely to undergo second endoscopy in the unadjusted model. We did not, however, find this difference in the adjusted model, suggesting that the absolute difference was due to our *a priori* selected adjustment variables.

The strength of this study is the use of multivariate models and a comprehensive general medical database that captures variables

Table 2 Unadjusted clinical outcomes for patients admitted with UGIB during the COVID-19 and control time periods

Outcome	COVID-19 time period March 1 to July 31, 2020	Pre-COVID-19 time period March 1 to July 31, 2018 and 2019	*P*-value
In-hospital mortality (%)	13 (3.9)	36 (4.2)	0.983
Length of stay (days), median [IQR]	3.8 [2.2, 6.4]	3.8 [2.2, 6.8]	0.494
Admitted to ICU (%)	35 (10.6)	110 (12.8)	0.358
30-day readmission (%)	42 (13.5)	126 (15.5)	0.454
Received endoscopy (%)	204 (61.8)	612 (71.0)	0.003
Total units of blood transfused, median [IQR]	1.0 [0.0, 2.0]	0.0 [0.0, 2.0]	0.575
Persistent bleeding (%)	33 (10.0)	92 (10.7)	0.815
Received second endoscopy (%)	25 (7.6)	104 (12.1)	0.033
Angiographic/surgical intervention (%)	8 (2.4)	16 (1.9)	0.693

ICU, intensive care unit; IQR, interquartile range; UGIB, upper gastrointestinal bleeding.

Table 3 Clinical outcomes for patients with UGIB before and after multivariable adjustment[†]

Outcome	Unadjusted effect (95% CI)	Adjusted effect (95% CI)
In-hospital mortality	0.93 (0.47–1.75)	0.64 (0.25–1.48)
Length of stay (days)	0.86 (0.77–0.97)	0.89 (0.79–1.01)
Admitted to ICU	0.84 (0.55–1.25)	0.72 (0.42–1.20)
30-day readmission	0.89 (0.6–1.30)	1.04 (0.68–1.58)
Received endoscopy	0.66 (0.50–0.86)	0.64 (0.49–0.84)
Total units of blood transfused	1.03 (0.76–1.39)	1.2 (0.91–1.59)
Persistent bleeding	0.92 (0.60–1.39)	0.84 (0.51–1.36)
Received second endoscopy	0.62 (0.38–0.97)	0.65 (0.39–1.05)
Angiographic/surgical intervention	1.33 (0.53–3.08)	1.32 (0.45–3.51)

[†]Adjustment for age, sex, Charlson comorbidity index, underlying cirrhosis, etiology of bleeding (variceal *vs* non-variceal), pre-endoscopy RS, and presenting hospital.
CI, confidence interval; ICU, intensive care unit; RS, Rockall score; UGIB, upper gastrointestinal bleeding.

known to affect UGIB outcomes.[19] Additionally, we evaluated objective and clinically relevant outcomes such as mortality, LOS, and intensive care utilization. There are several limitations. First, we lacked granular data on interventions used during endoscopy. Second, we focused on large urban hospitals that may not represent the spectrum of health centers to which patients present with UGIB. Third, this study was retrospective, though data used for this study are collected and maintained in a rigorous and standardized manner. Finally, we did not capture the subset of patients who were admitted to ICU and died there or were transferred to a non-GIM service.

In the Greater Toronto Area, there was substantial restructuring of inpatient medical services and redeployment of healthcare workers to care for patients with COVID-19. While there was strain on resources and staffing that may have affected the ability to deliver patient care, the finding that survival from UGIB did not fall below the accepted 90% standard[33] during the first wave in our study hospitals is reassuring. UGIB outcomes should continually be assessed during the course of the pandemic to ensure that raising the threshold for inpatient endoscopy is being performed so safely.

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