LETTER TO THE EDITOR

Admission Characteristics and Mortality Risk Among Patients Hospitalized with COVID-19

To the Editor:

Studies are ongoing to improve our understanding of the factors predictive of adverse outcomes in coronavirus disease 2019 (COVID-19) patients. This may assist in appropriate triaging and allocation of resources as health care systems get repeatedly strained by surges of the pandemic. We have previously published our initial experience with the presenting characteristics and outcomes for patients admitted to the hospital with COVID-19. In the current study, institutional data on hospitalized COVID-19 patients were analyzed with regard to presenting characteristics that may be associated with mortality.

METHODS

A retrospective cohort study was performed, which included all patients who tested positive for severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) and were admitted to 1 of 8 hospitals of the Allegheny Health Network (1 quaternary, 4 tertiary, and 3 community hospitals) from March 1 to June 30, 2020. The study was exempt from institutional review board oversight.

Patients were characterized by demographics, comorbidities, and presenting characteristics. The primary outcome was inpatient mortality. Secondary outcomes included length of stay, inpatient complications (intensive care unit requirement, intubation, organ system failure), and discharge disposition. Categorical variables are described in percentages, and continuous variables as median with interquartile range (IQR). Stepwise multivariate regression analysis was used to identify the predictors of inpatient mortality and reported as odds ratios (ORs). A P value <0.05 was considered statistically significant. The analysis was performed using Stata version 15.1.

RESULTS

Data were available for 131 patients. The cohort had a median age of 61 (IQR, 51–70) years, and was predominantly male (64.4%) and non-Hispanic White (67.2%), with a median Charlson comorbidity index of 1 (IQR, 0–1). The baseline characteristics are outlined in Table 1.

Overall mortality was 16.0%, and overall median length of stay was 6 (IQR, 3–13) days. Complication rate ranged from 3% to 45% including respiratory complications such as acute respiratory distress syndrome (34; 26.0%) and mechanical ventilation (38; 29.0%), shock (30; 32.3%), coagulopathy (16; 12.2%), renal failure requiring dialysis (5; 3.8%), and cardiac arrest (4; 3%). A majority of patients (73; 55.7%) were able to be discharged home, whereas 31 (23.7%) were discharged to a skilled nursing facility or long-term acute care. Twenty-nine patients (26.4%) required oxygen at discharge.

On multivariate regression analysis, Charlson comorbidity index (OR, 1.6; 95% confidence interval [CI], 1.1–2.2; P = 0.01), presentation with tachypnea (OR, 13.9; 95% CI, 1.4–133.7; P = 0.02), hypoxia (OR, 6.2; 95% CI, 1.3–30.7; P = 0.03), and lymphopenia (OR, 5.2; 95% CI, 1.3–20.1; P = 0.02) were all independently associated with mortality.

DISCUSSION

Our findings reaffirm that COVID-19 requiring hospitalization is a serious illness with high mortality and complication rates. It

TABLE 1. Patient Characteristics for Patients Admitted With COVID-19 (n = 131)

| Characteristics | Value* |
|-----------------|--------|
| Age, y          | 61 (51–70) |
| Sex             |        |
| Female          | 48 (36.6%) |
| Male            | 83 (64.4%) |
| Race            |        |
| Non-Hispanic White | 88 (67.2%) |
| Non-Hispanic Black | 28 (21.4%) |
| Hispanic        | 4 (3.1%) |
| Other/unknown   | 11 (8.4%) |
| Smoking         |        |
| Current smoker  | 44 (33.9%) |
| Comorbidities   |        |
| Cardiovascular  | 90 (68.7%) |
| Obesity (BMI >30 kg/m²) | 69 (52.7%) |
| Diabetes        | 43 (32.8%) |
| Pulmonary       | 33 (25.2%) |
| Renal           | 16 (12.2%) |
| Other           | 48 (36.6%) |
| CCI             | 113 (86.3%) |

Symptoms

- Temperature >38°C
- Heart rate >100 beats/min
- Respiratory rate >20 breaths/min
- Systolic blood pressure <90 mm Hg
- Hypoxia at presentation (including those who required oxygen in the ED)
- Abnormal imaging (CXR or chest CT)
- Abnormal laboratory findings
- AST/ALT >40 U/L (n = 94)
- Absolute lymphocyte count <0.60 k/μL (n = 124)
- Procalcitonin (n = 92), ng/mL
- 0.15 (0.09–0.32)
- Other laboratory findings
- White blood cell count, k/μL
- 6.72 (5.26–8.89)
- Creatinine, mg/dL
- 1.05 (0.78–1.46)
- C-reactive protein (n = 39), mg/dL
- 12.7 (6.3–36.1)
- Ferritin (n = 59), mg/dL
- 615 (242–1075)
- D-dimer (n = 64), mg/mL
- 1.86 (0.88–11.35)
- Lactate dehydrogenase (n = 60), U/L
- 452.5 (308.5–654.5)
- Probrain natriuretic peptide (n = 50), pg/mL
- 349.5 (53–2106)
- Treatment received
- HCQ
- 61 (46.6%)
- Empiric antibiotics
- 92 (70.2%)
- Steroids
- 30 (22.9%)

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seems that respiratory involvement at the time of initial presentation may be predictive of severe COVID and associated with an increased risk of mortality.

A similar study from China that included 140 hospitalized COVID-19 patients with an associated mortality rate of 25.7% also demonstrated that hypoxemia and dyspnea at presentation correlated with mortality, with hazard ratios of 47.4 and 3.2, respectively, in multivariate analysis.\(^2\) In the current study, we decided to use tachypnea rather than dyspnea as an indicator of respiratory distress, given its objectivity. In addition to respiratory distress, several laboratory parameters reflecting organ dysfunction at admission and presence of cardiometabolic comorbidities have been associated with mortality risk in meta-analyses.\(^3\) \(^4\) In our study, lymphopenia was the only marker significantly associated with increased mortality risk, although this could be a reflection of other biomarkers not being consistently obtained at admission, as is reflected in Table 1. Therefore, although the significance of lymphopenia as a predictive marker is an important finding, the lack of association with other biomarkers could represent false-negative results and warrants further investigation. It is interesting that in the present study, it was the cumulative comorbidity burden as reflected by the comorbidity index, rather than individual comorbidities that were associated with increased mortality.

Ultimately, the purpose of studies such as ours is to risk stratify patients being admitted to the hospitals for appropriate allocation of resources. Computational models such as the Mount Sinai Hospital prediction model are being developed precisely for this purpose and being validated prospectively.\(^5\) Limitations of the present study include its retrospective nature and that the long-term outcomes were not captured. Variations may also exist owing to practice and population patterns because the included data represented 8 different hospitals, ranging from urban academic to rural community hospitals.

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### TABLE 1. (Continued)

| Characteristics                      | Value* |
|--------------------------------------|--------|
| Convalescent serum                   | 20 (15.3%) |
| Remdesivir                           | 5 (3.9%) |
| Tocilizumab                           | 5 (3.9%) |
| Plasmapheresis                        | 4 (3.1%) |
| Lopinavir/ritonavir                   | 1 (0.7%) |
| Intravenous immunoglobulin           | 1 (0.7%) |

*Continuous variables are reported as median (IQR) and categorical variables as frequency (percentage).

ALT indicates alanine aminotransferase; AST, aspartate aminotransferase; BMI, body mass index; CCI, Charlson comorbidity index; CT, computed tomography; CXR, chest x-ray; ED, emergency department; HCQ, hydroxychloroquine.