RESEARCH LETTER

Intracerebral Hemorrhage in Patients With COVID-19
An Analysis From the COVID-19 Cardiovascular Disease Registry

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Spontaneous intracerebral hemorrhage (ICH) is a devastating consequence of coronavirus disease 2019 (COVID-19) infection. Prior single-center studies have reported ICH in patients with COVID-19, but these findings have not been confirmed in a multicenter study.

We sought to describe the prevalence of ICH among hospitalized patients with COVID-19 in the American Heart Association COVID-19 Cardiovascular Disease registry and compare the clinical characteristics and outcomes of COVID-19 patients with and without ICH.

METHODS

Data are available from the American Heart Association after approval of a research proposal (www.heart.org/qualityresearch). We performed a retrospective, cross-sectional analysis of patients enrolled in the American Heart Association COVID-19 Cardiovascular Disease registry. This registry includes consecutive patients ≥18 years old hospitalized with COVID-19 from March 2020 to December 2020 at 107 US hospitals. Patients were enrolled without consent through the Common Rule or through an institutional review board authorization/exemption waiver. Presence of ICH was recorded on the registry case report form. Mortality was defined as either in-hospital death or discharge to hospice. We report descriptive statistics of those with and without ICH. Statistical comparisons were not performed due to the small number of patients with ICH.

RESULTS

This release of the COVID-19 registry included 21,483 patients, of which 48 (0.2%) had an ICH. COVID-19 was diagnosed before ICH in 26 patients, on the same day as ICH in 10 patients, and during hospitalization for ICH in 6 patients. Compared with patients without ICH, those with ICH were nominally older (65 versus 61 years), predominantly male (73% versus 54%), and had more vascular risk factors (Table).

During hospitalization, 75% of patients with ICH received anticoagulation compared with 57% of patients without ICH. Patients with ICH had higher levels of inflammatory markers at admission; were more likely to require intensive care (90% versus 30%), mechanical ventilation (77% versus 19%), and extracorporeal membranous oxygenation (4% versus 0.6%); and had a higher mortality (48% versus 18%) than those without ICH (Table). Of the patients with ICH who died, 15 were diagnosed with COVID-19 before ICH.

DISCUSSION

We report characteristics of ICH in over 21,000 hospitalized patients with COVID-19 from the American Heart Association COVID-19 Cardiovascular Disease registry. We found that ICH was rare among hospitalized patients with COVID-19 and that patients with ICH had higher mortality than those without ICH. We also observed greater

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## Table. Clinical Characteristics of COVID-19 Positive Patients With and Without ICH

| Baseline characteristics | Patients without ICH (N=21483) | Patients with ICH (N=48) |
|--------------------------|----------------------------------|-------------------------|
| **Patient demographics** |                                  |                         |
| Age, y, mean±SD          | 61.2±17.9                        | 64.8±12.7               |
| 18–45 y                  | 4368/21 483 (20.3%)              | 4/48 (8.3%)             |
| 46–64 y                  | 7372/21 483 (34.3%)              | 14/48 (29.2%)           |
| 65+                      | 9742/21 483 (45.4%)              | 30/48 (62.5%)           |
| Female sex, %            | 9871/21 483 (45.9%)              | 13/48 (27.0%)           |
| **Race/ethnicity, %**    |                                  |                         |
| Non-Hispanic White       | 8184/21 483 (38.1%)              | 19/48 (39.6%)           |
| Non-Hispanic Black       | 5522/21 483 (25.7%)              | 10/48 (20.8%)           |
| Hispanic                 | 5466/21 483 (25.4%)              | 12/48 (25%)             |
| Asian                    | 854/21 483 (4.0%)                | 4/48 (8.3%)             |
| Other/undetermined        | 1351/21 483 (6.2%)               | 3/48 (6.3%)             |
| **Medical history, %**   |                                  |                         |
| Atrial fibrillation/flutter | 1997/21 483 (9.3%)             | 5/48 (10.4%)            |
| Previous stroke/TIA      | 2437/21 483 (11.3%)              | 5/48 (10.4%)            |
| CAD/prior MI             | 1195/21 483 (5.5%)               | 4/48 (8.3%)             |
| Diabetes mellitus        | 7591/21 483 (35.3%)              | 23/48 (47.9%)           |
| Hypertension             | 12640/21 483 (56.9%)             | 35/48 (72.9%)           |
| Smoker                   | 1408/21 483 (6.5%)               | 1/48 (2.1%)             |
| Dyslipidemia             | 7402/21 483 (34.4%)              | 22/48 (45.8%)           |
| Heart failure            | 2498/21 483 (11.6%)              | 4/48 (8.3%)             |
| Pulmonary disease        | 4012/21 483 (16.7%)              | 4/48 (8.3%)             |
| Chronic kidney disease   | 2778/21 483 (12.9%)              | 6/48 (12.5%)            |
| **Medications before admission, %** |                      |                         |
| Antihypertensive         | 11 119/21 483 (52.8%)           | 29/48 (63.0%)           |
| Antiplalet               | 5804/21 483 (27.1%)              | 15/48 (31.2%)           |
| Anticoagulant            | 2957/21 483 (14.1%)              | 7/48 (15.2%)            |
| Statin                   | 7773/8035 (96.7%)                | 21/26 (95.4%)           |
| **COVID-19 diagnosis, %** |                                  |                         |
| Before admission         | 7330/21 428 (34.2%)              | 17/48 (35.4%)           |
| During admission         | 13665/21 428 (63.8%)             | 30/48 (62.5%)           |
| After admission          | 341/21 428 (1.6%)                | 0/48                    |
| Unknown                  | 92/21 428 (0.4%)                 | 1/48 (2.1%)             |
| **Presenting symptoms, %** |                                  |                         |
| Fever                    | 11 844/21 297 (55.6%)           | 23/48 (47.9%)           |
| Cough/shortness of breath | 11 951/21 297 (56.1%)           | 24/48 (50%)             |
| Headache                 | 2013/21 297 (9.5%)               | 7/48 (14.6%)            |
| Nausea/vomiting          | 5812/21 297 (27.3%)              | 10/48 (20.8%)           |
| Loss of smell/taste      | 983/21 297 (4.6%)                | 1/48 (2.1%)             |
| Altered mental status    | 2217/21 297 (10.4%)              | 8/48 (16.7%)            |
| Hospital course, %       |                                  |                         |
| ICU care                 | 6562/21 382 (30.7%)              | 43/48 (89.6%)           |
| Mechanical ventilation   | 4115/21 378 (19.2%)              | 37/48 (77.1%)           |
| ECMO                     | 131/21 368 (0.6%)                | 2/48 (4.2%)             |
| **Admission labs, median (IQR)** |                        |                         |
| Hemoglobin, g/dL         | 13.0 (11.4–14.3)                | 13.3 (10.9–14.1)        |

(Continued)
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