Quality; she received funding from the Anesthesia Patient Safety Foundation; she disclosed that she is on the Board of Directors for the Foundation for Anesthesia Education and Research and has received speaking honoraria from multiple nonprofit academic medical centers. Dr. Murphy has disclosed that he does not have any potential conflicts of interest.

REFERENCES

1. Vollam S, Gustafson O, Morgan L, et al: Patient Harm and Institutional Avoidability of Out-of-Hours Discharge From Intensive Care: An Analysis Using Mixed Methods. *Crit Care Med* 2022; 50:1083–1092
2. van Sluisveld N, Hesselink G, van der Hoeven JG, et al: Improving clinical handover between intensive care unit and general ward professionals at intensive care unit discharge. *Intensive Care Med* 2015; 41:589–604
3. Goldfrad C, Rowan K: Consequences of discharges from intensive care at night. *Lancet* 2000; 355:1138–1142
4. Vollam S, Gustafson O, Young JD, et al: Problems in care and avoidability of death after discharge from intensive care: A multi-centre retrospective case record review study. *Crit Care* 2021; 25:10
5. Palinkas LA, Aarons GA, Horwitz S, et al: Mixed method designs in implementation research. *Adm Policy Ment Health* 2011; 38:44–53
6. Murphy DJ, Pronovost PJ, Lehmann CU, et al: Red blood cell transfusion practices in two surgical intensive care units: A mixed methods assessment of barriers to evidence-based practice. *Transfusion* 2014; 54(10 Pt 2):2658-2667
7. Lane-Fall MB, Pascual JL, Massa S, et al: Developing a standard handoff process for operating room-to-ICU transitions: Multidisciplinary clinician perspectives from the Handoffs and Transitions in Critical Care (HATRICC) study. *Jt Comm J Qual Patient Saf* 2018; 44:514–525
8. Centofanti JE, Duan EH, Hoad NC, et al: Use of a daily goals checklist for morning ICU rounds: A mixed-methods study. *Crit Care Med* 2014; 42:1797–1803
9. Ervin JN, Kahn JM, Cohen TR, et al: Teamwork in the intensive care unit. *Am Psychol* 2018; 73:468–477
10. Barr J, Paulson SS, Kamdar B, et al: The coming of age of implementation science and research in critical care medicine. *Crit Care Med* 2021; 49:1254–1275
11. Gershengorn HB, Kocher R, Factor P: Management strategies to effect change in intensive care units: Lessons from the world of business. Part II. Quality-improvement strategies. *Ann Am Thorac Soc* 2014; 11:444–453
12. Wensing M, Wollersheim H, Grol R: Organizational interventions to implement improvements in patient care: A structured review of reviews. *Implement Sci* 2006; 1:2
13. Murphy DJ, Ogbu OC, Coopersmith CM: ICU director data: Using data to assess value, inform local change, and relate to the external world. *Chest* 2015; 147:1168–1178
14. Starmer AJ, Spector ND, Srivastava R, et al; I-PASS Study Group: Changes in medical errors after implementation of a handoff program. *N Engl J Med* 2014; 371: 1803–1812
15. Gerry S, Bonnici T, Birks J, et al: Early warning scores for detecting deterioration in adult hospital patients: Systematic review and critical appraisal of methodology. *BMJ* 2020; 369:m1501
16. Thompson D, Holzmueller C, Hunt D, et al: A morning briefing: setting the stage for a clinically and operationally good day. *Jt Comm J Qual Patient Saf* 2005; 31:476–479

Can Early Electroencephalography Findings Predict Survival and Functional Outcome in Patients With Severe COVID-19 Infection?*

KEY WORDS: acute respiratory distress syndrome; COVID-19; electroencephalography; encephalopathy; mortality

Adriana Bermeo-Ovalle, MD[1]
Andrew M. Naidech, MD, MSPH[2,3]

COVID-19 has affected nearly half a billion people globally and is responsible for over 5 million deaths, approximately 1 million of whom are in the United States (1). Although vaccination has resulted in reduced mortality rates and severity of disease (2), COVID infections and their consequences for patients will continue. Although COVID-19 is primarily a respiratory disease, neurologic symptoms are frequent (3). Anosmia, ageusia (3), dizziness, headache, myalgias (4), cerebrovascular ischemia, and encephalitis

***See also p. 1103.**

DOI: 10.1097/CCM.0000000000005537

have been reported (3). However, the most appropriate methods for acute neurologic monitoring for COVID-19 in critically ill patients remain unsettled.

Electroencephalography (EEG) monitoring presents challenges in patients with COVID-19. The placement of EEG leads requires close contact from technologists, modification of protocols, and potential changes in the interpretation of the study (5). Clinical seizures are typically seen in patients with history of epilepsy in the context of viral febrile illness, dehydration, hypoxemia, hypercapnia, or fever during acute COVID-19 infection (6). Critically ill patients frequently have subclinical seizures seen only on EEG, which result in delayed neurologic recovery and worse functional outcomes (7). Subclinical seizures may also occur as a complication (8). Hence, continuous video EEG monitoring is helpful (9, 10). Patients with COVID-19 often have unusual and abnormal EEG findings, such as sporadic epileptiform discharges (11), abnormal background activity, or slowing. The severity of the EEG abnormalities often reflects the severity of the illness in general (12, 13). How best to interpret EEG data in patients with COVID-19 is unclear, particularly to anticipate crucial events: awakening, delirium, and mortality.

In this issue of *Critical Care Medicine*, Benghanem et al (14) prospectively assessed EEG in patients with respiratory failure in the setting of COVID-19. EEG and structured clinical assessments were obtained within the first 12–72 hours, when paralytics were first stopped (T1) and 4–7 days after sedation was discontinued (T2) at two university hospitals. Poor reactivity of the EEG and discontinuous background in early EEGs were predictive of a longer need for mechanical ventilation, longer time comatose, more delirium, and higher mortality (41% vs 11% for poor reactivity and 40% vs 4% for discontinuity) at 28 days. The authors reasonably attempt to control for confounders, such as sedation, neuromuscular blockers, and analgesia following a standardized protocol at the institutions. It is a commendable effort for a challenging population to study. These results suggest that EEG has a promising role in anticipating complications and outcomes in patients with COVID-19, even in the setting of severe illness that can potentially confound EEG interpretation.

COVID-19 seems unlikely to be vanquished. It seems more likely to become another of the common viral causes of critical illness that leads to multisystem illness and multiple complications. The EEG abnormalities described may be helpful to explain some of the varied consequences of COVID-19 in survivors (15). A variety of neuropsychologic symptoms (e.g., reduced cognitive function) may be ascribed to both delirium (16) and COVID-19, yet their relative contribution is unclear. The descriptions of EEG abnormalities are not specific, and future work might define abnormalities that are pathognomonic, lead to specific future events, or be recognizable by artificial intelligence algorithms. COVID-19 is becoming another endemic disease that requires neuromonitoring, anticipating complications, and prognosticating for loved ones of critically ill patients. For better or worse, COVID-19 is a part of the landscape for multiple specialties of critical care.

1 *Department of Neurological Sciences, Rush University Medical Center, Chicago, IL*

2 *Department of Neurology, Northwestern University, Feinberg School of Medicine, Chicago, IL*

3 *Northwestern Memorial Healthcare, Evanston, IL*

Dr. Bermeo-Ovalle disclosed that she is a Board of Directors member for the American Board of Clinical Neurophysiology. Dr. Naidech's institution received funding from the National Institutes of Health (NIH) (R01 NS110772) and (U01 NS110779); he received funding from Society of Critical Care Medicine for the annual board review course; he received support for article research from the NIH.

REFERENCES

1. Johns Hopkins University of Medicine Coronavirus Resource Center: COVID-19 dashboard. Available at: https://coronavirus.jhu.edu/map.html. Accessed January 30, 2022
2. Haas EJ, Angulo FJ, McLaughlin JM, et al: Impact and effectiveness of mRNA BNT162b2 vaccine against SARS-CoV-2 infections and COVID-19 cases, hospitalisations, and deaths following a nationwide vaccination campaign in Israel: An observational study using national surveillance data. *Lancet* 2021; 397:1819–1829
3. Roy D, Ghosh R, Dubey S, et al: Neurological and neuropsychiatric impacts of COVID-19 pandemic. *Can J Neurol Sci* 2021; 48:9–24
4. Collantes MEV, Espiritu AI, Sy MCC, et al: Neurological manifestations in COVID-19 infection: A systematic review and meta-analysis. *Can J Neurol Sci* 2021; 48:66–76
5. Gélisse P, Rossetti AO, Genton P, et al: How to carry out and interpret EEG recordings in COVID-19 patients in ICU? *Clin Neurophysiol* 2020; 131:2023–2031
6. Elgamasy S, Kamel MG, Ghozy S, et al: First case of focal epilepsy associated with SARS-coronavirus-2. *J Med Virol* 2020; 92:2238–2242

7. Claassen J, Mayer SA, Kowalski RG, et al: Detection of electrographic seizures with continuous EEG monitoring in critically ill patients. *Neurology* 2004; 62:1743–1748
8. Hepburn M, Mullaguri N, George P, et al: Acute symptomatic seizures in critically ill patients with COVID-19: Is there an association? *Neurocrit Care* 2021; 34:139–143
9. Claassen J, Taccone FS, Horn P, et al; Neurointensive Care Section of the European Society of Intensive Care Medicine: Recommendations on the use of EEG monitoring in critically ill patients: Consensus statement from the neurointensive care section of the ESICM. *Intensive Care Med* 2013; 39:1337–1351
10. Herman ST, Abend NS, Bleck TP, et al; Critical Care Continuous EEG Task Force of the American Clinical Neurophysiology Society: Consensus statement on continuous EEG in critically ill adults and children, part I: Indications. *J Clin Neurophysiol* 2015; 32:87–95
11. Galanopoulou AS, Ferastraoaru V, Correa DJ, et al. EEG findings in acutely ill patients investigated for SARS-CoV-2/COVID-19: A small case series preliminary report. *Epilepsia Open* 2020;5:314–324
12. Kubota T, Gajera PK, Kuroda N: Meta-analysis of EEG findings in patients with COVID-19. *Epilepsy Behav* 2021; 115:107682
13. Antony AR, Haneef Z: Systematic review of EEG findings in 617 patients diagnosed with COVID-19. *Seizure* 2020; 83:234–241
14. Benghanem S, Cariou A, Diehl J-L, et al: Early Clinical and Electrophysiological Brain Dysfunction Is Associated With ICU Outcomes in COVID-19 Critically Ill Patients With ARDS: A Prospective Bicentric Observational Study. *Crit Care Med* 2022; 50:1103–1115
15. Graham EL, Clark JR, Orban ZS, et al: Persistent neurologic symptoms and cognitive dysfunction in non-hospitalized Covid-19 "long haulers". *Ann Clin Transl Neurol* 2021; 8:1073–1085
16. Patel MB, Bednarik J, Lee P, et al: Delirium monitoring in neurocritically ill patients: A systematic review. *Crit Care Med* 2018; 46:1832–1841

Should We Intubate Pediatric Hematopoietic Cell Transplant Patients With Respiratory Failure Sooner?*

KEY WORDS: hematopoietic cell transplant; noninvasive ventilation; pediatrics; respiratory failure

Caitlin Hurley, MD[1]
Matt S. Zinter, MD[2]

Respiratory failure in immunocompromised children is associated with mortality rates of 25–30%, with mortality exceeding 50% in hematopoietic cell transplant (HCT) patients with acute respiratory distress syndrome (1–6). The advancement of respiratory support modalities, notably high-flow nasal cannula (HFNC) and noninvasive positive-pressure ventilation (NIPPV), has transformed the care of children with respiratory failure, often resulting in a stepwise escalation across interfaces prior to endotracheal intubation and invasive mechanical ventilation (IMV) (7–9). For some patients, HFNC and NIPPV can offer adequate support without the need for sedation and invasive procedures. In contrast, IMV offers more advanced support but frequently requires sedation and carries a risk of procedural complications. Approximately 15–23% of children using HFNC or NIPPV ultimately require IMV; for HCT patients, this number may exceed 60%, likely due to a greater propensity for severe respiratory disease (5).

Therefore, it remains a complex and daily question for bedside physicians treating patients with respiratory failure to determine who should receive upfront NIPPV support and for how long before escalating to IMV. Many factors affect this decision, including illness severity, anticipated illness trajectory, comorbidities, and patient goals of care. Recent data in the pediatric HCT

***See also p. 1127.**

DOI: 10.1097/CCM.0000000000005548