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Neurocritical Care: Advancements, Monitoring, Treatment, Global Equity

Michael T. Nguyen*

Department of Neurology, University of California, San Francisco (UCSF), San Francisco, CA, USA

Introduction

Neurocritical care, a critical and rapidly evolving specialty, focuses on complex neurological emergencies. Advancements in diagnostic tools, monitoring techniques, and therapeutic strategies are continuously shaping how clinicians manage severe brain injuries and neurological diseases. This body of work highlights several key areas of progress and ongoing challenges in the field.

Crucial role of continuous electroencephalography (cEEG) monitoring in managing status epilepticus, especially in the neurocritical care setting. cEEG helps detect nonconvulsive seizures and status epilepticus, guiding treatment escalation and improving patient outcomes. Tailoring cEEG use to individual patient needs and clinical context [1].

Updated guidelines for severe traumatic brain injury (TBI) specifically refining physiological thresholds. This re-evaluation of blood pressure, oxygenation, and hypothermia targets aims to improve patient management and outcomes based on the latest evidence. It provides a clearer roadmap for clinicians in the acute phase of TBI [2].

Novel insights into delayed cerebral ischemia (DCI) following subarachnoid hemorrhage (SAH), a critical complication in neurocritical care. The discussion highlights advanced diagnostic tools and emerging therapeutic strategies, moving beyond traditional vasospasm-focused approaches to consider microcirculatory dysfunction and cortical spreading depolarization as key players in DCI pathogenesis. Addressing this devastating complication is key [3].

The management of acute ischemic stroke within the neurocritical care unit. It covers everything from initial resuscitation and reperfusion therapies to advanced neuromonitoring and secondary prevention strategies. The need for rapid, coordinated care to optimize outcomes for these complex patients, emphasizing personalized approaches [4].

An in-depth overview of intracerebral hemorrhage (ICH), from its underlying pathology to current management strategies and future research directions. It highlights the dynamic nature of ICH, including hematoma expansion and edema, and discusses various interventions aimed at minimizing secondary brain injury. Improving outcomes for a condition with high morbidity and mortality [5].

Multimodal neuromonitoring in neurocritical care is examined, questioning if it's standard practice or evolving. While various monitoring techniques exist (like ICP, cEEG, brain tissue oxygen), effectively integrating them to guide clinical decisions remains challenging. Finding the right balance of information to personalize patient care is key [6].

Crucial insights into neurological prognostication after cardiac arrest, a particularly challenging aspect of neurocritical care. The authors discuss the latest evidence on multimodal prognostication, integrating clinical examination, neurophysiology, imaging, and biomarkers. Avoiding premature prognostication and recognizing the potential for late neurological recovery, aiming for a more nuanced and accurate assessment of patient outcomes [7].

Delirium in the neurocritical care unit is updated, covering its pathophysiology, diagnosis, and treatment. Recognizing delirium as acute brain dysfunction, not just a behavioral disturbance, is important. The article pushes for early detection, identification of reversible causes, and tailored non-pharmacological and pharmacological interventions to improve patient comfort and long-term outcomes [8].

Critical illness polyneuropathy and myopathy (CIP/CIM) are examined as common, debilitating ICU complications. The authors synthesize evidence on risk factors, diagnostic approaches, and potential preventive and therapeutic strategies. The impact of these conditions on long-term functional recovery, underscoring the need for early recognition and rehabilitative interventions in neurocritical care [9].

A compelling call for action addresses global neurocritical care, highlighting disparities in resources, training, and access worldwide. The authors argue for collaborative efforts to standardize care, expand education, and develop sustainable models to improve outcomes for neurologically critically ill patients in low- and middle-income countries. Ensuring equitable care is essential [10].

Together, these studies highlight the dynamic landscape of neurocritical care, underscoring continuous efforts to refine diagnostic strategies, enhance therapeutic interventions, and address systemic challenges to improve patient outcomes globally.

Description

Neurocritical care continually integrates advanced monitoring techniques to enhance patient management. Continuous electroencephalography (cEEG) is essential for detecting nonconvulsive seizures and status epilepticus, which guides timely treatment escalation and significantly improves patient outcomes [1]. In a related effort to refine care, updated guidelines for severe traumatic brain injury (TBI) have been introduced. These guidelines establish new physiological thresholds for blood pressure, oxygenation, and hypothermia, providing a clearer roadmap for clinicians in the acute phase of TBI based on the latest evidence [2]. These foundational elements emphasize precision and responsiveness in managing neurological crises.

The field also focuses intensely on understanding and mitigating the impact of specific, often devastating, neurological conditions. Novel insights into delayed cerebral ischemia (DCI) following subarachnoid hemorrhage (SAH) are moving beyond traditional vasospasm-focused approaches. Researchers now consider microcirculatory dysfunction and cortical spreading depolarization as key players in DCI pathogenesis. This shift allows for more targeted diagnostic tools and emerging therapeutic strategies [3]. Similarly, comprehensive management of acute ischemic stroke within the neurocritical care unit highlights the critical need for rapid, coordinated care. This encompasses initial resuscitation, reperfusion therapies, advanced neuromonitoring, and secondary prevention strategies to optimize patient outcomes [4]. Another significant challenge is intracerebral hemorrhage (ICH), which demands an in-depth understanding of its underlying pathology and dynamic nature, including hematoma expansion and edema, to effectively implement interventions aimed at minimizing secondary brain injury and improving survival for a condition with high morbidity and mortality [5].

Despite technological advancements, the effective integration of various monitoring techniques remains an ongoing challenge. Multimodal neuromonitoring, which includes tools like intracranial pressure (ICP), cEEG, and brain tissue oxygen, is still evolving rather than being a universally standardized practice. The goal is to integrate these tools effectively to guide clinical decisions without overwhelming clinicians, ultimately personalizing patient care [6]. Beyond the primary injury, secondary complications significantly impact patient recovery and long-term outcomes. Delirium, often mistakenly seen as merely a behavioral disturbance, is now recognized as a distinct marker of acute brain dysfunction in the neurocritical care unit. Its management requires early detection, identification of reversible causes, and tailored non-pharmacological and pharmacological interventions to improve patient comfort and long-term outcomes [8]. Moreover, critical illness polyneuropathy and myopathy (CIP/CIM) are common and debilitating complications for Intensive Care Unit (ICU) patients. A systematic review underscores their profound impact on long-term functional recovery, highlighting the need for early recognition and rehabilitative interventions in neurocritical care settings [9].

Accurate neurological prognostication after cardiac arrest remains a particularly challenging aspect of neurocritical care. Multimodal prognostication, which integrates clinical examination, neurophysiology, imaging, and biomarkers, is crucial. This approach emphasizes avoiding premature prognostication and recognizing the potential for late neurological recovery to ensure a more nuanced and accurate assessment of patient outcomes [7]. On a broader, systemic scale, there is a compelling call for action regarding global neurocritical care. This addresses significant disparities worldwide in resources, training, and access to specialized care. Collaborative efforts are essential to standardize care, expand education, and develop sustainable models, especially in low- and middle-income countries, to ensure equitable and improved outcomes for neurologically critically ill patients globally [10]. These collective efforts signify a commitment to advancing the entire field of neurocritical care, both locally and internationally.

Conclusion

Neurocritical care constantly advances, integrating new monitoring and refined treatment protocols for severe neurological conditions. Continuous electroencephalography (cEEG) detects nonconvulsive seizures and status epilepticus, guiding treatment and improving outcomes. Updated guidelines for severe traumatic brain injury (TBI) refine physiological thresholds, providing clearer clinical roadmaps. Research explores novel insights into delayed cerebral ischemia (DCI) after subarachnoid hemorrhage (SAH), considering microcirculatory dysfunction beyond vasospasm. Comprehensive reviews highlight rapid, coordinated care for acute ischemic stroke and an in-depth understanding of intracerebral hemorrhage (ICH) to minimize secondary brain injury. Multimodal neuromonitoring, while offering various techniques, faces challenges in effective integration for personalized patient care. Neurological prognostication after cardiac arrest emphasizes multimodal approaches and avoiding premature assessment. Delirium, identified as acute brain dysfunction, requires early detection and tailored interventions. Critical illness polyneuropathy and myopathy (CIP/CIM) are recognized as debilitating complications requiring early rehabilitation. Ultimately, a compelling call for global action addresses disparities in neurocritical care resources, training, and access, striving for equitable, standardized, and sustainable care worldwide.

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Conflict of Interest

None.

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Address for Correspondence: Michael, T. Nguyen, Department of Neurology, University of California, *San Francisco* (UCSF), San Francisco, CA, USA, E-mail: michael.nguyen@ucsf.edu

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