



Neurocritical Care Management of Stroke Patients

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Abstract

Stroke is a leading cause of death and long-term adult disability worldwide. Rapid triage, diagnosis, and initiation of appropriate time-sensitive interventions are critical for optimizing outcomes after acute ischemic and hemorrhagic strokes. Neurocritical care units staffed by multidisciplinary teams provide comprehensive monitoring and management of stroke patients during the acute phase. This article outlines key principles and best practices in the neurocritical care management of ischemic stroke, intracerebral hemorrhage, and aneurysmal subarachnoid hemorrhage. Aggressive medical and surgical interventions alongside holistic supportive care measures are reviewed. As stroke systems of care and neurocritical care capabilities continue advancing, patient outcomes are improving..

Keywords: Stroke; Neurocritical Care; Ischemic Stroke; Hemorrhagic Stroke; Intracerebral Hemorrhage; Subarachnoid Hemorrhage

Abbreviations

ICH: Intracerebral Hemorrhage; rtPA: Recombinant Tissue Plasminogen Activator; EVD: External Ventricular Drain; SAH: Aneurysmal Subarachnoid Hemorrhage; ICP: Invasive intracranial pressure.

Introduction

Initial Evaluation and Stabilization

Patients with suspected acute stroke require immediate triage, with the stroke team simultaneously performing the initial evaluation and stabilizing airway, breathing, and circulation as needed. The neurologic deficit should be quantified using a standardized scale like the NIH Stroke Scale. Accurate timing of symptom onset or last known normal time is critical, as this determines eligibility for acute reperfusion therapies.

Acute Ischemic Stroke

For eligible acute ischemic stroke patients within the therapeutic window, IV thrombolysis with recombinant tissue plasminogen activator (rtPA) should be initiated as soon as possible after ruling out contraindications per guidelines [1]. In parallel, the stroke team activates the catheter angiography suite for evaluation of mechanical thrombectomy candidacy if indicated [2].

Maintaining physiologic parameters like blood pressure within strict target ranges before, during and after reperfusion therapy is crucial to ensure adequate cerebral perfusion.

In the neurocritical care unit, ischemic stroke patients require frequent neurological assessments to monitor for cerebral edema, hemorrhagic conversion, or other complications. Patients commonly require intensive medical management

of blood pressure, oxygenation, temperature, blood glucose, and other physiologic parameters to promote penumbral salvage and minimize secondary brain injury [3]. This often necessitates hemodynamic augmentation, osmotherapy, targeted temperature management, and other aggressive interventions.

Decompressive craniectomy is a key neurosurgical intervention that can be life-saving for malignant cerebral edema refractory to maximal medical measures [4]. As a neurointensivist, I collaborate closely with our neurosurgical colleagues regarding optimal timing and utility of this intervention balanced against prognostic limitations.

Intracerebral Hemorrhage (ICH)

Spontaneous ICH is a particularly morbid form of hemorrhagic stroke requiring urgent stabilization and neurocritical care. The initial priorities are securing airway/ventilation as needed and optimizing hemodynamics with fluid resuscitation and vasopressor support if indicated. Rapid non-contrast CT is essential to confirm diagnosis, estimate ICH volume, evaluate for intraventricular extension, and exclude underlying structural lesions like tumors or vascular malformations [5].

Acute obstructive hydrocephalus may necessitate emergent external ventricular drain (EVD) placement. Patients with severe intraventricular hemorrhage often require EVD and intensive medical management with intermittent intraventricular thrombolytic irrigation. Invasive intracranial pressure (ICP) monitoring is frequently required to guide optimized cerebral perfusion pressure targets and osmotherapy in patients with significant mass effect or elevated ICP. In refractory cases, decompressive craniectomy may be a final life-saving option [6].

As a neurointensivist, I am involved in complex decision-making regarding the appropriateness and timing of surgical interventions like minimally invasive hematoma evacuation or decompressive craniectomy versus non-operative management. This requires carefully assessing pre-morbid functional status, ICH characteristics like volume and location, medical comorbidities, and weighing potential for meaningful neurological recovery against risks of therapeutic futility.

Aneurysmal Subarachnoid Hemorrhage (SAH)

Aneurysmal SAH is a particularly morbid form of hemorrhagic stroke requiring rapid aneurysm repair, typically via endovascular coiling or surgical clipping, followed by intensive neurocritical care monitoring and management. Key priorities include maintaining euvolemia and judicious blood pressure control to prevent aneurysm re-rupture

during the initial 24 hours.

Head-of-bed elevation, analgesics, anti-epileptics, and oral nimodipine are standard measures to help prevent and manage common complications like cerebral vasospasm, delayed cerebral ischemia, hydrocephalus, and seizures [7]. Patients often require advanced multimodal monitoring with transcranial doppler ultrasonound, continuous electroencephalography, invasive ICP monitoring, and cerebral micro-dialysis to guide interventions.

Deterioration from cerebral vasospasm may prompt triple-H therapy (Hypertension, Hypervolemia, Hemodilution) or endovascular interventions like intra-arterial vasodilator infusion or percutaneous transluminal angioplasty. Hydrocephalus and intracranial hypertension may necessitate CSF diversion with EVD or ventriculoperitoneal shunt placement.

General Supportive Care

Beyond the disease-specific interventions outlined above, general supportive care measures in the neurocritical care unit are crucial for optimizing outcomes in all stroke patients. This includes airway protection and ventilator management, maintaining adequate cerebral perfusion pressure, treating fever, optimizing glucose control, and preventing/treating common complications like seizures, venous thromboembolism, gastrointestinal hemorrhage, and hospital-acquired infections [8].

Vigilant nursing care, antimicrobial stewardship, and interdisciplinary rounding help mitigate complications like pneumonia, urinary tract infections, and pressure ulcers that stroke patients are susceptible to. Early mobility and involvement of rehabilitation services like physical therapy, occupational therapy, and speech & language pathology are essential when feasible.

Frequent communication and meetings with families are necessary to convey patients' clinical status, anticipated clinical trajectory, prognosis for functional recovery, and goals of care. As a neurointensivist leading the stroke neurocritical care team, I greatly value working alongside our neurosurgeons, neurointerventionalists, neurologists, intensivists, nurses, therapists, and the entire multidisciplinary team. This collaborative approach is key to providing comprehensive care for this vulnerable patient population.

Conclusion

Neurocritical care management is indispensable for optimizing outcomes in the acute phase after ischemic stroke,

intracerebral hemorrhage, subarachnoid hemorrhage, and other neurological emergencies. At comprehensive stroke centers, neurointensivists oversee rapid triage, delivery of time-sensitive reperfusion therapies, and aggressive medical/surgical strategies to mitigate cerebral edema, intracranial hypertension, and delayed complications alongside holistic supportive care measures. As neurocritical care protocols and technologies continue advancing, the outlook for stroke and other acute neurological injury patients continues improving.

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