

# Intensive Care Management of Acute Ischemic Stroke

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## KEYWORDS

- Acute ischemic stroke • Neurocritical care • Blood pressure control
- Cerebral edema • Induced normothermia • Pneumonia • Prophylaxis

## KEY POINTS

- The goal of neurocritical care for the patient with acute ischemic stroke is to optimize long-term outcomes by minimizing the amount of brain tissue that is lost to secondary injury.
- Emergency department management of hypertension in acute ischemic stroke should follow a strategy of “permissive hypertension”, with treatment when the blood pressure exceeds 220/120 mm Hg in patients not treated with tPA, 180/105 mm Hg in patients who have been treated with tPA, and in any patient who shows signs of acute end-organ dysfunction.
- Neurosurgical consultation for possible decompressive surgery should be considered early for patients with large middle cerebral artery or cerebellar infarctions.
- Normal saline is the intravenous solution of choice for patients with acute ischemic stroke as more hypotonic solutions can worsen cerebral edema and do not augment intravascular volume as well.
- Sufficient uncertainty surrounds early prognostication in acute ischemic stroke that it is generally not advisable to make definitive neurologic prognoses in the emergency room setting regarding such patients.

## INTRODUCTION

In a typical ischemic stroke, neurons die at a rate of about 2 million per minute.<sup>1</sup> Although acute reperfusion therapies are currently the best way to minimize the volume of infarcted brain and optimize outcomes,<sup>2</sup> few acute stroke patients receive such treatment.<sup>3</sup> Even patients who receive reperfusion therapy remain at risk for

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further neuronal death through progressive infarction and secondary injury mechanisms. The goal of neurocritical care for the patient with acute ischemic stroke (AIS) is to optimize long-term functional outcomes and quality of life by minimizing the amount of brain tissue that is lost to these processes. This is accomplished by optimizing brain perfusion, limiting secondary brain injury, and compensating for associated dysfunction in other organ systems. Because of the rapid and irreversible nature of ischemic brain injury, it is crucial for best neurocritical care practices to begin as early as possible. Given data indicating that acute stroke patients might spend an average of 5 hours in the emergency department (ED),<sup>4</sup> it is clear that optimal neurocritical care should begin in the ED and not be delayed until the patient arrives in the intensive care unit (ICU). This article will discuss optimal, pragmatic neurocritical care management of patients with AIS during the golden ED hours from the perspective of the neurointensivist.

## PRELIMINARY CONSIDERATIONS

### *Triage*

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Determination of what constitutes critical illness in the AIS patient can be challenging. AIS patients have markers of the need for critical care that are unique to AIS in the absence of the more typical signs of respiratory or hemodynamic instability. Chief among these is the potential for neurologic decline, which can be caused by progression of the initial stroke, early recurrent stroke in a different vascular territory, progressive cerebral edema with tissue shifts, and severe reperfusion injury.<sup>5</sup> Early in the course of evaluation of a patient with AIS, it can be difficult to accurately gauge an individual patient's risk for neurologic decline. At the same time, compared with other organs, the brain is exquisitely sensitive to ischemia and other physiologic perturbations; once injured, the adult brain heals very poorly. For these reasons, reactive management strategies are far less effective in patients with critical brain injuries than in illness primarily involving other organ systems. Optimal care for AIS patients, therefore, requires a hypervigilant strategy of prevention, early detection, and ultrarapid treatment of neurologic decline. It follows that all AIS patients should be considered to be critically ill, at least while they remain in the ED.

### *Physiologic Monitoring*

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Cardiovascular monitoring and respiratory monitoring in AIS do not differ significantly from that required for any other critically ill patient in the ED. Continuous cardiac telemetry and blood pressure monitoring every 5 to 10 minutes with an automated cuff are sufficient in most patients. In patients who require continuous antihypertensive or vasopressor infusions, an arterial catheter is the preferred method of blood pressure monitoring. Pulse oximetry and quantification of the respiratory rate are sufficient for most patients. However, due to the rapidity by which hypercapnia can develop and critically worsen cerebral edema and intracranial pressure (ICP), there should be a low threshold for the determination of the arterial partial pressure of carbon dioxide (CO<sub>2</sub>) by arterial blood gas. Similarly, intubated AIS patients in the ED should ideally have the end-tidal CO<sub>2</sub> continuously monitored.

Several devices are currently available for continuous monitoring of key parameters of cerebral physiology beyond ICP, including brain tissue oxygen tension, cerebral blood flow, and electrical activity.<sup>6</sup> Cerebral microdialysis allows for the monitoring of the concentration of numerous small molecules in the hemispheric interstitium, giving a very precise picture of neuronal metabolic milieu.<sup>7</sup> Most of these devices are invasive, introduced into the brain through a small burr hole craniotomy in a fashion

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