

# Critical Care Management of Intracerebral Hemorrhage



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## KEYWORDS

- Anticoagulants/adverse effects • Antihypertensive agents/therapeutic use
- Blood coagulation disorders • Intracerebral hemorrhage
- Hypertensive/diagnosis/cause/therapy • Neurocritical care
- Neurosurgical procedures

## KEY POINTS

- Acute care of patients with intracerebral hemorrhage should prioritize stabilization of airway, breathing, and circulation; making a quick diagnosis; triage to an appropriate hospital unit; and measures to reduce risk of hematoma expansion, secondary neurologic deterioration, and complications of prolonged neurologic dysfunction.
- Physicians caring for patients with ICH should anticipate the need for emergent blood pressure reduction, coagulopathy reversal, cerebral edema management, and surgical interventions including ventriculostomy and hematoma evacuation.
- Neurologic aspects of critical care management extend to ventilation, cardiac monitoring, early feeding, infection surveillance, fever and hyperglycemia management, and venous thromboembolism prophylaxis.
- Early outcome prediction models are limited by the influence of elective withdrawal of care, do-not-resuscitate orders, and evolving effectiveness of new treatments.

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## INTRODUCTION

Primary, spontaneous intracerebral hemorrhage (ICH) confers significant early mortality and long-term morbidity worldwide. The overall incidence is estimated at 24.6 cases per 100,000 person years, with a case fatality rate approximately 40% at 1 month and 54% at 1 year, and only 12% to 39% of patients achieving long-term functional independence.<sup>1</sup> A meta-analysis of ICH outcomes between 1980 and 2008 showed no appreciable change in case fatality rate over that time period, although retrospective studies of large cohorts in the United Kingdom and United States have shown a significant decrease in early mortality since 2000.<sup>2,3</sup> Decreases in 30-day and in-hospital mortality are possibly related to the introduction of improved investigative, diagnostic, and management strategies including bedside neuromonitoring, as well as ascertainment of less severe cases that may previously have been misdiagnosed as ischemic stroke. Example guidelines for the diagnosis and management of spontaneous ICH include those from the American Heart Association (American Stroke Association) and the Neurocritical Care Society (part of the Emergency Neurological Life Support [ENLS] program).<sup>4,5</sup> This article briefly reviews the pathogenesis and diagnosis of ICH, then details the acute management of spontaneous ICH in the critical care setting based on existing evidence and these published guidelines.

## PATHOGENESIS

Spontaneous ICH results from the bursting of small intracerebral arteries, most commonly because of increased susceptibility to rupture caused by chronic vasculopathy.<sup>6</sup> Long-standing high blood pressure commonly leads to lipohyalinosis of tiny perforating arteries serving the thalamus, basal ganglia, and pons, causing deep hemorrhages that often extend into the ventricles.<sup>7-9</sup> In contrast, cerebral amyloid angiopathy (CAA) typically involves cortical perforators, and is the leading cause of lobar hemorrhage in patients more than 70 years of age.<sup>10</sup> Genetic alleles associated with high blood pressure and cerebral amyloid correlate with higher ICH risk, larger hematoma volume, and poor outcome.<sup>9,11,12</sup> Other common risk factors for spontaneous ICH include older age, history of stroke, history of heavy alcohol use, and education attainment at less than a high school level.<sup>8,9</sup> **Table 1** lists various primary and secondary causes of ICH.<sup>13</sup>

Table 1 Causes of nontraumatic intracerebral hemorrhage	
Primary ICH	Secondary ICH
Hypertension	Vascular malformations
CAA	Arteriovenous malformation
Sympathomimetic drugs of abuse	Cavernous malformation
Cocaine	Saccular aneurysm
Methamphetamine	Mycotic aneurysm
Coagulopathy	Dural arteriovenous fistula
	Moyamoya
	Ischemic stroke (hemorrhagic conversion)
	Cerebral venous sinus thrombosis (hemorrhagic conversion)
	Tumor (primary or metastatic)
	Cerebral vasculitis

Data from Eljovich L, Patel PV, Hemphill JC 3rd. Intracerebral hemorrhage. *Semin Neurol* 2008;28(5):657-67.

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