

# Early Identification of Intracranial Hemorrhage Using a Predictive Nomogram

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**OBJECTIVES:** To identify predictive signs and symptoms occurring in hospitalized adults with hematologic malignancies with intracranial hemorrhage (IH).

**SAMPLE & SETTING:** In a National Cancer Institute (NCI)-designated comprehensive cancer center, a retrospective matched case-control design included adult inpatients with hematologic malignancies with (n = 39) and without (n = 39) IH.

**METHODS & VARIABLES:** Conditional logistic regression, t test, and Fisher's exact tests were used to assess increased risks for IH and the development of a prognostic nomogram with signs, symptoms, and laboratory values relevant to IH.

**RESULTS:** Composite outcomes for signs, symptoms, and laboratory values were included in a prognostic nomogram that had good discriminative ability to predict IH, with a bootstrap corrected concordance index of 0.766 (95% confidence interval [0.657, 0.866]) and good calibration. Prognostic nomogram predicted patients with prolonged activated partial thromboplastin time (APTT) (greater than 30.6), headache, and systolic blood pressure (SBP) of 140 or greater were more likely to have IH.

**IMPLICATIONS FOR NURSING:** Nurses should recognize that patients with the combination of prolonged APTT, SBP of 140 or greater, and headache are more likely to have IH.

**KEYWORDS** intracranial hemorrhage; hematologic malignancies; head bleed

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A 72-year-old patient with newly diagnosed acute myelogenous leukemia (AML) on an inpatient hematologic malignancy unit had a delay in diagnosis of acute intracranial hemorrhage (IH) in February 2013. On day two of the patient's chemotherapy regimen, the patient developed acute onset nausea, vomiting, headache, hypertension, and bradycardia. Although the signs and symptoms were communicated to the medical team, the head computed tomography (CT) scan demonstrating IH was not obtained until 12 hours later. By that time, the patient had developed mental status changes (a known symptom of IH) and incontinence. The patient was transferred to the neurology intensive care unit where he became agitated and aphasic. Several days later, he was transitioned to home hospice. The delay in diagnosis of IH and adverse outcome in this case served as the impetus to form an interprofessional team on the inpatient nursing unit to review patients diagnosed with IH.

IH is defined as any bleeding within the "intracranial vault, including the brain parenchyma and surrounding meningeal spaces" (Caceres & Goldstein, 2012, p. 771). This definition includes intracerebral hemorrhage, subarachnoid hemorrhage, and subdural hematoma. These hemorrhages usually occur suddenly from external or internal causes and can be life-threatening because the brain relies on blood vessels to supply oxygen and nutrients (Cleveland Clinic, 2016). As blood vessels in the brain leak or pool and put pressure on the brain, it becomes deprived of oxygen, which causes cell death (Cleveland Clinic, 2016). Where the injury is located affects what kind of deficits the patient may have. In adult patients with hematologic malignancies, IH is the leading cause of mortality after infection, with a mortality rate as high as 64%-67% within 30 days of IH diagnosis (Chen, Tai, Tsay, Chen, & Tien, 2009). Half of these deaths