# Subarachnoid Hemorrhage

## Updates in Diagnosis and Management

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**KEYWORDS**

• Subarachnoid hemorrhage • Computed tomography • Lumbar puncture
• Angiography • Cerebral aneurysm • Xanthochromia • Vasospasm • Rebleed

**KEY POINTS**

- Subarachnoid hemorrhage (SAH) is deadly, with 25% dying within 24 hours and an overall mortality rate of 50%.
- Outside of trauma, SAH most commonly arises from aneurysmal rupture (80%) but may be due to peri-mesencephalic bleed or other less common causes.
- Most patients will present with sudden, maximal headache, associated with nausea/vomiting, neck pain, and exertion. The headache is usually different than patients' baseline headaches.
- Diagnosis centers on head noncontrast computed tomography (CT). If conducted within 6 hours of headache onset, this test is reliable. If it is negative but patients present after 6 hours, lumbar puncture and/or CT angiography should be used.
- Management requires rapid neurologic assessment, monitoring for intracranial pressure elevation, nimodipine, blood pressure management, analgesia, seizure treatment, and coagulopathy correction.

## INTRODUCTION

Subarachnoid hemorrhage (SAH) is a neurologic emergency and is defined by bleeding in the subarachnoid space, which lies between the arachnoid and pia mater. This area is normally filled with cerebrospinal fluid (CSF). Trauma is the most common cause of SAH.[1–3] Most nontraumatic SAH, approximately 80%, is due to ruptured aneurysm.[1–3] The causes of nonaneurysmal SAH are diverse, and the mechanism may not be identified.[4,5]

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## EPIDEMIOLOGY

Headache accounts for approximately 2% of emergency department (ED) visits, with SAH occurring in 1% to 3% of these patients.[1,6–8] The incidence is approximately 7 to 10 per 100,000, with mortality approaching 50%.[6–8] SAH is the most common form of intracranial hemorrhage in trauma.[1–5] Close to 15% of patients will die before they reach the hospital, with 25% dying within 24 hours and 45% of patients dying within 30 days.[9–12] Morbidity is also severe, with only one-third of patients demonstrating full recovery after treatment.[9]

Prognosis is predicted by level of consciousness and neurologic examination on initial evaluation, patient age (younger patients experience better outcome), and amount of hemorrhage on initial imaging (increased hemorrhage associated with worse outcome).[13–15] For patients who reach the hospital, early complications of SAH account for most mortality, including rebleeding, vasospasm, seizures, increased intracranial pressure (ICP), and cardiac complications.

## PATHOPHYSIOLOGY

### *Aneurysmal*

Most nontraumatic SAHs are due to aneurysmal rupture, and these aneurysms are usually not congenital. Most never rupture and arise at sites of arterial branching, specifically the circle of Willis in the anterior circulation.[1–6] Saccular aneurysms account for 90%, and the overall prevalence of cerebral aneurysm ranges from 0.5% to 6.0% depending on the population.[4,5,16–19] A systematic review including more than 56,000 patients from 23 studies found an incidence of 2.3%.[18] Risk factors include a family history of SAH or aneurysm, smoking, hypertension, and heavy alcohol use.[1–3]

### *Nonaneurysmal*

Peri-mesencephalic SAH is characterized by localized blood on computed tomography (CT) without aneurysm.[4,5,20] These bleeds are defined by hemorrhage restricted to the cisterns around the brainstem with absence of aneurysm on vascular imaging, such as CT angiography (CTA) and magnetic resonance angiography (MRA).[4,5,20] This type has a much better prognosis than aneurysmal SAH. Other causes include vascular malformation, intracranial dissection, sickle cell disease with intracerebral hemorrhage, pituitary apoplexy, cerebral amyloid angiopathy, central nervous system tumor, cocaine use, and cerebral venous thrombosis.[20–28]

### *Traumatic*

SAH is a common form of intracranial bleeding in trauma. It results from disruption of the parenchyma and subarachnoid vasculature and often presents with headache, meningeal signs, and photophobia.[1–4,29] This finding is one of the most common CT findings in patients with moderate to severe traumatic brain injury, and traumatic SAH is associated with a 3-fold increase in mortality.[1–4,29]

## FEATURES AND PRESENTATION

Most patients with SAH experience abrupt headache, often thunderclap in nature, defined by a headache that reaches maximal intensity within 1 minute.[30] However, 10% to 25% of patients with thunderclap headache have SAH.[31–34] Most of these headaches are atypical in nature and different from patients' prior headaches. The headache may begin or worsen with exertion, and it may lateralize to the side of the bleed in 30% of patients.[31,34] Key historical features are shown in **Table 1**.

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