

# Nonaneurysmal Subarachnoid Hemorrhage: A Review of Clinical Course and Outcome in Two Hemorrhage Patterns

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**Abstract:** Patients who experience a nonaneurysmal subarachnoid hemorrhage differ from patients who suffer an aneurysmal subarachnoid hemorrhage in initial presentation (including neurological examination and computed tomography [CT] scans), clinical course, and outcome. A perimesencephalic distribution of nonaneurysmal subarachnoid blood on CT imaging has been described as a distinct clinical entity with a benign course and an excellent prognosis; research suggests that the majority of these patients have excellent outcomes. In most cases, these patients return to their previous level of functioning. Surviving a subarachnoid hemorrhage can be emotionally devastating to patients and their families and can threaten employment and health insurance eligibility. Using evidence-based practice, neuroscience nurses can reassure and educate patients, staff members, and the public and facilitate their understanding of the clinical course and outcome.

Patients who experience a spontaneous nonaneurysmal subarachnoid hemorrhage (NASAH) differ from patients who suffer an aneurysmal subarachnoid hemorrhage (ASAH) in their presenting symptoms, clinical course, and outcomes. Rupture of an aneurysm is typically associated with significant morbidity and mortality. Up to 20% of patients die as a result of their initial hemorrhage. Of those who survive, about half will have a poor outcome. Complications related to aneurysmal rupture depend on clinical grade, the extent of subarachnoid hemorrhage (SAH), and the presence of delayed cerebral ischemia (Adams, Kassell, Torner, & Haley, 1987; Hasan, Vermeulen, Wijdicks, Hijdra, & van Gijn, 1989; Jane, Kassell, Torner, & Winn, 1985; Kassell, Sasaki, Colohan, & Nazar, 1985). Patients who survive the rupture of an aneurysm are often faced with a lengthy hospital stay that centers on hemodynamic monitoring, hyperdynamic therapy, and management of hydrocephalus, hyponatremia, and other complications. Following the acute care stay, most patients require formal therapies to address mobility and cognitive deficits. After hospital discharge, patients and their families must manage many issues: the need for supervision of the patient; the loss of the patient's ability to drive, live alone, manage finances, or return to work; and the risk of recurrent ASAH.

In contrast, patients with a NASAH tend to make an excellent recovery. The pattern of hemorrhage in this group has been reported to correlate with clinical course and patient outcome (Alexander, Dias, & Uttley, 1986; Brilstra, Hop, &

Rinkel, 1997; Rinkel et al., 1990; Rinkel, Wijdicks, Hasan et al., 1991; Rinkel, Wijdicks, Vermeulen et al., 1991). Within this group, two distinct hemorrhage patterns have been described: an aneurysmal hemorrhage pattern and a perimesencephalic hemorrhage pattern. The recognition of perimesencephalic SAH as a subgroup with a benign clinical course has provided clinicians with valuable information that directly influences patient care and education. In general, patients with perimesencephalic SAH have a better clinical grade upon presentation and little to no hydrocephalus or delayed cerebral ischemia. Most of these patients return rapidly to their premorbid level of functioning and employment (Alexander et al.; Brismar & Sundbarg, 1985; Rinkel et al., 1990; Rinkel, Wijdicks, Hasan, et al.; Rinkel, Wijdicks, Vermeulen, et al., 1991; van Gijn, van Dongen, Vermeulen, & Hijdra, 1985).

This article describes the two distinct patterns of spontaneous and angiographically negative NASAH:

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the perimesencephalic hemorrhage pattern and the aneurysmal hemorrhage pattern. The goal of this article is to enrich the clinical armamentarium of the neuroscience nurse, provide a comprehensive overview of nonaneurysmal SAH, and enhance patient and family education.

### Definition and Presentation of Subarachnoid Hemorrhage

A *subarachnoid hemorrhage* is defined as blood in the subarachnoid space (Hickey, 2003) that may result from a fall, trauma, or the rupture of an aneurysm or other vascular malformation. Patients with spontaneous SAH present with a sudden onset of severe headache (97%), classically described as “the worst headache of my life.” Meningeal signs, such as nuchal rigidity, positive Kernig’s sign, or Brudzinski’s sign, may also be noted (Greenberg, 2001). Patients may present with an altered level of consciousness caused by massive hemorrhage, increased intracranial pressure (ICP), or hydrocephalus (Greenberg; Hickey).

### Nonaneurysmal Subarachnoid Hemorrhage

For the purposes of this article, *nonaneurysmal subarachnoid hemorrhage* is defined as nontraumatic, spontaneous SAH of unknown etiology. The term *angiographically negative SAH*, often used interchangeably with NASAH, refers to the fact that conventional cerebral angiography fails to reveal a source for the hemorrhage. Patients with NASAH are often divided into two groups on the basis of the pattern of SAH—perimesencephalic or aneurysmal—seen on the initial computed tomography (CT) scan (Alexander et al., 1986; Brilstra et al., 1997; Greenberg, 2001; Rinkel, Wijdicks, Hasan, et al., 1991). In both groups, the clinical presentation may be indistinguishable from that of a patient with a ruptured intracranial aneurysm.

### Perimesencephalic Subarachnoid Hemorrhage Pattern

Perimesencephalic NASAH is characterized by a distinctive pattern of blood seen on an initial CT scan performed within hours of symptom onset. The subarachnoid blood is confined to the midbrain cisterns, with no evidence of intraventricular or intracerebral hemorrhage (Fig 1).

Perimesencephalic subarachnoid hemorrhage accounts for approximately 10% of patients with SAH and for two-thirds of patients with angiographically negative SAH. A review of the literature revealed that patients with perimesencephalic SAH are typically younger and male. Loss of consciousness at hemorrhage onset is rare in these

**Fig 1.** Perimesencephalic SAH Pattern: A CT Scan of the Brain



*Note.* This CT scan demonstrates the distinct hemorrhage pattern of subarachnoid blood confined to the midbrain cisterns.

patients, and hydrocephalus is uncommon (Brilstra et al., 1997; Rinkel et al., 1990; Rinkel, Wijdicks, Vermeulen, et al., 1991). Perimesencephalic SAH is associated with a favorable prognosis and a very low risk of rebleeding, hydrocephalus, or delayed cerebral ischemia (Alexander et al., 1986; Biller et al., 1987; Brilstra et al.; Brismar & Sundberg, 1985; Eskesen, Sorensen, Rosenorn, & Schmidt, 1984; Rinkel et al., 1990; Rinkel, Wijdicks, Hasan, et al., 1991; Schievink, Wijdicks, Piepgras, Nichols, & Ebersold, 1994; Schwartz & Solomon, 1996). Because of the gradual onset of headache and the low incidence of hydrocephalus associated with perimesencephalic SAH, some authors have speculated that its cause may be venous, not arterial (van Gijn et al., 1985).

### Aneurysmal Subarachnoid Hemorrhage Pattern

The aneurysmal hemorrhage pattern involves more than the prepontine cisterns. This pattern mimics aneurysmal rupture, with the presence of one or more of the following: subarachnoid blood distributed in the carotid cisterns, Sylvian fissure(s), and interhemispheric fissure. Hydrocephalus may also be present on the initial CT scan.

### Natural History

The findings of several important studies have guided clinicians in the management of patients with NASAH. These studies evaluated differences in outcome and prognosis in patients with

ASAHs, versus NASAHs, particularly those with the perimesencephalic pattern of hemorrhage.

Brismar and Sundborg (1985) retrospectively analyzed 127 patients who presented with angiographically negative SAH from 1968 to 1978. Average follow-up time was 5.4 years. Among these patients, two fatal rebleeds (1.5%) occurred within 5 days of the initial hemorrhage. A third patient died within the second week, following elevated ICP and cerebral ischemia. Five patients died after hospital discharge, from 2 to 7 years after hemorrhage; these deaths were related to cardiac disease and malignancy, and none of these patients had any documented neurological deficits at discharge. Of the remaining 119 patients, the authors found that 94% ( $n = 112$ ) returned to at least part-time work and 82% ( $n = 98$ ) resumed usual activities an average of 2 weeks after the hemorrhage. These findings supported previous research by Hayward (1977), who found that, at 1 year after hemorrhage, 95% of patients with NASAH had returned to at least part-time employment, and 68% had returned to their usual activities ( $n = 51$ ).

Van Gijn and colleagues (1985) compared the clinical presentation and outcome in 92 patients with ASAH to that in 28 patients with angiographically negative NASAH. In the NASAH group, 13 patients (46%) had a perimesencephalic pattern of hemorrhage on their admission CT scan. The authors noted that headache onset was more gradual in patients with NASAH. In the ASAH group, 28 patients (30%) died as a result of their hemorrhage, and 20 of the 64 survivors (31%) experienced significant residual deficits. In contrast, clinical outcome was good in all 28 patients with angiographically negative NASAH.

Other groups have confirmed these findings, emphasizing the more gradual onset of severe headache in NASAH patients compared to the "thunderclap" headache that accompanies aneurysm rupture, and the benign clinical course, particularly in patients with the perimesencephalic pattern of SAH (Brilstra et al., 1997; Rinkel et al., 1990; Rinkel, Wijdicks, Vermeulen, et al., 1991; van Gijn et al., 1985). Perhaps even more important, these authors and others have reported that the risk of recurrent hemorrhage in patients with NASAH is extremely low, essentially equivalent to that of the general population (Alexander et al., 1986; Brismar & Sundborg, 1985; Rinkel et al., 1990; Rinkel, Wijdicks, Hasan, et al., 1991; Rinkel, Wijdicks, Vermeulen, et al., 1991; van Gijn et al.).

### Assessment and Diagnosis

Patients who present with an SAH will classically describe the sudden onset as the worst headache of their life. However, a gradual onset of the severe headache over several minutes has been reported in patients with NASAH (Brilstra et al., 1997; Rinkel et al., 1990; Rinkel, Wijdicks, Hasan, et al., 1991;

Rinkel, Wijdicks, Vermeulen, et al., 1991; van Gijn et al., 1985). Patients may report associated symptoms such as nausea, vomiting, and photophobia. Family may report an altered level of consciousness in the patient.

Objective data assessment should include time, location, and character of headache onset; headache duration; associated symptoms (e.g., altered level of consciousness, extremity weakness, or slurred speech); and exacerbating and alleviating factors. The assessment should also note what type of activity preceded the headache onset (i.e., a headache that came on during rest or sedentary activity, or a headache that started abruptly during intercourse or strenuous exercise). In the authors' experience, onset of severe headache during intercourse or strenuous exercise may be a result of elevated venous sinus pressure (not SAH) from the Valsalva maneuver. Physical assessment data should consist of a comprehensive neurological examination, including documentation of the Glasgow Coma Scale (GCS) score, motor and sensory examination, cranial nerve function, and vital signs. Other pertinent information includes patient history of recent illicit drug use, hypertension, polycystic kidney disease, previous ASAH or aneurysms, use of anticoagulants, or tobacco use, which can increase the risk of aneurysm formation (Juvola, Hillbom, Numminen, & Koskinen, 1993; Schievink, Torres, Piepgras, & Wiebers, 1992). Pertinent family history includes polycystic kidney disease, ASAH, or aneurysms.

Diagnostic assessment usually starts with a CT scan of the brain. This scan can be done quickly after a patient is evaluated in the emergency department. A CT scan is the diagnostic study of choice for SAH and is useful in ruling out other pathologies that may mimic aneurysm rupture, such as hypertensive intracerebral hemorrhage or hemorrhage from a tumor mass. It also allows rapid identification of ventricular size and the presence of intraventricular hemorrhage.

CT angiography (CTA) may be performed to determine the source of hemorrhage. A minimally invasive test, CTA uses a timed bolus of intravenous (IV) contrast to visualize the arteries. In patients with ruptured aneurysms, CTA has a reported sensitivity of 86% (Anderson, Findlay, Steinke, & Ashforth, 1997); however, conventional cerebral angiography remains the "gold standard" for evaluation and is likely to be done when the CTA is negative. A conventional angiogram is performed to evaluate the cerebral circulation for the source of SAH: aneurysm, arteriovenous malformation (AVM), or dural arteriovenous fistula. Conventional catheter-based cerebral angiography is an invasive test requiring significant technical expertise and is best performed at specialized centers where the risk of serious complications

is in the range of 0.5% to 1% (Heiserman et al., 1994). When considering conventional angiography or CTA in patients with abnormal renal function, the administration of contrast poses a significant risk of further compromising renal function. These risks can be significantly reduced by pretreating patients with acetylcysteine and IV sodium bicarbonate solution (Liu, Nair, Ix, Moore, & Bent, 2005); a nephrology consult may be useful in managing such patients. Patients allergic to contrast, iodine, or shellfish require pretreatment with steroids, usually 32 mg oral methylprednisolone administered 12 hours and 2 hours before exam, or, if emergent, 100 mg IV methylprednisolone. Patients may also be given IV diphenhydramine, 25–50 mg, before angiography (Greenberg, 2001).

A negative angiogram may be followed by a magnetic resonance imaging (MRI) scan of the brain, and possibly of the cervical spine, to rule out other sources of SAH. A tumor or vascular lesion, such as a cavernous malformation in the posterior fossa or upper cervical spine, would not be visible on a cerebral angiogram.

It is important to emphasize the significance of a cognitive evaluation as part of the neurological assessment.

Repeat cerebral angiography is controversial in patients with a nonfocal neurological examination and a negative invasive workup. At the authors' institution, repeat cerebral angiography is not routinely performed in a patient with a perimesencephalic hemorrhage pattern and a negative initial high-quality cerebral angiogram. Repeat angiography is reserved for patients with an aneurysmal pattern of subarachnoid blood or a suboptimal initial study. If a second cerebral angiogram is recommended, it is usually completed approximately 5 to 7 days after the hemorrhage. This interval allows for repeat evaluation for aneurysm or AVM that may have been obscured and for identification of the presence of vasospasm.

### Medical Management

Management of patients with SAH includes admission to the intensive care unit for close observation of neurological status, vital signs, and cardiac function. Careful observation is necessary to evaluate for increased headache, alteration in level of consciousness, extremity weakness, changes in speech, or other neurologic deficits. Blood pressure parameters in these patients are usually set to maintain systolic blood pressure (SBP) parameters less than 140 mm Hg. In hypertensive patients, IV medications such as nicardipine can be titrated

to maintain these parameters. An external ventricular drain (EVD) is placed in patients with CT evidence of hydrocephalus or a depressed level of consciousness.

Daily evaluation of laboratory chemistries is recommended to monitor for hyponatremia, a common complication of SAH. To maintain a sodium level greater than 135 mEq/L, patients may need oral sodium supplementation (1 or 2 grams three times a day with meals) or IV 1.5%–3% sodium chloride at 30–50 cc per hour, along with adequate fluid replacement. After sodium replacement has been initiated, the sodium value is monitored frequently, often two to four times daily until the level is stable and until supplementation is weaned.

Nimodipine is initiated on admission in all patients with SAH for the prevention and treatment of vasospasm (Feigin, Rinkel, Algra, Vermeulen, & van Gijn, 1998; Rinkel et al., 2005). However, after NASAH has been identified, nimodipine is discontinued, because the incidence of vasospasm is low in this population (Brismar & Sundborg, 1985; Rinkel, Wijdicks, Vermeulen, et al., 1991; van Gijn et al., 1985). Symptom management includes the use of appropriate analgesics or nonpharmacological modalities for headache management, nuchal rigidity, nausea, emesis, and constipation.

### Nursing Interventions

Nursing interventions include the initial admission of the patient to the unit, physical examination, administration and titration of medications according to prescribed parameters, and assessment of hemodynamic status to achieve and maintain goals as outlined by the neurosurgical service.

Ongoing collaboration with the neurosurgical team (attending physician, residents, nurse practitioners) fosters communication regarding test results, the patient's response to treatment modalities, and plans for repeat testing (CT scans, angiograms). Nurses should also review the patient's medications. Initial medications include nimodipine; antihypertensive medication may be initiated to maintain SBP goal of less than 140 mm Hg until aneurysmal rupture has been excluded. After ASAH is excluded, a patient's SBP parameters are relaxed, allowing the patient's SBP to return to baseline. Patients with persistently elevated SBP of greater than 160 mm Hg are usually started on low-dose oral antihypertensive medications before hospital discharge. These medications can be gently titrated by the primary care provider toward a goal SBP of 120–140 mm Hg. In patients with hypotension (SBP less than 110 mm Hg), pressors such as IV phenylephrine may be initiated to maintain an SBP greater than 110 mm Hg. The use of antiepileptic drugs (AEDs) in this population depends on the presence or potential risk of seizure

activity; this decision is at the discretion of the attending neurosurgeon or neurosurgical team.

Other issues to be addressed by nurses are the patient's diet and activity status and the assessment and management of pain. These patients rarely require surgical intervention, with the exception of a few who may require placement of an EVD. Therefore, patients with an appropriate level of consciousness and adequate swallow function typically begin taking a diet shortly after admission. Early mobilization is beneficial from a pulmonary and psychological standpoint, as well as in reducing the incidence of deep vein thrombosis (DVT). Initiation of subcutaneous enoxaparin or heparin for DVT prophylaxis in patients on prolonged bed rest is left to the discretion of the attending neurosurgeon. Physical and occupational therapy may be initiated at the discretion of the nurses and neurosurgical team.

Analgesics, prescribed upon admission, usually include IV morphine sulfate at 1–2 mg per hour for mild pain, 3–4 mg per hour for moderate pain, and 5–6 mg per hour for severe pain. In addition, patients may take oral narcotic analgesics (e.g., one or two tablets of hydrocodone 5 mg/acetaminophen 325 mg every 4–6 hours as needed). The 0–10 Numeric Pain Intensity Scale (Agency for Health Care Policy and Research, 1992), a standardized pain assessment tool, is helpful in evaluation of adequate analgesia. Nonpharmacologic interventions include the use of ice packs, warm compresses, and relaxation techniques.

Additional pertinent patient care issues reviewed with the neurosurgical team are the results of transcranial Doppler (TCD) studies and cerebrospinal fluid (CSF) studies in patients with an EVD, as well as the need for repeat cerebral angiography and frequency of follow-up CT imaging. Finally, one of the most important nursing interventions is regular communication with the patient and family regarding the plan of care, patient and family education, patient progress, upcoming tests, symptom relief, and discharge planning.

### **Sequelae Following a Nonaneurysmal Subarachnoid Hemorrhage Pattern**

After an SAH, patients may report persistent headaches. The headaches are a normal aspect of the recovery process and gradually resolve as the subarachnoid blood dissipates. Use of a standardized pain assessment scale provides a consistent method to rate a patient's headache and evaluate the effectiveness of analgesia. Collaboration with the neurosurgical team regarding the patient's initial and follow-up CT scans may help establish whether hydrocephalus may be contributing to a patient's headache. For this patient population, the

incidence of hydrocephalus upon admission is low (1%–2%), as is the number of patients that require placement of a ventricular shunt (Rinkel, Wijdicks, Hasan, et al., 1991; van Gijn et al., 1985).

The incidence of delayed cerebral ischemia or vasospasm is also low for this patient population (Brismar & Sundbarg, 1985; Rinkel, Wijdicks, Vermeulen, et al., 1991; Schievink et al., 1994; van Gijn et al., 1985). Nonetheless, this poorly understood phenomenon could affect patient outcome. TCDs performed three times a week while a patient is hospitalized are useful for evaluating the presence of vasospasm.

Patients are usually hospitalized for 7 to 10 days following the SAH. The duration of hospital stay depends on the course of care. For example, a patient with hyponatremia will have a slightly longer stay than a patient without hyponatremia.

On occasion, a patient may initially display cognitive deficits related to the SAH. Sedation and sleep deprivation issues may also arise during hospitalization. In addition to routine orientation questions, a cognitive assessment by a speech and language pathologist with daily follow-up is an appropriate intervention. It is important to emphasize the significance of a cognitive evaluation as part of the neurological assessment.

### **Case Study 1**

JG, a 55-year-old Caucasian female, presented to the emergency department (ED) reporting onset of a severe headache earlier that day. Her headache almost completely resolved soon after her arrival at the ED. Her neurological examination was nonfocal with a GCS score of 15. A CT scan demonstrated a perimesencephalic SAH (Fig 1, Fig 2). A conventional four-vessel cerebral angiogram was negative for intracranial aneurysm and arteriovenous malformation. Serial CT scans showed rapid resolution of the perimesencephalic subarachnoid blood, and no hydrocephalus. She was discharged home on her fifth hospital day with no neurological deficits and no discharge needs.

JG came to the outpatient clinic for a 3-week follow-up. On the 12th day after her hemorrhage, she returned to her job as a registered nurse, full time and without difficulty. She noted complete resolution of her previous headaches and no perceived physical or cognitive deficits.

### **Case Study 2**

LD, a 59-year-old Caucasian female, presented to the ED reporting a sudden onset of "the worst headache of my life." Her past medical history was significant for congestive heart failure, peripheral vascular disease, and coronary artery disease. Medications upon admission included clopidogrel

and 81 mg of aspirin. Her admission GCS score was 10. A CT scan demonstrated extensive SAH in the basilar cisterns and Sylvian fissures bilaterally, as well as evidence of acute hydrocephalus (Fig 3, Fig 4). A CT angiogram performed at the same time showed no evidence of aneurysm.

LD was admitted to the intensive care unit, where she was intubated; an EVD was immediately placed to manage acute hydrocephalus. A CT scan after placement confirmed good position of the catheter in the right lateral ventricle. A nicardipine drip was ordered and titrated to achieve a goal SBP of less than 140 mm Hg. A subsequent four-vessel cerebral angiogram was negative for aneurysm or arterial venous malformation.

LD remained stable over the next several days with a GCS score of 10T. An MRI scan of the brain and cervical spine and an MR angiogram were performed. These studies revealed no evidence of vascular malformation or tumor to explain the SAH. The initial plan was to repeat her cerebral angiogram on the 10th postbleed day.

On her fourth postbleed day, LD developed increased pulmonary congestion, and a pulmonary artery catheter was placed. At that point, target hemodynamic parameters were to maintain SBP at 120–140 mm Hg and a wedge pressure of no greater than 8 mm Hg. LD was able to maintain these parameters without medication.

On her fifth postbleed day, LD was found to be less responsive and was not following commands. A cerebral angiogram showed mild bilateral middle

cerebral artery (MCA) vasospasm. No other vascular abnormality was noted. Because of the vasospasm, her SBP parameters were raised to 140–200 mm Hg, and a phenylephrine drip was ordered to maintain these parameters. The goal for the pulmonary wedge pressure was increased to no greater than 10 mm Hg, and 5% human albumin was ordered to maintain this wedge parameter.

During the next several days, LD became more alert, and her pulmonary status improved. On her 11th postbleed day, a follow-up cerebral angiogram demonstrated resolution of the vasospasm and no evidence of vascular malformation or aneurysm. Her phenylephrine drip and pulmonary artery catheter were discontinued 3 days later. She was alert and following commands with a GCS score of 11T. She was extubated on the 12th day after her hemorrhage.

Her EVD was weaned, and no evidence of hydrocephalus was seen on serial CT scans. Her neurological examination remained stable, with only mild short-term memory deficits. A repeat CT scan of her brain, performed the day before her transfer to acute neurological rehabilitation, showed resolution of her subarachnoid blood and no evidence of hydrocephalus.

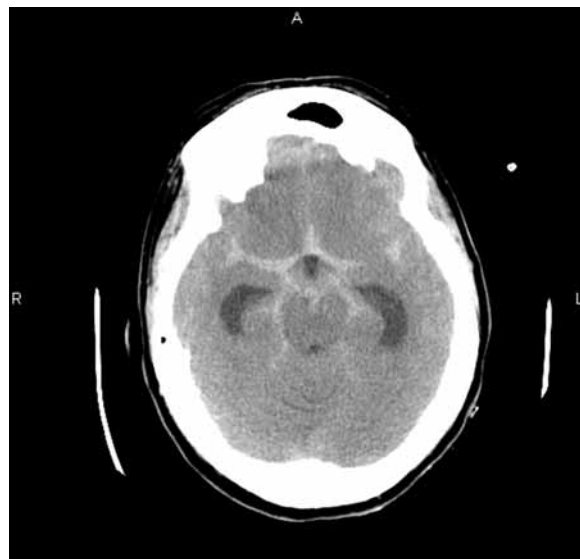
LD was evaluated in the outpatient clinic 6 weeks after her SAH. She had returned home and participated in outpatient physical, occupational, and speech therapies. Her 6-week follow-up CT scan of the brain showed no evidence of delayed hydrocephalus. She was given permission to resume her

**Fig 2.** Case Study 1: A CT Scan of the Brain

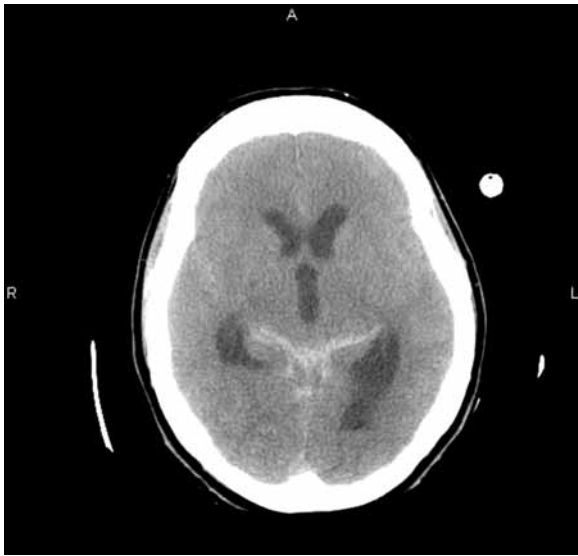


*Note.* This CT scan shows subarachnoid blood in midbrain cisterns (perimesencephalic distribution hemorrhage pattern).

**Fig 3.** Case Study 2: A CT Scan of the Brain



*Note.* This CT scan shows extensive subarachnoid blood in basilar cisterns and Sylvian fissures; also note acutely dilated temporal horns and third ventricle (hydrocephalus).

**Fig 4.** Case Study 2: A CT Scan of the Brain

Note. This CT scan shows subarachnoid blood and acute hydrocephalus.

usual doses of clopidogrel and daily aspirin. LD had made an excellent recovery, with only occasional mild short-term memory deficits and decreased endurance. The extent of SAH in this patient may have been related to her being on double antiplatelet therapy; nevertheless, a four-vessel cerebral angiogram was planned for her 6-month follow-up visit.

## Discussion

These two case studies demonstrate the differences in clinical presentation and management of patients with the perimesencephalic distribution of SAH compared to those with the aneurysmal pattern of SAH. The first case illustrates the benign clinical course reported for the perimesencephalic pattern of hemorrhage as well as the fact that repeat angiography is seldom needed. The second case demonstrates the more complicated clinical course seen in patients with an aneurysmal pattern of hemorrhage, which may include hydrocephalus and vasospasm. Patients with this latter pattern of hemorrhage require invasive monitoring, astute nursing care, and repeat angiography to exclude an aneurysm. The key to management of these patients is the severity and distribution of blood on the initial CT scan.

## Summary

Patients with angiographically negative SAH, particularly those with a perimesencephalic pattern of hemorrhage, have a significantly better clinical outcome than patients with a ruptured aneurysm. Patients with the perimesencephalic pattern

present with a more gradual onset of headache and a nonfocal neurological examination. Hydrocephalus is rare, and outcome from hemorrhage is excellent in this group. Patients with NASAH can be assured that they are at no increased risk of recurrent hemorrhage, and they may gradually resume all of their usual activities without restriction.

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