Spontaneous, non-traumatic SAH is a hemorrhagic stroke and is a medical emergency that is frequently misdiagnosed.

- A high level of suspicion for SAH should exist in patients with acute onset of severe headache.
  - Other features include: Worst headache of life, onset with exertion, onset with syncope, neck stiffness/pain, vomiting

- To make a differential diagnosis or to confirm SAH:
  - Obtain further history and physical exam, and/or
  - Obtain diagnostic testing
    - Please refer to Algorithm 1, Subarachnoid Hemorrhage(SAH) Decision Pathway

- To assess severity of SAH, use an accepted grading system (e.g., Hunt and Hess Severity Scale, Fisher Scale, or World Federation of Neurological Surgeons Scale). See scales below.

If SAH confirmed or any doubt about the diagnosis

- Consult Neurosurgery to determine if additional testing necessary.
- Consult Neurovascular if no evidence of ruptured aneurysm or arteriovenous malformation (AVM) on imaging.

See next page for “Treating the Patient” and “Possible Complications”

### Subarachnoid Hemorrhage Grading Scales

#### A. Hunt and Hess Severity Scale
- Grade 1 – Asymptomatic, mild headache
- Grade 2 – Moderate to severe headache, nuchal rigidity, no focal deficit other than cranial nerve palsy
- Grade 3 – Mild mental status change (drowsy or confused), mild focal neurologic deficit
- Grade 4 – Stupor or moderate to severe hemiparesis
- Grade 5 – Comatose or decerebrate rigidity

#### B. World Federation of Neurological Surgeons
- Grade 1 – Glasgow Coma Scale 15, no motor deficit
- Grade 2 – Glasgow Coma Scale 13-14, no motor deficit
- Grade 3 – Glasgow Coma Scale 13-14, motor deficit present
- Grade 4 – Glasgow Coma Scale 7-12, motor deficit may be present or absent
- Grade 5 – Glasgow Coma Scale 3-6, motor deficit may be present or absent

#### C. Fisher Scale (Computed Tomography Appearance)
- Group 1 – No blood
- Group 2 – Diffuse deposits of subarachnoid hemorrhage blood, no clots, no layers of blood > 1 mm
- Group 3 – Local clots or vertical layers or blood > 1 mm thickness
- Group 4 – Diffuse or no subarachnoid hemorrhage, but intracerebral or intraventricular clot
Algorithm 1. Subarachnoid Hemorrhage (SAH) Decision Pathway*

Symptoms concerning for SAH:
- Rapid onset of headache
- Worst headache of life
- Onset with exertion
- Onset associated with syncope
- Neck stiffness or neck pain
- Vomiting

Patient presents with headache concerning for but not yet diagnosed as Subarachnoid Hemorrhage

> 6 Hours since onset?

- NO

≤6 hours AND NO additional concerns for SAH per ED Attending:
  - CT head without contrast

Ongoing concern for SAH

- NO

Positive CT?

NO

SAH Ruled Out

NO

Positive CTA or LP?

YES

Stat Neurosurgery Consult and follow CPG guidelines for medical care

*Note: This pathway only pertains to patients who present with a chief complaint that is consistent with possible subarachnoid hemorrhage. It does not apply to general headache presenting to the emergency department.

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**General Medical Care**

- Perform neurological assessment every hour until specified and report changes to MD/LIP
- Maintain SAH Precautions (reduction of internal and external stimuli or stressors to minimize the risk of re-bleeding)
- Screen for and treat pain
- Mechanical VTE prophylaxis is indicated; initiate early mobility as patient is able
- Pharmacological VTE prophylaxis is contraindicated until surgical intervention. On post-op day 1, start pharmacological prophylaxis. Refer to the VTE Prophylaxis Guidelines
  - Monitor for heparin-induced thrombocytopenia (HIT)
  - Perform Swallow Screening for dysphagia prior to any oral intake
  - Provide stroke education
  - Provide tobacco cessation information
  - Consult Physical Medicine & Rehabilitation, PT, OT and Speech Language Pathology as indicated
  - Obtain lab values for Hb A1C and fasting lipids; if elevated, manage appropriately
  - Control glucose with strict avoidance of hypoglycemia
  - Treat fever aggressively with goal of normothermia

**Medical Care to Prevent Re-bleeding after SAH**

- Blood Pressure Control
  - Manage hypertension appropriately to balance risk of stroke, hypertension-related rebleeding, and maintenance of cerebral perfusion pressure.
  - Target ranges:
    - *Prior to intervention*: SBP < 140 mmHg
    - *After intervention*: SBP < 220 mmHg (to maintain adequate perfusion and prevent vasospasm)
  - Caution: For coiled aneurysms, SBP must be maintained at < 140 mmHg until thrombosis is formed
  - Avoid uses of medications in the management of hypertension that may induce cerebral vasodilatation (including nitroglycerin and nitroprusside). Suitable options include labetalol and nicardipine.
  - Maintain bed rest until aneurysm secured
  - Consider aminocaproic acid (Amicar®) when early aneurysm protection is not an option.

**Possible Complications**

**Cerebral Vasospasm**

- Early management begins with treating the ruptured aneurysm, and in most cases, maintaining normal circulating blood volume and avoiding hypovolemia.
- Administer enteric nimodipine 60 mg q4h while hospitalized to reduce poor outcomes (Consider 30 mg q2h if systemic hypotension occurs).
- Daily transcranial Dopplers (TCDs)
- Strict hourly intake and output (I/O) Strictly maintain euvelomic goals

  **For symptomatic vasospasm consider:**
  - Volume expansion
  - Vasopressor
  - Selective intrarterial vasodilator
  - Cerebral angioplasty
  - Intraventricular nicardipine
  - Milrinone infusion

**Hydrocephalus**

- Consider ventriculostomy in patients with ventriculomegaly and diminished level of consciousness after acute SAH
- Use permanent CSF diversion in symptomatic patients with chronic hydrocephalus after SAH

**Surgical and Endovascular Methods**

- Assess by neurosurgeon before and after surgery as well as endovascular procedures.
- Perform surgical clipping or endovascular coiling to reduce rate of Re-bleeding.
- Complete obliteration of aneurysm recommended.
- Early aneurysm treatment is reasonable and probably indicated in the majority of cases.

**Anesthetic Management**

- Prior to surgery, discussion should occur with anesthesiologist regarding hemodynamic targets.
- Minimizing the degree and duration of intraoperative hypotension during aneurysm surgery probably indicated.
- Consider use of pharmacological strategies to induce hypertension during temporary vessel occlusion in certain instances.
- Induced hypothermia during surgery may be a reasonable option in some cases but is not routinely recommended.

**Seizures**

- If antiepileptic prophylaxis is used a short course (3-7 days) in post-hemorrhagic period is recommended
- Routine long-term use of antiepileptics is not recommended, but may be considered for patients with risk factors such as:
  - Prior seizure
  - Parenchymal hematoma
  - Infarct
  - Middle cerebral artery aneurysms

**Hyponatremia and Volume Contraction**

- Monitor electrolytes, especially sodium; notify MD/LIP if out of patient-specific goal range.
- Generally avoid administration of large volumes of hypotonic fluids and intravascular volume contraction after SAH.
- Strict intake and output (I/O) and Daily weights
- Monitoring volume status in certain patients with recent SAH using some combination of central venous pressure, or pulmonary artery wedge pressure, or stroke volume variation, is reasonable, as is treatment of volume contraction with isotonic fluids.
- Consider urine and electrolyte studies.
- Use of hypertonic saline* is reasonable for preventing and correcting hyponatremia
- The use of fludrocortisone may reduce the amount of volume required to maintain fluid goals in cerebral salt wasting syndrome.
- In some instances, consider reducing fluid administration to maintain euvelomic state. Avoid hypervolemia.
- Target sodium levels are dependent on baseline levels
- Do not increase sodium by more than 10-12 mEq/L for the first 24 hours.

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*Sodium requirement (mEq) = total body water X (desired serum sodium concentration – current serum concentration) Where the total body water = weight (kg) X correction factor.
Factor = 0.6 in children; 0.6 and 0.5 in nonelderly men and women, respectively; and 0.5 and 0.45 in elderly men and women, respectively.
### Order Sets
- OSU IP ED: Hemorrhagic Stroke – Confirmed [2972]
- OSU IP ED: Stroke Alert [2265]
- OSU IP NV1: Admission Subarachnoid Hemorrhage [2186]
- OSU IP PMR: Admission Stroke Rehab [2030]
- OSU IP NV1: Stroke Bundle [2473]

### References
- Probst MA, Hoffman JR. Computed tomography angiography of the head is reasonable next test after a negative noncontrast head computed tomography result in the emergency department evaluation of subarachnoid hemorrhage. Annals of Emergency Medicine 2016 –
- Robert F. McCormack, MD, and Alan Hutson, PhD. Can Computed Tomography Angiography of the Brain Replace Lumbar Puncture in the Evaluation of Acute-onset Headache After a Negative Noncontrast Cranial Computed Tomography Scan 2010 by the Society for Academic Emergency Medicine

### Quality Measures
- Dysphagia screening
- Venous thromboembolism (VTE) prophylaxis
- Subarachnoid severity documentation
- Stroke education including tobacco cessation
- Assessed for rehabilitation

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### Guideline approved

**Disclaimer:** Clinical practice guidelines and algorithms at The Ohio State University Wexner Medical Center (OSUWMC) are standards that are intended to provide general guidance to clinicians. Patient choice and clinician judgment must remain central to the selection of diagnostic tests and therapy. OSUWMC's guidelines and algorithms are reviewed periodically for consistency with new evidence; however, new developments may not be represented.