

Chapter 9

Management of Aneurysmal Subarachnoid Hemorrhage (aSAH) in the ICU



9.1 Introduction

Aneurysmal subarachnoid hemorrhage (aSAH) is a life-threatening condition resulting from the rupture of an intracranial aneurysm, leading to bleeding into the subarachnoid space. It carries significant mortality and morbidity and prompt, comprehensive management in the intensive care unit (ICU) is crucial to improve patient outcomes. A multidisciplinary approach involving neurologists, neurosurgeons, interventional neuroradiologists, and critical care specialists is essential. The general management strategy includes prompt diagnosis, stabilization, early aneurysm treatment, vigilant monitoring for complications, and planning for long-term recovery [1] (Ref. Algorithm 9.1).

9.2 Management Algorithm

1. Initial Assessment and Grading

Neurological Examination

- Thorough Neurological Assessment: Evaluate the patient's level of consciousness, motor and sensory functions, and cranial nerve integrity to determine the neurological status [2].

Grading Scales

- Hunt and Hess Scale: Assesses the clinical severity of aSAH.
 - Grade I: Asymptomatic or mild headache and slight nuchal rigidity.
 - Grade II: Moderate to severe headache, nuchal rigidity, no neurological deficit except cranial nerve palsy.
 - Grade III: Drowsiness, confusion, or mild focal deficit.

- Grade IV: Stupor, moderate to severe hemiparesis, early decerebrate rigidity.
- Grade V: Deep coma, decerebrate rigidity, moribund appearance.
- World Federation of Neurological Societies (WFNS) Scale: Based on the Glasgow Coma Scale (GCS) score and presence of focal neurological deficits.
 - Grade I: GCS 15, no motor deficit.
 - Grade II: GCS 13–14, no motor deficit.
 - Grade III: GCS 13–14, with motor deficit.
 - Grade IV: GCS 7–12, with or without motor deficit.
 - Grade V: GCS 3–6, with or without motor deficit.
- Modified Fisher Scale: Radiologic grading based on the amount and distribution of subarachnoid blood on CT scans, useful for predicting the risk of cerebral vasospasm and delayed cerebral ischemia (DCI).
 - Grade 0: No blood detected.
 - Grade 1: Minimal thin layer of blood (<1 mm).
 - Grade 2: Thick layer of blood (>1 mm) without ventricular blood.
 - Grade 3: Thin layer of blood with ventricular hemorrhage.
 - Grade 4: Thick layer of blood with ventricular hemorrhage.

Blood Volume Estimation

- ABC/2 Method: A simplified quantitative method for estimating the volume of subarachnoid hemorrhage using CT scans. A = width/thickness, B = length, C = vertical extension) on head non-contrast computed tomography in five major SAH cisternal compartment. This estimation correlates with patient outcomes and the risk of DCI, especially useful in settings lacking advanced imaging modalities [3].

2. Initial Management

Blood Pressure (BP) Control

- Maintain Optimal BP: Keep systolic BP below 160 mm Hg or mean arterial pressure (MAP) below 110 mm Hg using short-acting intravenous medications to prevent rebleeding [4].
- Avoid Large BP Fluctuations: Stabilize BP to prevent sudden increases or decreases, which can contribute to poor outcomes.

Reverse Anticoagulation

- Anticoagulant Reversal: If the patient is on anticoagulants, administer appropriate reversal agents promptly to reduce the risk of further bleeding.

Administer Analgesics and Antiemetics

- Pain and Nausea Management: Use analgesics and antiemetics to improve patient comfort and prevent complications like increased intracranial pressure (ICP) due to vomiting.

Seizure Prophylaxis

- Avoid Routine Prophylactic Antiseizure Medications: Do not administer antiseizure medications prophylactically unless the patient has risk factors such as high-grade aSAH (Hunt and Hess Grades IV–V) or intraparenchymal hemorrhage.
- Treat New-Onset Seizures: If seizures occur, initiate antiepileptic drugs (AEDs) and continue for a duration guided by neurology consultation.

3. Early Aneurysm Treatment (within 24 H)**Endovascular Coiling**

- Preferred Method: Especially for aneurysms in the posterior circulation or those amenable to coiling. Involves inserting detachable coils into the aneurysm to promote thrombosis and prevent rebleeding.

Surgical Clipping

- Alternative Option: Considered for younger patients (<40 years) or when coiling is not feasible. Involves placing a clip at the aneurysm neck during open surgery to exclude it from circulation.

Specialist Evaluation

- Multidisciplinary Assessment: Aneurysm evaluation by both endovascular and surgical specialists to determine the most appropriate treatment modality.

Partial Obliteration

- Interim Measures: If complete obliteration is not immediately feasible, partial obliteration may secure the rupture site, with plans for definitive treatment later.

4. Preventing Rebleeding**Frequent BP Monitoring and Maintenance**

- Continuous Monitoring: Use arterial lines for real-time BP measurements to maintain BP within target ranges.

Avoid Large BP Fluctuations

- Stable Hemodynamics: Use vasoactive medications judiciously to prevent sudden changes in BP.

Avoid Routine Antifibrinolytic Therapy

- Risk of Complications: Routine use is not recommended due to increased risks of thromboembolic events and ischemia.

5. Monitoring and Managing Complications

9.3 Cerebral Vasospasm and Delayed Cerebral Ischemia

Early Identification

- Advanced Monitoring Techniques: Utilize transcranial Doppler ultrasonography, CT angiography (CTA), CT perfusion (CTP), or digital subtraction angiography (DSA) to detect cerebral vasospasm [5].
- Risk Stratification: Use grading scales (Hunt and Hess, WFNS, Modified Fisher) to predict the risk of vasospasm and DCI.

Nimodipine Administration

- Start Early: Initiate oral nimodipine (60 mg every 4 h) as soon as possible to reduce the risk of DCI and improve functional outcomes and continue for 21 days.

DCI Management

- Maintain Euvolemia: Ensure adequate fluid balance to optimize cerebral perfusion.
- Induced Hypertension: If signs of DCI develop, consider induced hypertension to improve cerebral blood flow under careful monitoring.

9.4 Cerebral Edema and Intracranial Pressure Control

Hyperosmolar Therapy

- Mannitol or Hypertonic Saline: Administer as needed to reduce cerebral edema and lower ICP.

ICP Monitoring

- Continuous Monitoring: Use ICP monitors in patients at risk of elevated ICP to guide therapy.

Additional Measures

- Hyperventilation: Temporarily reduce ICP in acute settings by lowering PaCO₂ levels.
- CSF Diversion: Utilize external ventricular drainage (EVD) to remove cerebrospinal fluid (CSF) and reduce ICP.
- Avoid Hypotonic Fluids: Prevent fluid shifts that can worsen cerebral edema.

9.5 Hydrocephalus Management

Early Detection

- Routine CT Scans: Perform serial imaging to monitor ventricular size and detect hydrocephalus promptly [6].

External Ventricular Drainage

- Acute Management: Place an EVD to relieve increased intracranial pressure and manage acute hydrocephalus effectively.

Seizure Management

- Treatment of Seizures: Initiate AEDs for patients who experience seizures, tailoring the duration and choice of medication to individual risk factors and consulting neurology services.

6. Multidisciplinary Approach

- Comprehensive Stroke Centers: Manage patients in facilities equipped with dedicated neurocritical care units.
- Team Collaboration: Involve neurosurgeons, neurologists, interventional neuroradiologists, critical care specialists, rehabilitation therapists, and nursing staff in patient care to improve outcomes.

7. Long-Term Recovery**Rehabilitation**

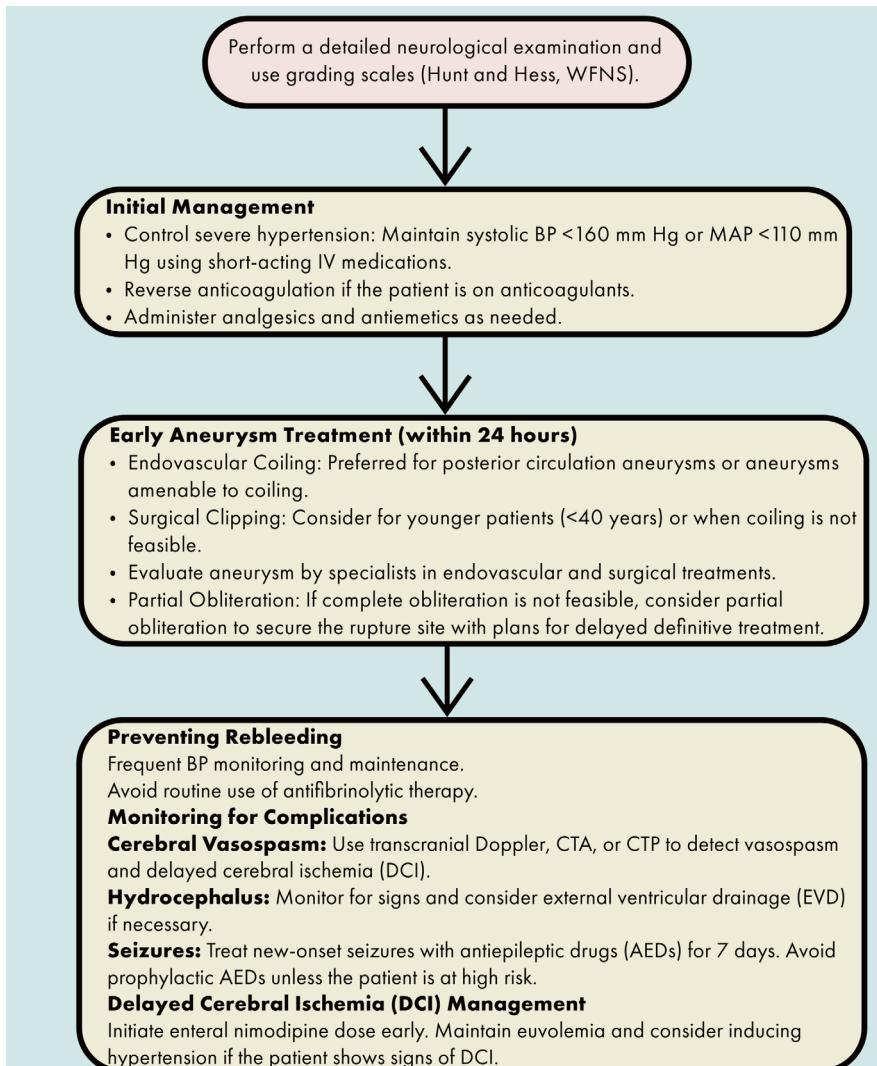
- Cognitive and Behavioral Therapy: Address cognitive deficits through specialized rehabilitation programs.
- Physical Therapy: Implement physiotherapy to improve motor function and reduce disability.
- Screening Tools: Use validated instruments to assess post-discharge deficits and plan ongoing care.

Follow-Up Care

- Outpatient Services: Arrange for continued neurological assessments and support services after discharge.
- Patient and Family Education: Provide education on lifestyle modifications and adherence to follow-up appointments.

9.6 Conclusion

Effective management of aneurysmal subarachnoid hemorrhage in the ICU requires a comprehensive, multidisciplinary approach. Early assessment using clinical and radiological grading scales aids in risk stratification and guides management decisions. Prompt control of blood pressure, reversal of anticoagulation, and early aneurysm repair are critical to prevent rebleeding. Vigilant monitoring for complications such as cerebral vasospasm, DCI, cerebral edema, elevated ICP, hydrocephalus, and seizures is essential. Implementing advanced monitoring techniques and evidence-based interventions like nimodipine administration can improve outcomes. Addressing long-term recovery needs through rehabilitation and follow-up care is vital for enhancing quality of life in survivors. Managing patients in specialized centers with multidisciplinary teams further optimizes outcomes, emphasizing the importance of collaborative care in aSAH management.

Algorithm 9.1: Management of aneurysmal subarachnoid hemorrhage (aSAH) in the ICU

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