Subarachnoid Hemorrhage

A subarachnoid hemorrhage (SAH) is bleeding into the subarachnoid space, which occurs most commonly due to trauma. The most common causes of non-traumatic SAH include rupture of a cerebral aneurysm or arteriovenous malformation (AVM), drugs (e.g. cocaine, caffeine), or strenuous physical activity. Patients often complain of the 'worst headache of my life'. Other clinical manifestations include meningismus and change in consciousness. Risk factors for SAH include hypertension, smoking, alcohol use, and a positive family history. Complications include ischemic stroke, seizures, SIADH, rebleeding, and Cushing's triad. The initial step in diagnosis is a non-contrast head CT scan. Definitive management is neurosurgery (clipping vs coiling). Other considerations include fluid resuscitation, blood pressure control, intracranial pressure control, anticoagulation reversal, vasospasm prophylaxis, and possibly seizure prophylaxis.

PLAY PICMONIC

Bleeding into Subarachnoid Space
Bleeding into Sub-arachnid Space
Trauma or aneurysm/AVM rupture can lead to bleeding into the subarachnoid space, which exists between the arachnoid membrane and the pia mater.

Mechanisms

Trauma
Trauma-spike
Trauma is the single most common overall cause of subarachnoid hemorrhage (SAH), often resulting from head injuries sustained in falls, motor vehicle accidents, or assaults. Traumatic SAH (SAH) occurs due to tearing of small blood vessels in the subarachnoid space, leading to bleeding around the brain. In contrast, non-traumatic or spontaneous SAH is most commonly caused by ruptured cerebral aneurysms, which can be life-threatening. Other less common causes of SAH include arteriovenous malformations (AVMs), blood clotting disorders, and the use of anticoagulant medications

Aneurysm Rupture
Bulging-aneurysm Rupturing
The most common cause of non-traumatic SAH is rupture of a cerebral aneurysm. Aneurysms come in all shapes and sizes e.g. fusiform (may have atherosclerotic areas within), saccular/berry (deteriorated tunica media), and mycotic (from infected emboli in patients with infective endocarditis).

AVM Rupture
A Tangle of Blood Vessels in the Brain
Arteriovenous malformations (AVM) can lead to SAH in 5-10% of cases.

Vasospasm causes Ischemia
Vessel-spaceship making Ice-Ischemia
Vasospasm occurs days following SAH and is due to blood breakdown products. It is a major cause of morbidity and mortality in patients with SAH. Thus, subarachnoid hemorrhage is treated with nimodipine (a calcium channel blocker) to prevent this.

Signs & Symptoms

"Worst Headache Of My Life"
"Worst Headache Of My Life"
Patients classically present with the ‘worst headache of my life’. This complaint is almost pathognomonic when paired with a correlating history. Other clinical manifestations include change in the level of consciousness and meningismus from subarachnoid blood irritating the meninges.

Diagnosis

Noncontrast Head CT

Cat-scanner

Noncontrast head CT is the best initial test to look for bleeding in the subarachnoid space. It allows for diagnosis in >90% of cases within 24 hours of initial bleeding.

Lumbar Puncture

Lumber Punctured

If CT is negative but SAH is still suspected, a lumbar puncture could be performed to look for blood in the cerebrospinal fluid (CSF), which manifests as xanthochromia. Xanthochromia is described as a yellow tint to the CSF, which occurs due to bilirubin from blood breakdown products.

Angiography

Angel with Angiography

Digital Subtraction Angiography (DSA) is performed to determine the exact etiology and location of bleeding (e.g. location of aneurysm). CT angiography (CTA) may be utilized if initial head CT were equivocal/non-confirmatory.

Considerations

Surgery

Surgeon

Definitive treatment is neurosurgery with either open surgical clipping or endovascular coiling depending on various patient factors. If hydrocephalus is present, the patient may require an external ventricular drain or ventriculoperitoneal shunt to alleviate the intracranial pressure. Also remember to reverse any anticoagulation therapy the patient may previously have been taking.

Blood Pressure Control

BP-cuff

After establishing intravenous access for fluid resuscitation and pharmacologic management, the clinician should aim to maintain blood pressure below 160 mm Hg systolic. This helps prevent rebleeding. Beta blockers are usually preferred unless contraindications exist.

Intracranial Pressure Control

Pressure-cooker Cranium

The addition of blood into the subarachnoid space causes intracranial pressure (ICP) to increase. Over time, an elevated ICP may lead to cranial nerve palsies or even herniation. Thus methods such as IV mannitol, hyperventilation, 30° elevation of the head of the bed, and stool softeners may be employed to control ICP.

Nimodipine for Vasospasm Prophylaxis

Knee-moped with Vessel-spaceship and Purple-axes

Nimodipine is a calcium channel blocker given orally that helps prevent vasospasm after SAH. Vasospasm is a dangerous complication of SAH that may lead to ischemic stroke. Seizure prophylaxis may also be considered; however, this is not routine.