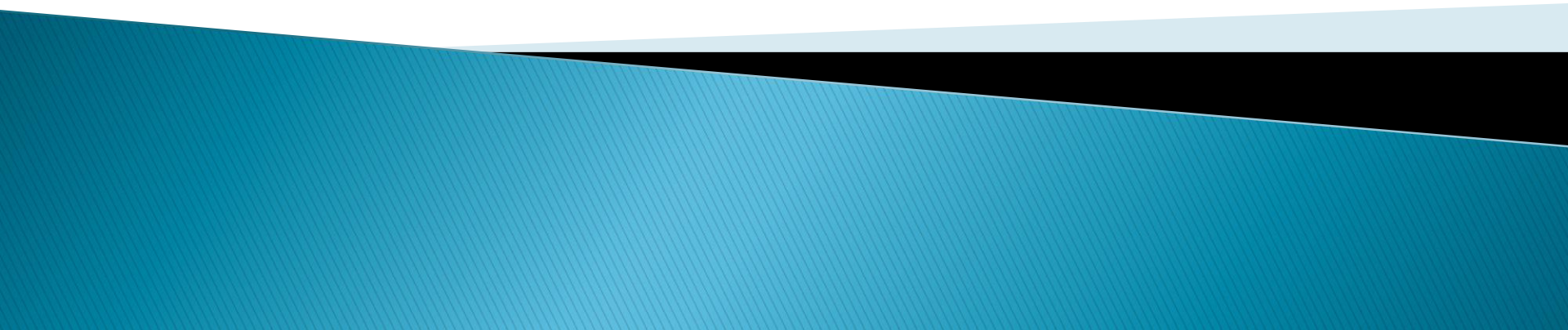


Subarachnoid Hemorrhage



Subarachnoid hemorrhage (SAH) refers to extravasation of blood into the subarachnoid space between the pial and arachnoid membranes.

Excluding head trauma, the most common cause of SAH is rupture of a saccular aneurysm.

Other causes include:

- ▶ mycotic aneurysms,
- ▶ bleeding from a vascular malformation (arteriovenous malformation or dural arterial-venous fistula)
- ▶ and extension into the subarachnoid space from a primary intracerebral hemorrhage.

Saccular ("Berry") Aneurysm

➤ about 2% of adults harbor intracranial aneurysms.

For patients who arrive alive at hospital, the mortality rate over the next month is about 45%. Of those who survive, more than half are left with major neurologic deficits.

If the patient survives but the aneurysm is not obliterated, the rate of rebleeding is:

- 20% in the first 2 weeks,
- 30% in the first month, and about
- 3% per year afterwards.

- Unruptured, asymptomatic aneurysms are much less dangerous than a recently ruptured aneurysm.
- The annual risk of rupture for aneurysms <10 mm in size is 0.1%, and for aneurysms 10 mm in size is 0.5–1%.

the surgical morbidity rate far exceeds these percentages.

- Because of the longer length of exposure to risk of rupture, younger patients with aneurysms >10 mm in size may benefit from prophylactic treatment

- The risk of rupture of *Giant aneurysms* (>2.5 cm) is 6% in the first year after identification and may remain high indefinitely.
- They account for 5% of cases and they often cause symptoms by compressing the adjacent brain or cranial nerves.

The three most common locations of aneurysms are:


- ▶ the terminal internal carotid artery,
- ▶ middle cerebral artery (MCA) bifurcation,
- ▶ top of the basilar artery.

Approximately 85% of aneurysms occur in the anterior circulation. About 20% of patients have multiple aneurysms, many at mirror sites bilaterally.

modifiable risk factors for SAH are:

- ▶ hypertension,
- ▶ cigarette smoking,
- ▶ heavy alcohol use,
- ▶ and drug abuse (e.g., cocaine, amphetamines).

Factors that reduce the risk of aneurysm are:

- ▶ hormone replacement therapy among women,
 - ▶ hypercholesterolemia,
 - ▶ and diabetes mellitus
- 

Clinical features

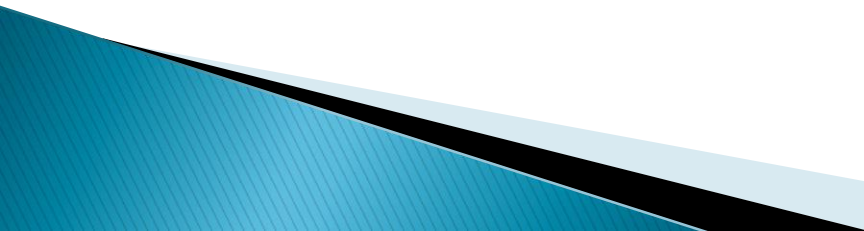
- ▶ A hallmark of SAH is an *acute (thunderclap) headache*, which the patient may describe as “*the worst headache of my life.*”

Sentinel or thunderclap headaches may be the only symptom of “warning leaks.”

- ▶ Nausea and vomiting.
- ▶ meningeal signs with neck pain and stiffness, Kernig, or Brudziski signs.

Meningeal signs can take **3–12 hours** to develop and can be completely absent in the case of *coma or minimal blood extravasation.*

Thus, the absence of neck stiffness cannot exclude the diagnosis of subarachnoid hemorrhage.

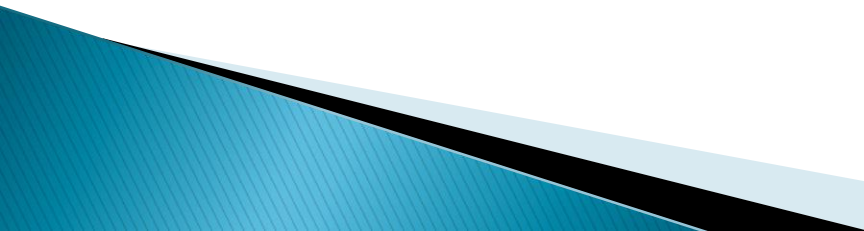
- ▶ Reduced level of consciousness.
 - ▶ hemiparesis, and other focal neurological symptoms.
 - ▶ Seizures may present in 7% of all patients.
 - ▶ Systemic features :
 - severe hypertension,
 - hypoxemia,
 - ECG changes (may mimic acute MI).
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Complications of SAH

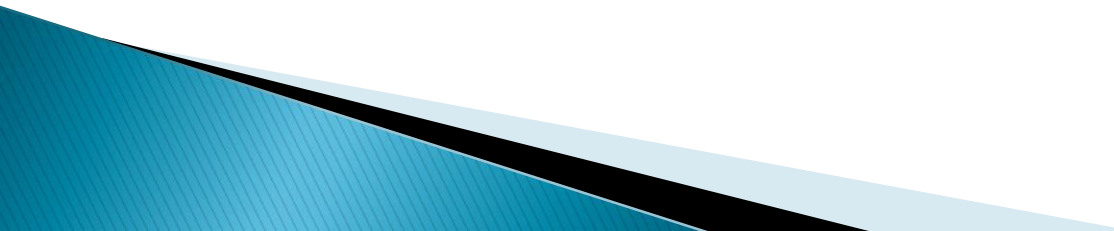
Recurrence of SAH

- is a common event within **2 weeks**, with **15%** occurring within the first few hours after the initial haemorrhage.
- The mortality of patients who suffer rebleeding is about **50%**.

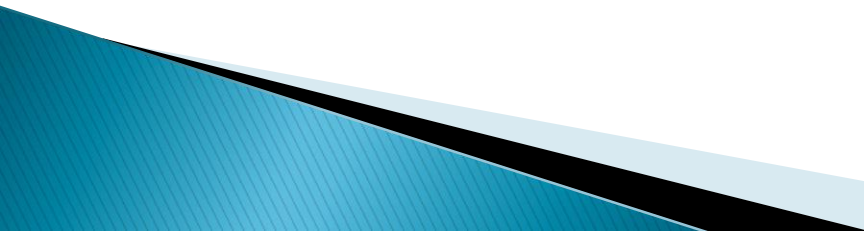
Vasospasm and delayed ischemic deficit

- Vasospasm occurs within the first 2 weeks after SAH.
 - It can cause delayed ischemic neurological deficit, leading to ischemic stroke and death in **one-third** of patients.
 - Transcranial sonography is a common modality for detecting and monitoring vasospasm.
- 

Hydrocephalus

- Acute, subacute, or chronic hydrocephalus is a common complication of SAH.
 - Obstructive Hydrocephalus is caused by a blockage of (CSF) drainage from the fourth ventricle/aqueduct.
 - non-obstructive hydrocephalus, resulting from ineffective reabsorption,.
- 

Other complications

- ▶ Seizures
 - ▶ pulmonary edema,
 - ▶ cardiovascular dysfunction secondary to increased autonomic discharges,
 - ▶ Hyponatremia and inappropriate secretion of antidiuretic hormone,
- 

Diagnostic investigations

CT scan

A CT scan is the first investigation if SAH is suspected. The ability to detect SAH is dependent on the:

- ▶ amount of subarachnoid blood,
- ▶ the interval after symptom onset,
- ▶ the resolution of the scanner,
- ▶ and the skills of the radiologist.

The sensitivity of CT performed within the *first 12 hours is 98%*, but is down to *85% by the fifth day* and to *30% by 2 weeks*.

Cerebral vasospasm may be predicted with CT findings. *A diffuse thick blood clot in the subarachnoid space* increases the risk of cerebral vasospasm and ischemia.

Lumber puncture

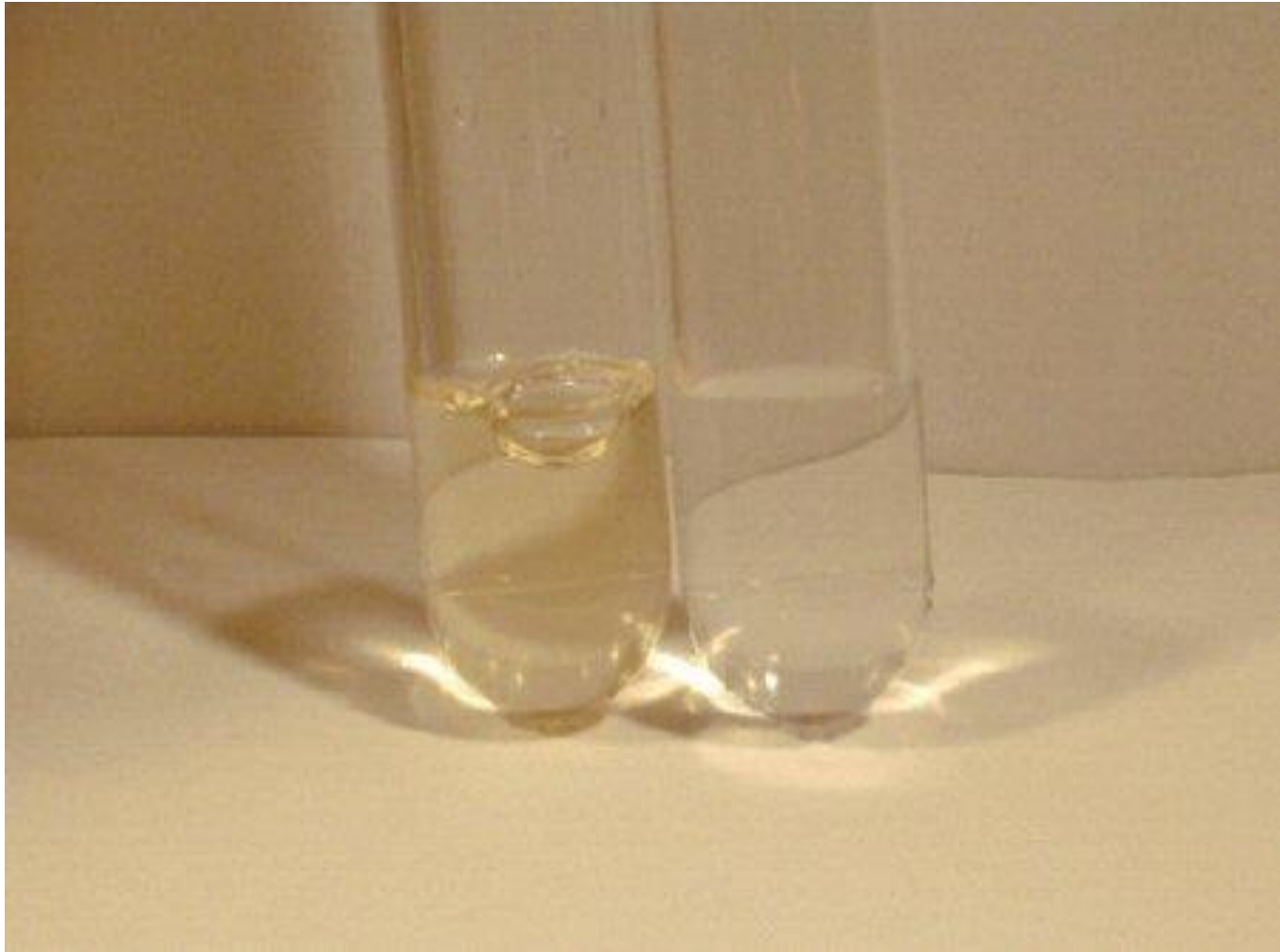
Indication

high clinical suspicion of SAH with negative neuroimaging

Look for

Xanthochromia; Lysis of the RBC and subsequent conversion of hemoglobin to bilirubin.

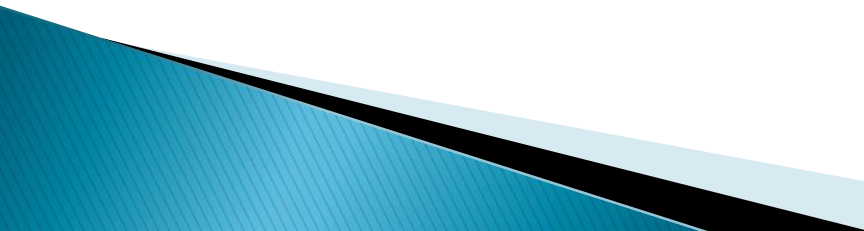
The spinal fluid yellow within 6–12 h, peaks in intensity at 48 h and lasts for 1–4 weeks.



Angiography

Once the diagnosis of hemorrhage from a ruptured saccular aneurysm is suspected,

four-vessel conventional x-ray angiography is performed to:

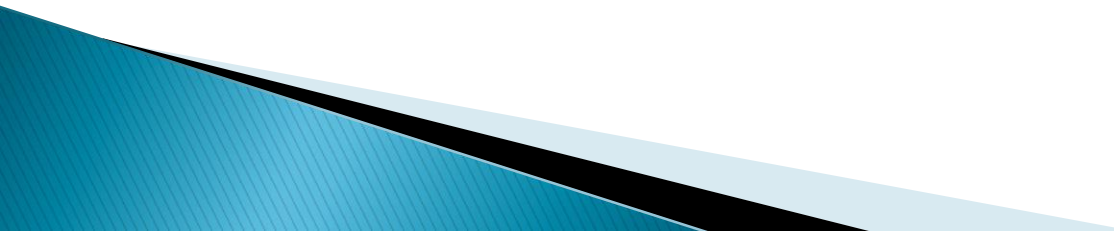
- 1- provide sufficient anatomical details of the aneurysm for selection of therapeutic modalities, either surgical and/or endovascular interventions.
 - 2- determine if other unruptured aneurysms exist.
- 

MRI

- it less optimal for detecting SAH because:
 - ▶ the higher cost,
 - ▶ lower availability,
 - ▶ longer study time,
 - ▶ is not sensitive for SAH within the first 48 hours.
- is a useful tool to:
 - ▶ diagnose AVMs that are not detected by cerebral angiography or spinal AVMs causing SAH.
 - ▶ It also be useful for diagnosing and monitoring unruptured cerebral aneurysms.

MRA

the current limitations of MRA, include:

- ▶ lower sensitivity than cerebral angiography in the detection of small aneurysms.
 - ▶ failure to detect posterior communicating artery and anterior communicating artery aneurysms.
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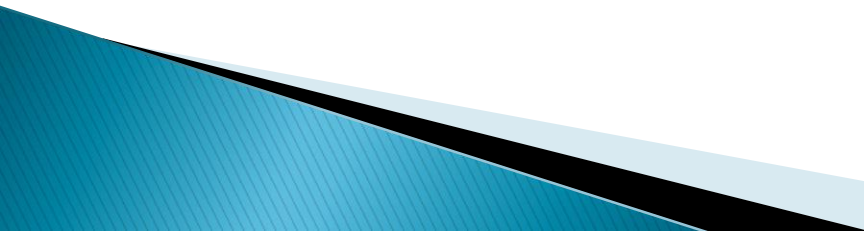
CTA

- A great advantage of CTA over MRA and catheter angiography is the *speed* with which it can be undertaken, *preferably immediately after the CT scan* of the brain by which the diagnosis of aneurysmal hemorrhage is made, and while the patient is still in the scanner,
- but is less feasible for SAH patients who are restless or need mechanical ventilation.

Medical treatment

- ▶ cardiovascular and respiratory functions monitoring.
- ▶ Medical therapies designed to combat raised ICP (e.g., mild hyperventilation, mannitol, and sedation) can be used.
- ▶ Acute hypertensive response must be controlled promptly with appropriate use of IV antihypertensive drugs such as nicardipine or labetalol. Reduction and maintenance of systolic blood pressure (BP) to values *below 140 mmHg* are recommended.
(Hypotension should be avoided to reduce the risk of hypoperfusion)
- ▶ If headache or neck pain is severe, mild sedation and analgesia are prescribed. (Extreme sedation is avoided because it can obscure changes in neurologic status).

- ▶ Seizures are *uncommon* at the onset of aneurysmal rupture. However, anticonvulsants are sometimes given as prophylactic therapy since a seizure could *promote rebleeding*.
- ▶ Glucocorticoids may help *reduce the head and neck ache* caused by the irritative effect of the subarachnoid blood. There is *no good evidence* that they reduce cerebral edema, are neuroprotective, or reduce vascular injury, and *their routine use therefore is not recommended*.
- ▶ All patients should have pneumatic compression stockings to prevent pulmonary embolism.
- ▶ Unfractionated heparin subcutaneously for DVT prophylaxis can be initiated immediately following endovascular treatment and within days following surgical clipping

- ▶ Hyperpyrexia should be managed appropriately, with the recommended body temperature being **37.2 °C**.
 - ▶ Hyperglycemia should also be controlled, with blood glucose levels kept in the range of **80–120 mg/dl**.
 - ▶ Stress peptic ulcers can be prevented by proton pump inhibitors.
 - ▶ The risk of cerebral vasospasm leading to ischemia can be reduced by **nimodipine 60 mg** orally every 4 hours for **21 days**.
- 

- ▶ Rebleeding can be prevented by antifibrinolytic or tranexamic acid. It should be noted, however, that the advantages of thrombostatic agents may be offset by their adverse effects in inducing ischemic complications.
- ▶ Many patients continue to experience a decline in serum sodium despite receiving parenteral fluids containing normal saline. Frequently, supplemental oral salt coupled with normal saline will mitigate hyponatremia, but often patients also require hypertonic saline.
- ▶ Care must be taken not to correct serum sodium too quickly in patients with marked hyponatremia of several days' duration, as central pontine myelinolysis may occur

Surgical and endovascular management

For the prevention of **rebleeding**, surgical or endovascular intervention is frequently needed.

The decision for surgical or endovascular intervention depends on a number of factors, including *age, medical condition, and aneurysm characteristics, such as location, size, and morphology.*



