Intracerebral Hemorrhage

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Learning Objectives

Title: Neurosurgical Management of ICH

Speaker: Farhad M. Limonadi, M.D.

Learning Objectives:

1. Distinguish intra-cerebral hemorrhage from other forms of intra-cranial hemorrhage
2. List etiologies for ICH
3. Recognize radiographic appearance for ICH and identify differential diagnosis
4. Explain immediate medical management
5. Describe the role of surgery and surgical management
6. Address risk factors and provide appropriate patient education.

Intracranial Hemorrhage

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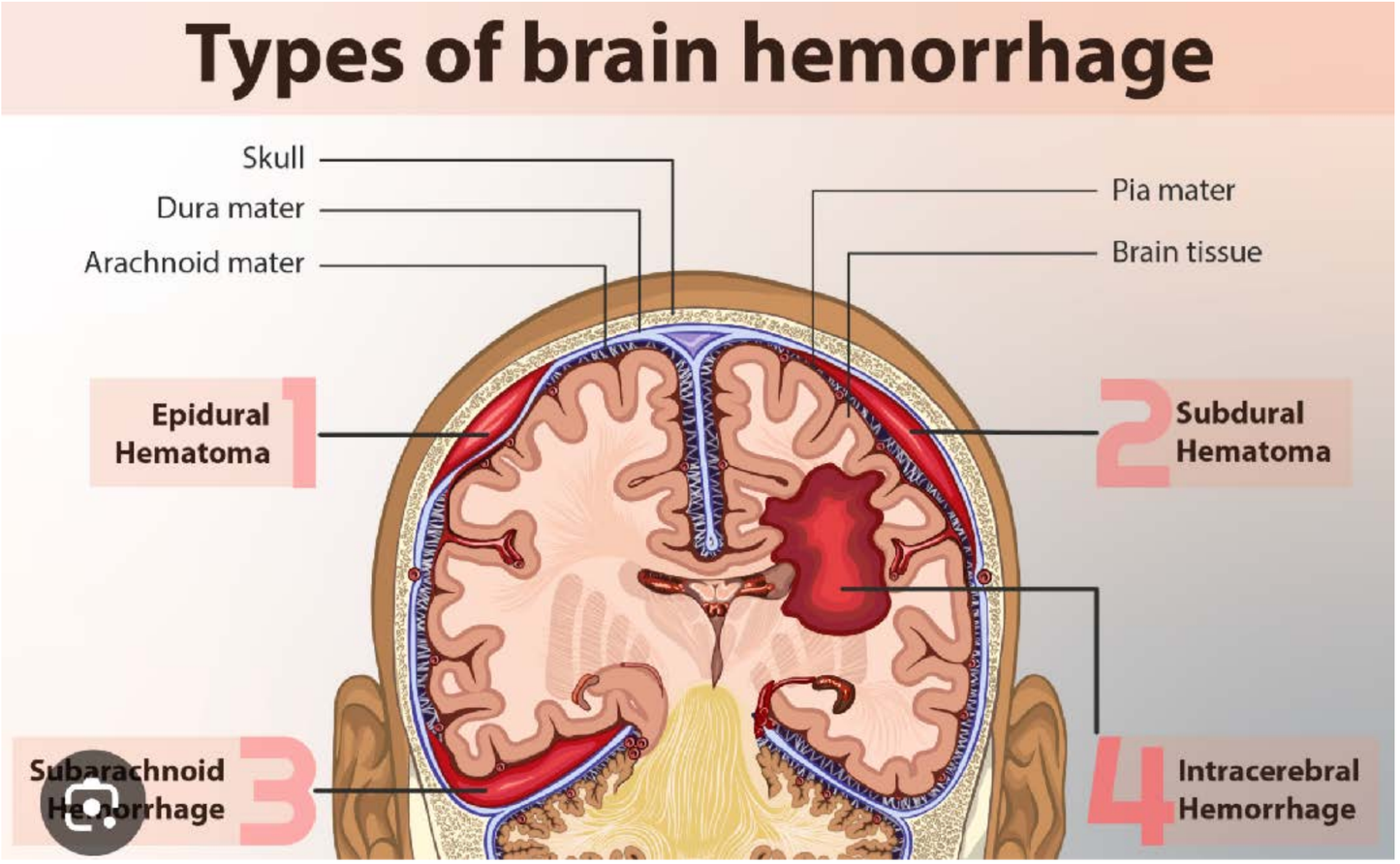
Intracranial hemorrhage encompasses four broad types of hemorrhage:

1 **Epidural hemorrhage (EDH)**
- **5-15% fatal head injuries**
- **85-95% associated with overlying skull fx**

2 **Subdural hemorrhage(SDH)**
- **Incidence increases throughout life**
- **Annual incidence of 5 per 100K population**

3 **Subarachnoid hemorrhage (SAH)**

4 **Intracerebral hemorrhage (ICH)**
- **Accounts for 10-20% of all strokes**
- **Significant increase in incidence after the age of 55**



Epidural hematoma (EDH)

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Intracranial hemorrhage encompasses four broad types of hemorrhage:

1. **Venous or arterial**
2. **Blunt trauma to the head (temporal common)**
3. **Skull fx and MMA**
4. **Venous common in pediatric population**

Subdural hematoma (SDH)

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Intracranial hemorrhage encompasses four broad types of hemorrhage:

1 Injury to vessel traversing between the brain and skull

2 Very common in elderly

3 Be aware of subdural empyema mimicking SDH

Subarachnoid hematoma (SAH)

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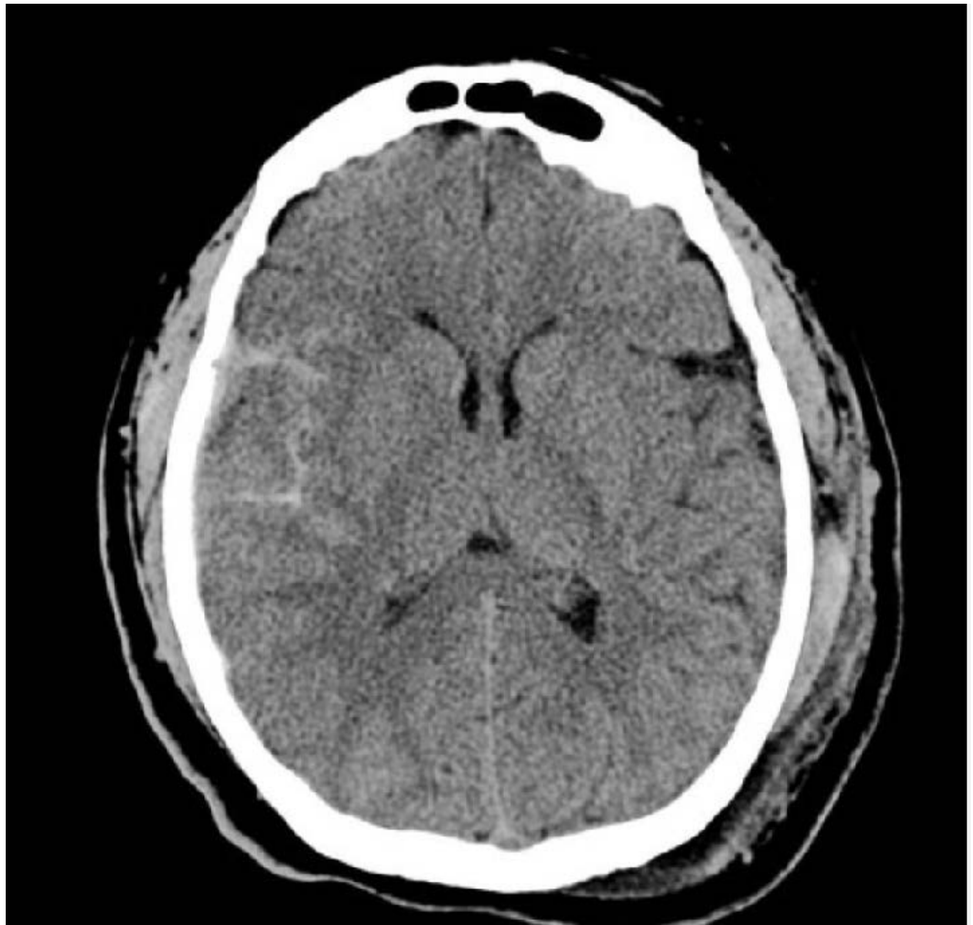
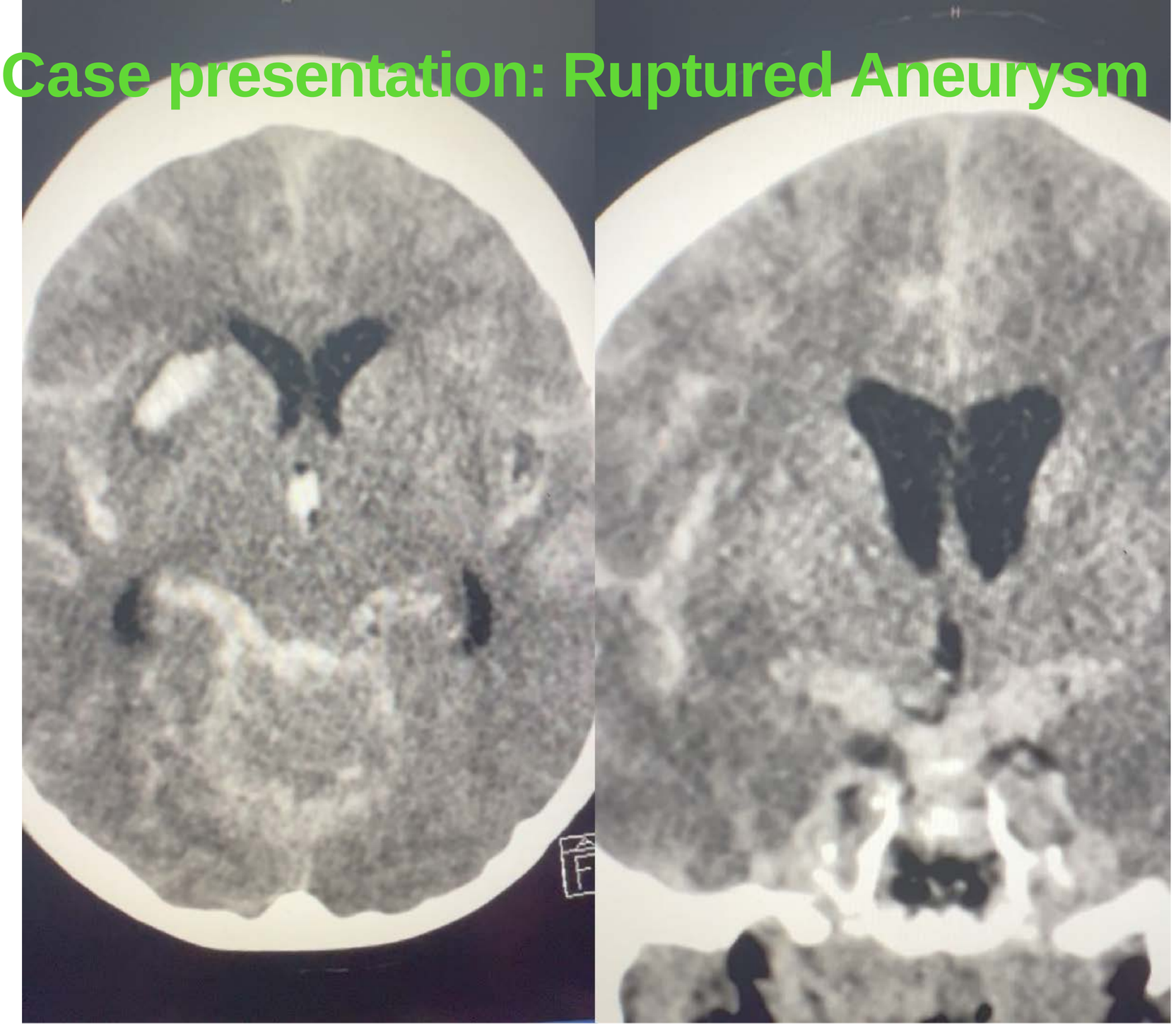
Intracranial hemorrhage encompasses four broad types of hemorrhage:

1 Traumatic versus non traumatic

2 Aneurysmal versus non-aneurysmal



Case presentation: Ruptured Aneurysm



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Case presentation: Ruptured Aneurysm

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Intracerebral hemorrhage (ICH)

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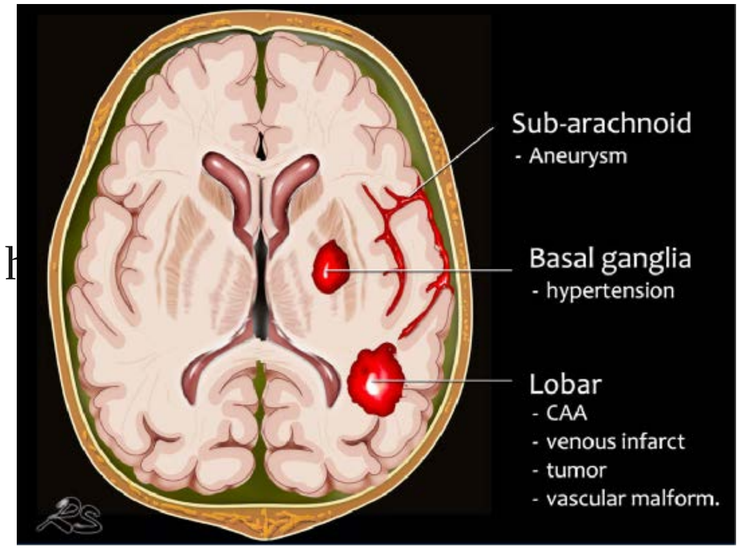
- Highest mortality rate of all stroke subtypes
- Hematoma growth is a principal cause of early neurological deterioration
- Prospective and retrospective studies indicate that up to 38% hematoma expansion is noted within three hours
- Hematoma volume is most important predictor of 30-day mortality
- Primary versus secondary ICH
- Hypertensive arteriosclerosis and cerebral amyloid angiopathy (CAA) are responsible for 80% of **primary hemorrhages**
- **Secondary ICH** is due to underlying vascular malformation, hemorrhagic conversion of an ischemic stroke, coagulopathy, intracranial tumor, etc.
- Sinus thrombosis should be suspected in patients with signs and symptoms suggestive of increased intracranial pressure and radiographic evidence of superficial cortical or bilateral symmetric hemorrhagesCavernous malformation
- Venous thrombosis

ICH Etiologies

Vessels are degenerated due to long-standing h

- Hypertension
- Stroke Evolution
- Trauma
- Tumor
- Amyloid antipathy
- DAVF
- Ruptured aneurysm
- AVM
- Cavernous malforma
- Venous thrombosis
- Coagulopathy



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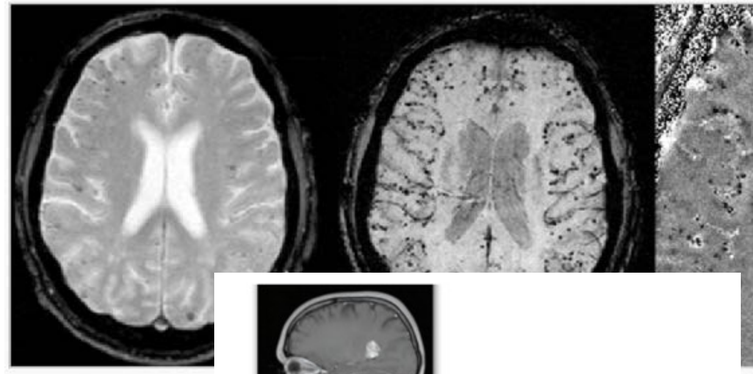
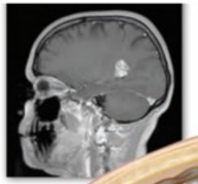
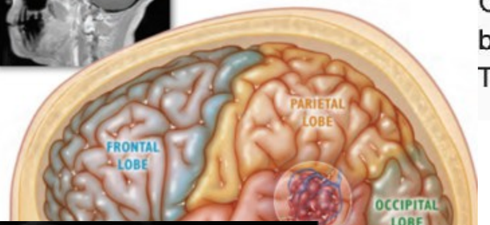
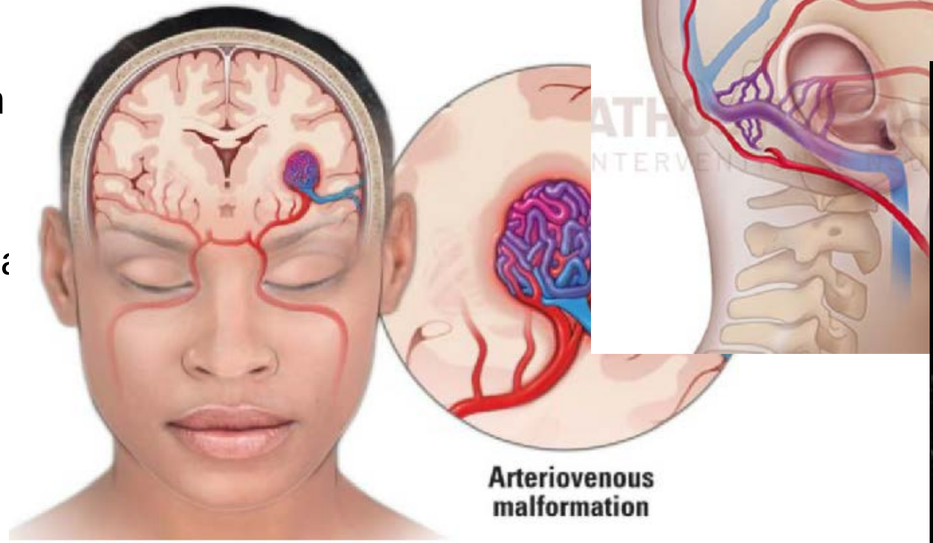
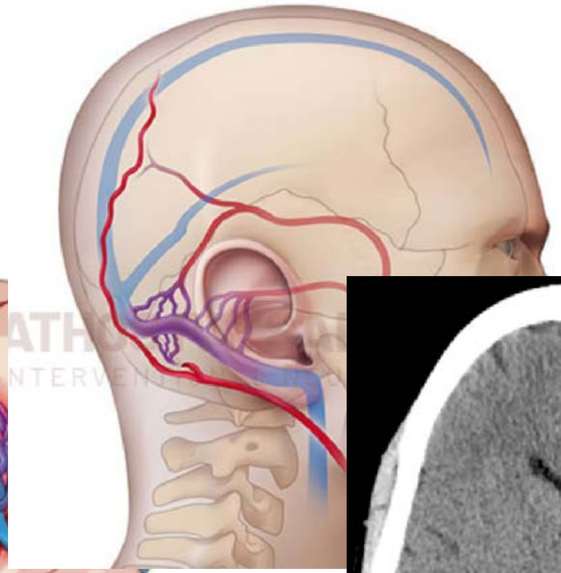


MRI showing low
gradient echo T2
(SWI) and SWI p
Tesla [26]









ICH and Hypertension

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Vessels are degenerated due to long-standing hypertension

- Most important risk factor for spontaneous ICH
- Contribution of hypertension is greater for deep ICH than for lobar ICH (Twice as common)
- Current smoking and heavy alcohol consumption are associated with increased risk of ICH
- Use of warfarin increases the risk of ICH by two- to five-fold
- Anti-platelet therapy can increase the risk of ICH
- ICH and sympathomimetic drugs such as cocaine, heroin, amphetamine, and ephedrine, particularly in young patients
- Chronic kidney disease was found to increase the risk for ICH

Case presentation: Basal Ganglia Hemorrhage

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ICH Presentation

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- Headache
- Nausea and vomiting
- Focal deficit
- Seizure
- Altered mentation

ICH Emergency Management

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- Airway, breathing capability, blood pressure and signs of increased intracranial pressure
- The patient should be intubated based on risk of aspiration, impending ventilatory failure (PaO_2 < 60 mmHg or pCO_2 > 50 mmHg), and signs of increased intracranial pressure
- Emergency measures for ICP
    - HOB elevated
    - Hypertonic Saline/Mannitol
    - Hyperventilation to PCO2 30-35
- Blood pressure control (cerebral perfusion pressure (MAP–ICP) should be kept >70 mmHg)
- Identify thrombolytic, antiplatelet or anticoagulant use and reversing their effects
- Blood should be drawn to measure the patient's hematocrit, hemoglobin, partial thromboplastin time, prothrombin time/INR, platelet count, and fibrinogen (2) blood should be typed and cross-matched if transfusions are needed (at least 4 U of packed red blood cells, 4–6 U of cryoprecipitate or fresh frozen plasma, and 1 U of single donor platelets) (Adams et al 1996). These therapies should be made available for urgent administration
- Concomitant use of vitamin K with FFP, cryoprecipitate, or clotting factor concentrates are recommended to hasten reversal of warfarin induced coagulopathy. Considering the short half-life of coagulation factors at least 5–20 mg of vitamin K is required to sustain reversal of anticoagulation. Intravenous administration of vitamin K should be limited due to concerns of allergic and anaphylactic reactions.
- Seizure prophylaxis

ICH Emergency Management

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- Elevated ICP is defined as intracranial pressure >20 mmHg for over 5 minutes
- The therapeutic goal of treating elevated ICP is to maintain ICP < 20 mmHg while maintaining cerebral perfusion pressure >70 mmHg
- Initially, acute and sustained increase in ICP should prompt a repeat CT to assess the need for a definitive neurosurgical procedure
- An intravenous sedative such as propofol (0.6–6.0 mg/kg/h) or fentanyl (0.5–3.0 μg/kg/h) should be given to the agitated patient to attain a motionless state
- controlling blood pressure with vasopressors such as dopamine and phenylephrine if the CPP is < 70 mmHg or with antihypertensive agents if the CPP is > 70 mmHg. If ICP does not respond to sedation and cerebral perfusion management, osmotic agents and hyperventilation should be considered
- Large ICH associated with elevated intracranial pressure refractory to these measures is fatal in most patients but a barbiturate coma may considered as a last resort to try to reduce intracranial pressure
- Ventricular drains should be used in patients with or at risk for hydrocephalus

Case presentation: Lobar Hemorrhage

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Prognosis of ICH

Poor prognostic factors of intracerebral hemorrhage

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Low score of Glasgow coma scale
Intracerebral hemorrhage volume ($\geq$30 cm^3)
Intraventricular extension of hemorrhage
Infra-tentorial origin of Intracerebral hemorrhage
Old age ($\geq$80)
Advanced white matter lesions
Underweight at admission
Hyperglycemia at admission
Chronic kidney disease (estimated glomerular filtration rate <60 mL/minute/m^2)

Case presentation: AVM

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