Cerebral Aneurysms & AVMs
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What is a Brain Aneurysm?

- It is a weak area on an artery in the brain that balloons out and fills with blood.

- This bulging aneurysm can be asymptomatic, or can also put pressure on a nerve or surrounding brain tissue (causing symptoms), and may even leak or rupture (medical emergency).

- **3 Types** – Saccular (pouch-like), Lateral (bulge on side wall), Fusiform (widening along all walls)
  - Small <11mm
  - Large 11-25mm
  - Giant >25 mm
Intra cranial aneurysms have different layers than the normal arteries they branch off of.

Microscopically aneurysms have very thin tunica media and internal elastic lamina is absent or severely fragmented.

Aneurysms form because of an attenuated tunica media (middle muscular layer) which causes structural defects with associated hemodynamic factors (high pressure and pulsations).

These factors act on distal walls between two exiting branches most commonly at branching points of major arteries coursing through subarachnoid space at base of brain causing aneurysm formation.

EPIDEMIOLOGY

- Most sporadically acquired.
- 1 - 5% prevalence (~10 - 12 million people)
- 0.5 – 1% incidental findings of asymptomatic aneurysms
- 50 - 80% do NOT rupture
- **Subarachnoid Hemorrhage:**
  - 1 / 10,000 (27,000 cases / year)
  - 2 : 1 (W : M)
  - Average age 55-60
- 5 - 15% strokes are related to rupture
Risk Factors

- Risk Factors that contribute to the formation of brain aneurysms:
  - Smoking
  - Hypertension
  - Atherosclerosis
  - Congenital cause resulting from inborn abnormality in artery wall
  - Drug use, particularly cocaine, OCP
  - Infection
  - Tumors (head and neck)
  - Traumatic head injury
  - Family history of brain aneurysms

- Other inherited disorders:
  - Ehler's Syndrome (IV)
  - Polycystic Kidney Disease (screen) – 5-40% (10-30% with multiple)
  - Neurofibromatosis type I
  - Marfan's Syndrome
  - Fibromuscular Dysplasia

  Presence of an arteriovenous malformation

Risk Factors that contribute to the rupture of brain aneurysms:

- Smoking
- Hypertension
Symptoms of an **Unruptured Aneurysm**

- **Most Common Symptoms:**
  - Pain over and behind eyes
  - Numbness
  - Weakness
  - Paralysis
  - Change in pupil size
  - Vision changes

- Mass-effect causing cranial nerve palsies and brain stem compression

- **Common** – 3rd nerve palsy secondary to PCA aneurysm.

- If symptomatic 6% increased risk of rupture per year (asymptomatic 1-2% per year)
Symptoms of a **Ruptured Aneurysm**

- High rate of rupture found with 10mm aneurysms of the basilar apex or PCA

- **Common Symptoms:**
  - Sudden / extreme headache (10% die before getting any help)
  - Double vision / drooping eye lid
  - Nausea / Vomiting
  - Stiff neck
  - LOC, change in MS, seizures

- **Subarachnoid Hemorrhage** usually occurs:
  - Ten to 15 percent of these patients will die before reaching the hospital.
  - Over 50 percent will die within the first thirty days after rupture.

<table>
<thead>
<tr>
<th>Neurologic Disease</th>
<th>Imaging Procedure</th>
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<tbody>
<tr>
<td>Cerebral or cerebellar ischemic infarction</td>
<td>CT in the first 12–24 hr; MRI after 12–24 hr (diffusion-weighted and perfusion-weighted MRI augments the findings, especially in the first 24 hr, and even before 8 hr)</td>
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<tr>
<td>Cerebral or cerebellar hemorrhage</td>
<td>CT in the first 24 hr; MRI after 24 hr; MRI and endovascular angiography for suspected arteriovenous malformation</td>
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<tr>
<td>Transient ischemic attack</td>
<td>MRI to identify lacunar or other small lesions; ultrasound studies of the carotid arteries; magnetic resonance angiography</td>
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<tr>
<td>Arteriovenous malformation</td>
<td>CT for acute hemorrhage; MRI and endovascular angiography as early as possible</td>
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<tr>
<td>Cerebral aneurysm</td>
<td>CT for acute subarachnoid hemorrhage; CT angiography or endovascular angiography to identify the aneurysm; TCD to detect vasospasm</td>
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<td>Brain tumor</td>
<td>MRI without and with injection of contrast material</td>
</tr>
<tr>
<td>Craniocerebral trauma</td>
<td>CT initially; MRI after initial assessment and treatment</td>
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<tr>
<td>Multiple sclerosis</td>
<td>MRI without and with injection of contrast material</td>
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<tr>
<td>Meningitis or encephalitis</td>
<td>CT without and with injection of contrast material initially; MRI after initial assessment and treatment</td>
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<tr>
<td>Cerebral or cerebellar abscess</td>
<td>CT without and with injection of contrast material for initial diagnosis or, if stable, MRI instead of CT; MRI without and with injection of contrast material subsequently</td>
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<tr>
<td>Granuloma</td>
<td>MRI without and with injection of contrast material</td>
</tr>
<tr>
<td>Dementia</td>
<td>MRI; PET; SPECT</td>
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<td>Movement disorders</td>
<td>MRI; PET</td>
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<tr>
<td>Neonatal and development disorders</td>
<td>Ultrasound in unstable premature neonates; otherwise MRI</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>MRI; PET; SPECT</td>
</tr>
<tr>
<td>Headache</td>
<td>CT in patients suspected of having structural disorders</td>
</tr>
</tbody>
</table>

*CT denotes x-ray computed tomography, MRI magnetic resonance imaging, PET positron-emission tomography, SPECT single-photon emission computed tomography, cranial Doppler ultrasonography.
AVM
Brain AVMs
- What is it?
- Incidence
- Treatment
68 yo Male, MVC
Arteriovenous Malformations

- Inborn errors of vascular morphogenesis
- Caused by a defect or malfunction of the embryonal capillary maturation process
- Resulting in the formation of abnormal arterial, venous, or capillary channels with or without a shunt
INCIDENCE

- Between 0.15% -6%
- Symptomatic AVM’s represent 1/10th the frequency of intracranial aneurysms
- Though the incidence is small, patients with AVMs suffer major morbidity and mortality
2% to 4% rupture rate per year
10% to 29% mortality for first bleed
50% mortality if first bleed in posterior fossa
Treatment choices

- Decision to treat and the plan to be carried out is arrived at by a multidisciplinary approach
  - No therapy
  - Surgical excision
  - Complete embolization
  - Radiosurgery
  - Combination of treatments