Cranial Dural AV Fistulas
Transvenous Treatment

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What makes dural fistula treatment particularly interesting?
• Strategy – may be multiple ways to treat
• Choice of best strategy for specific patient
  • No treatment
  • Embolization
  • Palliation
  • Surgery
• Curative treatment
  • Embolization
  • Surgery
• Treatment considerations
  • Risk/benefit
  • Approach: arterial, venous, both
  • Anesthesia Time
  • Radiation

Radiation exposure
• Deterministic effects
  • Epilation: 3 Gy
  • Erythema: 6 Gy
  • Desquamation: 15 Gy
  • Start at 15 millisieverts
• Columbia: 4-8 mSv

Dural fistula: historical perspective
• Francesco Rizzoli (1873) – Arteriovenous aneurysm passing through the skull of a 9 year old girl
  • Seizures and occipital pulsation
  • Cause of death, with post-mortem evaluation
• Ernest Sachs and Wilhelm Tönnis (1931) – first angiographic depiction of dural AV shunt
• Hans Newton and Sten Cronqvist at UCSF reviewed angiographic findings in dural fistulas (1969)

Etiology
• Related to thrombosis of dural sinus or cortical vein
• Venous Occlusion
• Venous congestion
• Hyaline remodeling
• Venous hypertension, cortical vein involvement
• AV Shunt is hallmark
• Antecedent events: trauma, craniotomy, infection, tumor
Angiogenesis and venous HTN

- Venous hypertension model in rat
  - Common carotid artery to external jugular fistula
  - Jugular +/- facial vein occlusion, 2-3 months duration
- Terada et al. (1994)
  - Control group: 0% DAVF
  - Group 1: 13.6% DAVF
  - Group 2: 23.1%

- Lawton et al. (1997)
  - 42% DAVF, 51% facial AVF
  - Angiogenic activity correlated with fistula formation

Cognard Classification

- Type I: confined to sinus wall
- Type Iia: reflux into sinus
- Type Iib: (10-20% hemorrhage)
- Type III: (40% hemorrhage)
- Type IV: (65% hemorrhage)
- Type V: (50% hemorrhage)

Classification of venous drainage in DAVF

<table>
<thead>
<tr>
<th>Venous Drainage Pattern</th>
<th>Cognard</th>
<th>Lalwani</th>
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</thead>
<tbody>
<tr>
<td>Antegrade flow into dural sinus</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Retrograde flow into dural sinus only</td>
<td>II</td>
<td>Ila</td>
</tr>
<tr>
<td>Retrograde flow into cortical vein only</td>
<td>II</td>
<td>Iib</td>
</tr>
<tr>
<td>Retrograde flow into dural sinus and cortical vein</td>
<td>III</td>
<td>III</td>
</tr>
<tr>
<td>Retrograde venous drainage, no antegrade</td>
<td>IV</td>
<td>IV</td>
</tr>
<tr>
<td>Cortical venous ectasia &lt;15 mm or 3X larger than normal draining vein</td>
<td>V</td>
<td></td>
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</tbody>
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Epidemiology

- Mean age at presentation: 50-60 years
- Uncommon but diagnosed with greater frequency - incidental findings on cross sectional imaging
- 10-15% of intracranial vascular lesions
  - 6% supratentorial lesions
  - 35% infratentorial lesions
- No gender predilection
  - More common in women (?)
  - More often hemorrhage in men (?)

Presentation

- Depends on location in general
- Anterior fossa: proptosis, chemosis, paresis/diplopia
- Middle fossa: pulsatile tinnitus
- Sagittal sinus/deep venous: hydrocephalus, papilledema, seizures, dementia
- Posterior fossa/brainstem: cranial neuropathies, quadriparese
Dural Arteriovenous Fistulas
UCSF, By Location, n=366
- Transverse/Sigmoid 38%
- Cavernous 34%
- Deep Cortical 7%
- Superior Sagittal 5%
- Ethmoidal 4%
- Sup. Petrosal 5%
- Inf. Petrosal 3%
- Marginal 4%

Dural Arteriovenous Fistulas
Columbia, By Location, n=238
- Transverse/Sigmoid 52%
- Cavernous 31%
- Deep Cortical 7%
- Superior Sagittal 7%
- Ethmoidal 1%
- Sup. Petrosal 1%
- Inf. Petrosal 1%
- Marginal 1%

66 y/o man with HTN, afib on coumadin, confusion and aphasia
Fistula in wall of sinus
Syncope, ataxia

Multiple cranial neuropathy after arterial treatment – petrous fistula
Indirect Carotid Cavernous Fistula

UCSF, 15 year experience

- 135 patients with dural CCF
- Independent evaluations
- 100% follow-up, mean 56 months/patient
- Over 600 patient-years clinical follow-up
- 97% Good outcome

Meyers AJO 134:85, 2002

Results

- Complete angiographic/clinical cure (90%)
- Single endovascular procedure in (71%)
- Signs/Symptoms resolved over 5.4±1.3 months

Results – Durability

- Transvenous:
  - One (0.8%) treatment failure
- Transarterial:
  - 23% required retreatment
  - 8 patients treated elsewhere underwent curative transvenous occlusion at UCSF

Meyers AJO 134:85, 2002
Columbia, 2001 - Present

- Single procedure in all patients
- 100% technical success with transvenous occlusion
- 100% angiographic cure, confirmed at 6 months
- No neurological morbidity
- No mortality
- 1 patient: DVT with symptomatic PE

Summary

- Fascinating form of dural pathology
- Care must be taken to pick the best option or treatment combination
- Readily amenable to endovascular treatment in most cases
- Palliation or clinical cure achievable in most cases with low treatment morbidity using transvenous technique