Carotid Duplex
TCD Examinations
“How one affects the other!”

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Definition: ---- Collateral Circulation

“Circulation of blood through a network of minor vessels that become enlarged and joined with adjacent vessels when a major vein or artery is impaired, as by obstruction”
CIRCLE OF WILLIS
Collateral Circulation for the Brain
CIRCLE OF WILLIS

• RECEIVES BLOOD FROM INTERNAL CAROTID ARTERIES

• RECEIVES BLOOD FROM THE BASILAR ARTERY

• COMMUNICATES THE ANTERIOR AND POSTERIOR CIRCULATION—RIGHT AND LEFT HEMISPHERE
CIRCLE OF WILLIS

• PROTECTS THE BRAIN BY SHUNTING BLOOD BETWEEN THE TWO SYSTEMS

• OCCURS FOLLOWING OBSTRUCTION
CIRCLE OF WILLIS

• ANTERIOR CIRCULATION VIA ANTERIOR COMMUNICATING ARTERY (ACOM)

• POSTERIOR CIRCULATION VIA POSTERIOR COMMUNICATING ARTERY (PCOM)
MCA / ACA Bifurcation
stroke, 2000;31;1656.)
2000 American Heart Association, Inc
TCI – MCA/ACA
COLLATERAL FLOW

TCI
# ANATOMIC VARIANTS

<table>
<thead>
<tr>
<th>Variant</th>
<th>Incidence (%)</th>
<th>Illustration</th>
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<th>Incidence (%)</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic circle of Willis</td>
<td>18-20</td>
<td><img src="image1" alt="Illustration" /></td>
<td>Duplicate A1</td>
<td>1</td>
<td><img src="image2" alt="Illustration" /></td>
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<tr>
<td>Hypoplasia of one or both PComAs</td>
<td>22-53</td>
<td><img src="image3" alt="Illustration" /></td>
<td>Absent A1</td>
<td>1</td>
<td><img src="image4" alt="Illustration" /></td>
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<tr>
<td>Hypoplasia of A1</td>
<td>15-40</td>
<td><img src="image5" alt="Illustration" /></td>
<td>Absent PComA</td>
<td>1</td>
<td><img src="image6" alt="Illustration" /></td>
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<tr>
<td>Hypoplasia of AComA</td>
<td>13</td>
<td><img src="image7" alt="Illustration" /></td>
<td>Absent AComA</td>
<td>0.3-1</td>
<td><img src="image8" alt="Illustration" /></td>
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<tr>
<td>Duplicate or triplicate AComA</td>
<td>9-40</td>
<td><img src="image9" alt="Illustration" /></td>
<td>Absent MCA</td>
<td>0.3</td>
<td><img src="image10" alt="Illustration" /></td>
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<tr>
<td>Hypoplasia of A1</td>
<td>2-12</td>
<td><img src="image11" alt="Illustration" /></td>
<td>Persistent trigeminal artery</td>
<td>0.1-0.2</td>
<td><img src="image12" alt="Illustration" /></td>
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<td>Third ACA arising from AComA</td>
<td>1.5-10</td>
<td><img src="image13" alt="Illustration" /></td>
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<td><img src="image14" alt="Illustration" /></td>
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EXTRACRANIAL DISEASE
Left ICA
LT EXTRACRANIAL ICA OCCLUSION
Interesting Carotid Cases
#1

- 68 yo Male
- Head hyperextended for 1 hr. during dental procedure
- Multiple episodes of syncope since
- Resident in access clinic questioned right carotid bruit
- Carotid Duplex ordered
Breath holding TCD

Due to the bilateral carotid disease there was concern that the patient did not have adequate cerebrovascular reserve.

A TCD with Breath Holding was ordered
Breath holding TCD

Head band is used to monitor the bilateral MCAs continuously.

The patient is asked to take in a breath, let it out, and take in another breath and hold as long as they can, 30sec is optimal.

If adequate cerebrovascular reserve is present the MFVs will increase 20% over baseline and the Breath holding index (BHI) will be >.70.

BHI <.69 is Abnormal
BHI <.30 is Severely abnormal
Breath holding TCD / Results

**Right MCA:**
- MFV Increased 28.7% - Normal
- Right MCA BHI .70 – Normal (just!)

**Left MCA:**
- MFV Increased 8.7% - Abnormal
- Left MCA BHI .2 – Severely Abnormal
Interesting Carotid Case
#1  Duplex Results

- Occluded right ICA
- Severe right ECA stenosis
- Occluded left CCA
- Retrograde flow left ECA
- Severe left ECA stenosis
- Left Subclavian stenosis
Interesting Carotid Cases
#1

- Patient admitted directly to Clinic
- Started on Plavix
- Heparin 5,000 units injection every 12 hours
- 81 mg ASA
- Schedule for Angiogram
Interesting Carotid Cases

#1  Angio results

- Right ICA occluded
- Right ECA stenosis
- Flow to right MCA from PCOM
- Small Superficial Temporal Artery
- ECA-ICA Collateral – Retrograde flow right OA
Interesting Carotid Cases
#1 Angio results

• Left CCA occluded
• Collateral flow via: Vertebral artery branches to occipital artery to ECA retrograde with antegrade flow into Left ICA
• Severe proximal
  Left Subclavian stenosis
Interesting Carotid Cases
#1

• Potential revascularization options
• Stenting of proximal right ECA (?? Improve flow to right hemisphere)
• ?? Stenting of left subclavian stenosis and then perform left subclavian bypass to distal left CCA.
• Continue Plavix and ASA
Interesting Carotid / TCD Case #2

• 53 yo female
• History of Type A aortic dissection, repaired with graft at OSH
• Began having abdominal pain, vomiting and nausea.
• Felt “clammy”, bilateral upper extremity weakness
• Went to OSH where CTA questioned new aortic dissection.
• Airlifted to Cleveland Clinic
Interesting Carotid / TCD Case #2

• History of Tobacco use:
  • **5 packs/day**
• Admitted to Cardiothoracic ICU
• Carotid Duplex
• Transcranial Monitoring ordered