Atherosclerotic Carotid Artery Disease: Risk Factors, Diagnosis & Treatment

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Disclosures

I have no financial relationships to disclose
Objectives:

- What is atherosclerotic disease
- Atherosclerosis risk factors
- Impact on cerebrovascular circulation
- Ultrasound imaging and diagnosis
- Treatment
  - Medical
  - Endovascular
  - Surgical
Severe Internal Carotid Stenosis
What is atherosclerosis?

- It is a systemic disease
- It has definite risk factors
- It can be treated with medication AND lifestyle changes
Understanding of Atherosclerosis

- 3 of 4 laypersons > age 55 have never heard of Atherosclerotic PAD
- Poor understanding that PAD is a chronic, systemic disease requiring lifelong treatment
- Doc, if it’s blocked, why don’t we just fix it?
- Once an intervention is performed, most patients assume things are “fixed”
- Lack of Patient initiative:
  - exercise program for claudicants
  - lifestyle and dietary changes
  - medication for risk factor modification
Risk factor management in APAD: It is of utmost importance!

- Smoking cessation and remove nicotine in all forms
- Control cholesterol and triglycerides → statins
  - Continue even with normalization of lab values
- Treat hypertension → ACE and ARB (CCB > Thiazides)
- Control diabetes → strict HbA1C goals (<6.5mg/dL)
- Anti platelet therapy (ASA, Plavix, Aggrenox)
- Diet (“Olive Oil, the Mediterranean Diet, & Cardiovascular Health” Sumpio; JACS SEP 2008)
- Exercise and weight loss
- Family history
Arterial Adaptation (DILATION) to Increasing Atherosclerotic Plaque Burden

NICOTINE VASOCONSTRICTION INHIBITS this adaptive response!
Impact on Cerebrovascular Circulation

- 800,000 new or recurrent stroke/year
  - 87% ischemic strokes
    - Embolic
    - Thrombotic
- 5th leading cause of death
- 80% strokes can be prevented
- Leading cause of adult disability
Atherosclerosis in the Carotid Arteries

- Carotid Artery Stenosis (asymptomatic, TIA, Stroke)
- Duplex Ultrasound is the workhorse for diagnosis
- Conservative treatment for asymptomatic patients with <70% stenosis
Duplex Indications

- Symptoms
  - Dysphagia/aphasia
  - Amaurosis fugax
  - Unilateral facial droop
  - Unilateral body weakness/numbness
  - NOT dizziness/syncope

- Physical Exam
  - Carotid bruit
  - Hollenhorst plaque
Abnormal Findings

- Atherosclerotic stenosis
- Aneurysms
- Carotid body tumors
- Dissections
- Fibromuscular dysplasia
Technique

- Grey scale
  - Transverse
  - Sagittal
- Evaluates plaque
  - Echolucent
  - Echogenic
  - Ulcerative
Technique

- Color Doppler
- Normal
  - Wall to wall color
- Abnormal
  - Narrowing
  - Color aliasing
Technique

- Spectral Doppler
  - Measures PSV/EDV
  - Use 45-60 degree angle
- Normal
  - Nice window
- Abnormal
  - Spectral broadening
  - PST distal to stenosis
**Classification of ICA stenosis By Duplex Velocity Criteria:**

<table>
<thead>
<tr>
<th>STENOSIS</th>
<th>PSV cm/s</th>
<th>EDV cm/s</th>
<th>Flow Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-49%</td>
<td>&lt; 125</td>
<td>*</td>
<td>Minimal or no spectral broadening. Boundary layer separation within the bulb is usually present.</td>
</tr>
<tr>
<td>50-79%</td>
<td>&gt; 125</td>
<td>&lt; 110</td>
<td>Marked spectral broadening is usually associated. ICA/CCA ratio ≥ 1.8</td>
</tr>
<tr>
<td>70-90%</td>
<td>&gt;270</td>
<td>≥ 110</td>
<td>Marked spectral broadening is usually associated. ICA/CCA ratio of ≥ 4.0</td>
</tr>
<tr>
<td>80-99%</td>
<td>*</td>
<td>≥ 140</td>
<td>Marked spectral broadening.</td>
</tr>
<tr>
<td>100%</td>
<td>*</td>
<td>*</td>
<td>No flow signal in an adequately visualized ICA with characteristic low or reversed diastolic component in CCA. A characteristic “thump” may be noted at the stump, or origin of the occlusion.</td>
</tr>
</tbody>
</table>
Normal Carotid Duplex Ultrasound with Normal Flow Reversal on the Outer Wall of the Bulb
Velocity change across lesion indicates severity of stenosis
Tight Stenosis with Vulnerable Plaque
ICA OCCLUSION
Thrombotic Occlusion of Internal Carotid Artery
Degenerating Plaque
Treatment

- Medical
- Surgical
- Endovascular
Medical Treatment

- Smoking cessation
- Anti-platelet therapy
- Statin
- Anti-hypertensive management
  - Angiotensin blockade
- Diabetic maintenance
- Low fat, low-sodium diet
Surgical Therapy

- Carotid endarterectomy
  - Removal of plaque burden
  - Patch angioplasty
- Reduce stroke risk
  - Symptomatic patients
  - Critical stenosis
Who benefits from Carotid Endarterectomy?*

- Asymptomatic patients with 70-99% stenosis who have at least a 5 year life expectancy

- Symptomatic patients with >60% stenosis; TIA, Stroke with good neurological recovery and functional status and amaurosis fugax

- No benefit to operation on symptomatic patient with <50% stenosis

- Not possible to reopen a totally occluded internal carotid artery

*Always combined with maximal risk factor reduction medical therapy
Surgical Therapy

- Risks
  - Myocardial infarction (2-3%)
  - Stroke (1-2%)
  - Cranial nerve injury (1%)
    - Vagus
    - Hypoglossal
    - Glossopharyngeal
  - Hematoma
Surgical Therapy
Endovascular Therapy

- Carotid artery stent
  - Avoids general anesthesia
  - Decreases risk of myocardial infarction

- Appropriate in high-risk surgical patients
  - Medical comorbidities
  - Redo operative field
  - Radiated field
  - High carotid bifurcation
Endovascular Therapy

- Risks
  - Access complications (5%)
  - Stroke (2-4%)
  - Dissection (1%)

- Importance of aortic arch
Carotid artery stent (CAS)
<table>
<thead>
<tr>
<th></th>
<th>CAS</th>
<th>CEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 day stroke/death risk</td>
<td>4.4%</td>
<td>2.3%</td>
</tr>
<tr>
<td></td>
<td>$P = 0.005$</td>
<td></td>
</tr>
<tr>
<td>Symptomatic patients</td>
<td>6.0%</td>
<td>3.2%</td>
</tr>
<tr>
<td></td>
<td>$P = 0.02$</td>
<td></td>
</tr>
<tr>
<td>Asymptomatic patients</td>
<td>2.5%</td>
<td>1.4%</td>
</tr>
<tr>
<td></td>
<td>$P = 0.15$</td>
<td></td>
</tr>
<tr>
<td>MI (based on elevated enzymes)</td>
<td>1.1%</td>
<td>2.3%</td>
</tr>
<tr>
<td></td>
<td>$P = 0.003$</td>
<td></td>
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Quality of life analysis among survivors at 1 year indicated that stroke had a greater effect on physical and mental health status than did MI. Also 4 year mortality after periprocedural stroke was 21.1% vs 11.6% for patients without stroke.