Management of Carotid Disease

CHRISTOPHER LAU
PGY-3
BROOKLYN VA
SUNY DOWNSTATE MEDICAL CENTER
Case

- 61 year old male referred to Vascular Surgery for left internal carotid stenosis
- Present with transient right hand numbness several months earlier
- No motor weakness or deficits
- No other sensory loss
- No aphasia
- No visual changes
- No LOC, slurred speech, or memory loss
Past Medical History

- Hypertension
- HIV – on HAART
- Hepatitis C
- Hyperlipidemia
- DVT – completed treatment with coumadin
- Head injury in MVA 1992
- Right shoulder, left leg, left elbow surgery

Medications: amlodipine, Atripla, HCTZ, valsartan, aspirin 81 mg

SH: + tobacco
Physical Exam

- Vital Signs normal
- HEENT: PERRL, EOMI
- Neck: no bruits
- CVS: S1S2, RRR, no murmurs
- Chest: CTA b/l
- Abdomen: soft, NT, ND, no pulsatile mass
- Extremities: no ulcerations, no edema
- Pulses: femoral pulses palpable, no palpable popliteal, DP or PT b/l
- Neuro: no focal motor or sensory deficits, no cranial nerve deficits
Imaging

- **Carotid duplex**
  - Left ICA >70% stenosis to near total occlusion
  - Right ICA <50% stenosis

- **MRI brain**
  - Left frontotemporal traumatic encephalomalacia
  - Chronic left basal ganglia lacunar infarct

- **MRI neck**
  - Severe focal stenosis of left ICA 1.5 cm distal to bifurcation
Carotid Doppler

FR 22Hz 60°
R1

2D
62%
C 50
P Low
Gen
CF
77%
3000Hz
WF 165Hz
Med

L Prox ICA
PSV -150 cm/s
EDV -50.5 cm/s

3.5-
Carotid Doppler

FR 22Hz 60°
R1
2D
63%
C 50
P Low
Gen
CF
75%
3000Hz
WF 165Hz
Med

L Mid ICA
PSV -484 cm/s
EDV -198 cm/s
Carotid Doppler

FR 22Hz  60°
R1

ZD  63%
C  50
P Low
Gen
CF  75%
3000Hz
WF 165Hz
Med

L Dist ICA
PSV  -478 cm/s
EDV  -109 cm/s

PW  42%
WF  130Hz
SV  1.0mm
M2
3.5MHz
1.7cm

M2 M3
+28.9
-28.9
-6.0
cm/s
-4.0
-2.0
m/s

6.6sec
MRI
Operation

- General anesthesia
- Left SCM incision made
- Arteriotomy from CCA to ICA
- 3x4 mm shunt placed from CCA to ICA
- ECA was occluded
- Endarterectomy performed
- Carotid bed was cleaned
- Hemashield polypropylene patch closure
Post Op

- Pt did not have any neurologic deficits
- Pt was monitored for neurologic changes and BP control
- POD 1
  - No cranial nerve or other neurologic deficits
  - BP intermittently high up to SBP 180’s
- POD 2
  - BP controlled
  - Discharged home
- POD 43
  - Pt seen in outpatient clinic doing well
Management of Carotid Disease
Introduction

• Stroke is the 3rd leading cause of death in the US
• 83% are ischemic stroke
• Primary indication for surgery is prevention of stroke
• Majority of strokes caused by cervical carotid artery disease, followed by atrial fibrillation
• Risk factors:
  ○ Hypertension
  ○ Atrial fibrillation
  ○ Heart disease
  ○ Diabetes
  ○ Smoking
  ○ Hyperlipidemia
Symptoms

- CVA
  - Symptoms lasting more than 24 hours
- TIA
  - Symptoms resolve within 24 hours
  - Most only last seconds to minutes
- Symptoms may not correlate with radiologic findings
- Symptoms mostly are from emboli
- Less often, low flow from severe stenosis
- Examples:
  - Hemiplegia of contralateral side
  - Weakness of paralysis of contralateral side
  - Visual changes – amaurosis fugax, window shade, flashing lights, sparks
  - Speech symptoms with left sided lesions
  - Less typical are light headedness, memory loss, loss of consciousness
Diagnostic Tests

- **Duplex Ultrasound**
  - B-mode to visualize the artery
  - Doppler mode to assess velocity of flow

<table>
<thead>
<tr>
<th>STENOSIS (%)</th>
<th>PEAK SYSTOLIC VELOCITY (cm/sec)</th>
<th>PEAK DIASTOLIC VELOCITY (cm/sec)</th>
<th>SPECTRAL BROADENING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–15</td>
<td>&lt;120</td>
<td>NA</td>
<td>None</td>
</tr>
<tr>
<td>16–49</td>
<td>&lt;120</td>
<td>NA</td>
<td>Present</td>
</tr>
<tr>
<td>50–79</td>
<td>&gt;120</td>
<td>&lt;125</td>
<td>Marked</td>
</tr>
<tr>
<td><strong>80–99</strong></td>
<td><strong>&gt;120</strong></td>
<td><strong>&gt;125</strong></td>
<td><strong>Marked</strong></td>
</tr>
<tr>
<td>100</td>
<td>No flow noted</td>
<td>No flow noted</td>
<td>No flow noted</td>
</tr>
</tbody>
</table>
Diagnostic Tests

- **Conventional Angiography**
  - Seldom used
  - 1% risk of stroke usually from dislodgement of emboli

- **MR Angiography**
  - Ability to see the entire carotid system
  - Turbulent blood flow can make lumen appear narrower than reality

- **CT Angiography**
  - Excellent 3D images
  - Becoming almost as accurate as conventional angiography
Medical Management

- **Risk factor reduction**
  - Reduction of elevated BP
  - Smoking cessation
  - Lipid lowering therapy may be effective

- **Antiplatelet therapy**
  - 23% risk reduction in pt with previous TIA or stroke
  - Optimal dose is not yet known
Indications for Surgery

- Prevent future stroke
- Best indicators for risk of future stroke are:
  - Focal neurologic symptoms
  - Degree of narrowing of vessel
- The 2 classic papers are:
  - The North American Symptomatic Carotid Endarterectomy Trial (NASCET)
  - Asymptomatic Carotid Atherosclerosis Study (ACAS)
Endarterectomy for Asymptomatic Carotid Artery Stenosis

Prospective, randomized, multicenter trial
1662 patients with >60% stenosis
Randomized to either medical management or medical management + CEA
825 patients were randomized to surgery arm
Patients underwent pre op arteriography
Endarterectomy for Asymptomatic Carotid Artery Stenosis

During the perioperative period
- 2.3% of surgical arm patient had a stroke or died
- 0.4% of the medical group had a stroke or died

Arteriographic complication rate was 1.2%

5 year risk of ipsilateral stroke:
- 11% for the medical group
- 5.1% for the surgical group
- 57% risk reduction (p=0.004)

Splitting sample into gradations of 60-69%, 70-79%, and 80-99% stenosis showed no statistically significant gradation in 5-year risk reduction
- However the study was not powered for this analysis
Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. North American Symptomatic Carotid Endarterectomy Trial Collaborators

Prospective, randomized, multicenter trial

Surgeons had <6% mortality for 50 consecutive cases over 2 years

659 patients with 70-99% stenosis

328 underwent carotid endarterectomy

Results:

- 30 day morbidity for surgical group was 5.8%
- Cumulative risk of major ipsilateral stroke at 2 years
  - 2.5% for the surgical group
  - 13.1% for the medical group
  - Absolute risk reduction of 10.6% (p<0.001)
NASCET continued to enroll patients with moderate stenosis <70% 

- 2267 patients enrolled 
- 858 patients in the 50-69% stenosis group 
- Among patients with 50-69% stenosis 
  - 5 year rate of any ipsilateral stroke: 
    - 15.7% in surgical group 
    - 22.2 percent in medical group 
    - Relative risk reduction 29% (p<0.045) 

- Among patients with <50% stenosis there was no statistically significant difference
# AHA Guidelines for CEA 1998

## Patients with Asymptomatic Carotid Disease

- **Surgical risk <3% and life expectancy >5 years**
  - Proven: ipsilateral CEA for >60% stenosis
  - Acceptable: Unilateral CEA for stenosis >60% simultaneously with CABG
  - Uncertain: Unilateral CEA for >50% stenosis with ulcer

- **Surgical risk 3-5%**
  - Proven: none
  - Acceptable: Ipsilateral CEA for >75% stenosis in presence of contralateral 75-99% stenosis
  - Uncertain: 75% without contralateral stenosis, or CEA with CABG

- **Surgical risk 5-10%**
  - Proven: none
  - Acceptable: none
  - Uncertain: CEA with CABG
AHA Guidelines for CEA 1998

- Patients with Symptomatic Carotid Disease
  - CEA for 70-99% stenosis with recent nondisabling carotid artery ischemic events
  - CEA is not beneficial for 0-29% stenosis
  - Benefit is uncertain for 30-69% stenosis
- Guidelines have not been updated with more recent data
• SAPPHIRE - Prospective, randomized, multicenter trial
• 334 patients with coexisting conditions that increased risk of CEA
• Symptomatic 50% stenosis or asymptomatic 80% stenosis
• CEA vs. carotid artery stenting with emboli-protection device
• 12.2% in the stenting group and 20.1% in the CEA group had adverse events
• P=0.004 for noninferiority and p=0.053 for superiority
SAPPHIRE showed that stenting was not inferior to CEA but the amount of adverse events was disturbingly high.

Multiple other trials:
- CaRESS – nonrandomized study, showed equivalence
- CAVATAS – no difference in major events but severe restenosis was high in the stent group
- SPACE – no difference in major events
• CREST – ongoing randomized, multicenter trial
• Report on 1565 patients enrolled in the lead-in phase with:
  ○ Symptomatic >50% stenosis by angiography
  ○ Asymptomatic >70% stenosis by angiography
• Interim analysis revealed excessive stroke and death rate of 12.1% in octogenarians (excluded from the study)
• Subjects considered high risk for CEA or with other comorbidities were eligible
• Initial results are promising
  ○ Stroke and death rate was 4.5% (2.9% if age >75 years excluded)
  ○ Stroke and death rate for NASCET was 5.8%
  ○ Stroke and death rate for ACAS was 2.3%
Surgical Technique
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Surgical Technique

Incision

Potts' scissors
Surgical Technique
### Anesthetic Considerations

<table>
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<th>Regional anesthesia</th>
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<tr>
<td>- Able to monitor neurologic status</td>
</tr>
<tr>
<td>- Some patients have been intolerant of clamping and required a shunt</td>
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<tr>
<td>- Unable to monitor neurologic status clinically</td>
</tr>
<tr>
<td>- Shunt can be used routinely</td>
</tr>
<tr>
<td>- Shunt can be used selectively if some monitoring technique is used to prevent cerebral ischemia</td>
</tr>
</tbody>
</table>
  - EEG, evoked potential, carotid stump pressure, transcranial doppler are all inferior to the awake patient |

| Several large studies have documented equal rates of neurologic and cardio pulmonary complications |
Closure Techniques

- **Primary closure**
  - Longitudinal arteriotomy
  - Eversion endarterectomy
- **Patch angioplasty**
  - Materials:
    - Autologous vein
    - Synthetic material
    - Bovine pericardium
- Excellent results have been independently reported with each technique
- Optimal method remains controversial
- Recent multivariate analysis of >10,000 CEA’s suggests a lower perioperative risk with patch angioplasty
Complications of CEA

- Perioperative stroke
  - Within 24 hours usually due to technical imperfection
- Cranial nerve injury
- Cerebral hyperperfusion syndrome
- Postoperative hematoma
  - Risk of airway compromise
- Infection
- Perioperative blood pressure instability
Summary

- CEA is a proven effective method of decreasing risk of stroke in patients with carotid stenosis
- CEA is safe and associated with acceptably low risk in appropriately selected patients
- Trials are ongoing for carotid artery stenting
References

- Sabiston Textbook of Surgery