MANAGEMENT OF CERVICAL AND INTRACRANIAL ATHEROMATOUS DISEASE

Vivek R. Deshmukh, MD
Director, Cerebrovascular and Endovascular Neurosurgery
Chairman, Department of Neurosurgery
Providence Brain and Spine Institute
The Oregon Clinic
Disclosure

- I declare that neither any immediate family member nor I currently have a financial arrangement or affiliation with any organization(s) that my have a direct interest in the subject matter of this continuing medical education presentation.
Overview

- **Extracranial**
  - Carotid bifurcation
    - Carotid endarterectomy
    - Carotid angioplasty and stenting
  - Vertebral origin
    - Vertebral transposition
    - Vertebral origin stenting

- **Intracranial**
  - Anterior and posterior circulation
  - Acute ischemic stroke
Stroke-Epidemiology

- 795,000 strokes each year
- Fifth leading cause of death
- Leading cause of disability
  - 6.5 million stroke survivors
- By 2025, over 1 million strokes per year
Stroke Etiology

- Hemorrhagic
  - Hypertension
  - Cerebral aneurysm
  - Arteriovenous malformation
  - Coagulopathy

- Ischemic
  - Carotid and vertebral stenosis
  - Intracranial stenosis
  - Cardioembolic
  - Prothrombotic state
  - Paradoxical embolus
  - Vasculitis
  - Dissection
Carotid Stenosis

- Primarily affects the cervical carotid bifurcation
- Carotid bulb is region of turbulent blood flow
- Common cause of TIA and stroke
- Plaque development as early as age 20
Carotid Stenosis - Evaluation

- Doppler Ultrasound
  - Operator dependent
- CT angiography
  - Radiation exposure
  - Calcification
- MR angiography with contrast
  - Calcification
- Catheter angiography
  - Risk for stroke
Asymptomatic Carotid Stenosis- Natural History

- Carotid stenosis >60% felt to be significant
- Stroke risk of 2.2%/year based on ACAS with medical therapy
- Mortality rate of 4% per year
Symptomatic Carotid Stenosis- Natural History

- NASCET data
- Stenosis > 70%
- Medical therapy
  - 26% risk of ipsilateral stroke at 2 years
  - 13.1% risk of major or fatal ipsilateral stroke at 2 years
Carotid Stenosis - Treatment Options

- Carotid endarterectomy
- Carotid angioplasty and stenting
- Medical therapy
  - ASA
  - Plavix
Carotid Endarterectomy

- General anesthesia
- Supine with head turned
- Burst suppression with EEG monitoring
- Systemic heparinization
- Microsurgical technique
- 6-0 prolene
 Existing Literature Supporting Carotid Endarterectomy

- Endarterectomy for asymptomatic carotid artery stenosis (ACAS)
  - > 60% stenosis, asymptomatic
    - Randomized to ASA or ASA + CEA groups
  - Decreased risk for ipsilateral stroke in surgical group compared to medical group (5.1% vs 11%)
  - CEA is superior to medical management alone in treatment of asymptomatic carotid stenosis as long as risk of surgery is ≤ 3%
  - Benefit for women with stenosis 60-79% less robust
  - Five year life expectancy
Existing Literature Supporting Carotid Endarterectomy

- North American symptomatic carotid endarterectomy trial (NASCET)
  - ≥ 70%, symptomatic stenosis
  - Randomized to medical or surgical management (ASA vs ASA + CEA)
  - At 2 years:
    - 17% less risk for ipsilateral stroke (26% vs 9%)
    - 11% less risk for major/fatal stroke (13% vs 2.5%)
  - Difference present for 50-69% and even more stark for stenosis >90%
  - Five year life expectancy
Case

- 76 y.o. female with left hand clumsiness
- History of hypertension, hypercholesterolemia
- Mild left hand weakness
CT Angiogram
Carotid Angioplasty and Stenting

- Emerging as viable alternative to carotid endarterectomy
- Progressive technical refinements
- Distal protection
Carotid Angioplasty and Stenting

- Approximately 5% complication rate periprocedurally
- Approximately 10% restenosis rate after one year - CAVATAS study
- Similar complication rate to CEA and higher restenosis rate
Literature comparing Carotid Endarterectomy versus Stenting

- Carotid Revascularization Endarterectomy versus Stenting (CREST)
  - CEA 2% risk stroke, 4% risk MI
  - CAS 4% risk stroke, 2% risk MI
  - Carotid artery stenting is associated with higher rate of complications in those over 80 yoa
Current Recommendations

- Typically treat asymptomatic carotid stenosis if >80%
- Treat >50-60% if symptomatic
- Older patients have greater benefit from intervention
Current Recommendations

- Carotid Angioplasty and stenting reserved for high risk patient, symptomatic, >70% stenosis
  - Contralateral occlusion
  - Prior endarterectomy or radiation
  - High carotid bifurcation
  - Contralateral recurrent laryngeal nerve palsy
  - Cardiopulmonary status
    - Congestive heart failure, low EF, recent MI
Vertebral Origin Disease

- Stenosis typically symptomatic if contralateral vertebral artery diminutive or ends in PICA
- VBI
  - Dizziness
  - Dysarthria
  - Visual field disturbance
  - Cerebellar symptoms
Vertebral Origin Disease- Natural History

- Poorly understood
- Consider patient high risk if unilateral >70% stenosis with small or absent contralateral vertebral or if vert ends in PICA
- Treatment strongly considered for patients with symptomatic stenosis
VAO Stenosis Treatment Options

- Vertebral artery transposition
- Vertebral angioplasty and stenting
- Medical therapy
  - ASA
  - Plavix
VAO Stenosis

- Better understanding of natural history
- Reduce restenosis
- Drug eluting stents
71 y.o. male with symptomatic VBI
Restenosis
Carotid to Vertebral Bypass
Intracranial Stenosis

- Typically affects supraclinoid ICA, middle cerebral artery, V4 segment of vertebral artery and basilar artery
- Under-recognized cause of stroke
  - Approximately 10% of all strokes
- Few therapeutic options until recently
Intracranial Stenosis- Natural History

- Warfarin and Aspirin for Symptomatic Intracranial Arterial Stenosis (WASID Trial)
  - Double-blinded, randomized, multicenter trial
  - Angiographically verified 50-99% stenosis of major intracranial artery
  - Warfarin with target 2.0 to 3.0 INR vs ASA 1300 mg daily
  - Primary endpoint of stroke, hemorrhage, or death from other vascular causes
WASID Trial

- 569 patients
- Enrollment stopped because of safety concerns with Warfarin, no benefit over ASA
- 20% stroke risk over 2 years
- 23% stroke risk for stenosis >70% over one year
Intracranial Stenosis- Treatment Options

- Medical therapy
- EC-IC bypass
  - Reserved for Moyamoya patients
- Angioplasty and stenting
  - Coronary balloons/stents
  - Gateway balloon/Wingspan stent
Intracranial stenosis - Angioplasty and Stenting

- Gateway balloon and Wingspan stent
  - Developed for intracranial use
  - Outward radial force
  - Better delivery system
  - High restenosis rates, particularly for supraclinoid ICA stenosis
SAMMPRIS Trial

- Randomized 70-99% intracranial major arterial stenosis with recent TIA or stroke to medical therapy versus PTAS
- 451 patients randomized
- 30 day stroke/death rate 14.7% in PTAS group and 5.8% in medical management group
- At one year, 20% stroke/death rate in PTAS group and 12.2% in medical management group
Moyamoya Disease

- Progressive stenosis of the supraclinoid ica
- Typically bilateral, spares posterior circulation
- Young patients present with ischemic strokes, older patients with hemorrhage

Treatment
  - Surgical revascularization
    - Sta-mca bypass
41 year old male with left hemispheric stroke
STA-MCA bypass
Acute Stroke Care - Mechanical Thrombectomy

- Sudden onset neurological deficits
- Occlusion of intracranial large vessel
- Emergent revascularization in cath lab
Mechanical Thrombolysis

- Balloon angioplasty
- Merci Retrieval System
- Penumbra Aspiration System
- Intracranial stenting
Merci Retrieval System

- Cork-screw configuration
Penumbra Aspiration System
Swift-Prime

- Randomized patients within 6 hours of acute ischemic stroke due to intracranial large vessel occlusion to iv tpa vs iv tpa + Solitaire
- High rate of revascularization, low complication rate
- 60% functional independence for iv tpa + Solitaire vs 39% of tpa alone at 90 days
52 y.o. male with acute onset aphasia and hemiplegia
Single Pass of Solitaire
73 y.o. female in a coma