Acute Stroke Management

Maggie S Johnson FNP BC DNP

Objectives
1. Distinguish between an ischemic and hemorrhagic type of stroke.
2. Review pharmacologic interventions for a stroke.
3. Identify interventions for pre-stroke and post-stroke clients.

Modifiable Risk Factors
- Hypertension
- Elevated cholesterol (statins reduce risk by 30%)
- Diabetes mellitus-independent risk factor
- Coronary Artery disease
- Heart disease-Valve disease/replacement, any factor that decreases ventricular contraction
- Atrial Fibrillation (3-4x risk)
- Previous stroke
- Obesity
- Excessive alcohol
- Smoking (2x risk ischemic; 4x risk hemorrhagic)
- Oral Contraceptives/HRT

Non-Modifiable Risk Factors
- Age-Risk doubles per decade over 55
- Gender-Men have greater risk, but women live longer.
- More women die from stroke (60% of stroke deaths)
- Race-African-American, Asian and Hispanic have greater risk, possibly due to hypertension
- Diabetes Mellitus-Exacerbated by hypertension or poor glucose control. Even diabetics with good control are at increased risk.
- Family history of stroke or TIA

Risk Factors for Ischemic Stroke
- Hypertension
- Age
- Cigarette smoking
- Male gender
- Family hx
- Race
- Previous stroke
- Carotid stenosis of more than 80%
- Atrial Fibr
- CHF
- Mitral Stenosis

Risk Factors for Hemorrhagic Stroke
- Intracranial vascular anomalies
- HTN
- Family Hx
- Polycystic kidney disease
- Ehlers-Danlos Syndrome
- SLE
- Neurofibramatosis
- Tuberculosis
- Pregnancy
- Cigarette smoking
- Atherosclerosis
Hemorrhagic Stroke
- In subarachnoid hemorrhage it is usually heralded by an abrupt onset of a severe headache (the worst headache of my life), N & V, signs of meningeal irritation, loss of consciousness initially is common.
- There is an atypical HA for 50% of the patients occurring days or weeks before
- Sometimes there are seizures
- Hypertensive intracerebral hemorrhage usually occurs when the patient is up and active, sleep onset is rare
- BP is elevated in most cases
- The patient lapses almost immediately into a stupor or coma with steady deterioration over the next few hours
- More often there is a HA, followed within a few minutes with unilateral facial sag, slurred speech, weakness in an arm and leg and eye deviation away from the paretic limbs

3 Regions of the Brain
- Cerebrum
- Cerebellum
- Brain Stem

Cerebrum
- Conscious thought
- Memory
- Personality
- Speech
- Motor Function
- Vision
- Touch (tactile)

Epidemiology
- Affects > 795,000 persons per year, a stroke occurs every 40 seconds
- #3 Major cause of death and long term disability
- Every 4 minutes someone dies of a stroke on average
- Estimated US cost for 2010 - $75 billion
- 14471 - the number of people treated for stroke in 2010 in SC, 2285 died in SC in 2010
- Women experience stroke at a rate 1.75 times that of men

Epidemiology
- Hispanics are twice as likely as Caucasians to suffer a stroke
- African Americans are four times more likely to have a stroke than Caucasians
- Ischemic strokes tend to occur in older persons with other disease processes, whereas hemorrhagic strokes generally occur in healthy individuals between the ages of 40-60.
- Stroke represents a significant burden for long term care:
  - 50-70% stroke survivors regain functional independence
  - 15-30% permanently disabled
- Approximately 25% of stroke victims die within 1 year of their first stroke

Cerebellum
- Coordination
- Balance
- Fine motor control
- Reflexes

Symptoms: dizziness, nausea, vomiting
Brain Stem

- Heart function
- Respiration
- Autonomic nervous system
- Digestion

Symptoms: Involuntary life-support functions (breathing, heartbeat, blood pressure), eye movement, hearing, speech, swallow, mobility on one or both sides of the body

Cerebral Circulation

- Anterior Circulation
  - Carotid arteries
  - Anterior cerebral arteries
  - Middle cerebral arteries
- Posterior Circulation
  - Vertebral arteries
  - Basilar artery
  - Posterior cerebral arteries

Stroke: What is it?

- Sudden interruption of blood supply to the brain
- Lack of oxygen and glucose to nerve cells
- Ischemia within 1 hour
- Cytotoxic and vasogenic edema
- Cellular death

Stroke

- Ischemic stroke is most prevalent and is occlusive in nature
- May be due to atherosclerotic disease and progressive occlusion with plaque or as a result of an embolism which travels to the brain and blocks blood flow.
- Atrial fib often can result in clot formation in the heart which then seeds small embolic particles that travel to the brain.
- Hemorrhagic stroke has a lower incidence than ischemic but is more deadly.
- Subarachnoid stroke is a rupture of a large vessel within the protective lining of the brain and intracerebral stroke is the rupture of a vessel within the brain itself.

Three Stroke Types

- Ischemic Stroke: 85%
- Intracerebral Hemorrhage: 10%
- Subarachnoid Hemorrhage: 5%
Ischemic Stroke - 88%
Embolic (24%): Blood clot forms somewhere in the body and travels to the brain
Thrombotic (61%): Clot forms on blood vessel deposits

Embolic Stroke

- Blood clot forms somewhere within the body and travels to the brain

Thrombotic Stroke

- Clot forms on blood vessel deposits

Intracerebral Bleed (ICB)
Subarachnoid Hemorrhage (SAH)

Hemorrhagic Stroke - 12%

- Responsible for 30% of stroke deaths
- Intracerebral - within the brain tissue. Most commonly from high blood pressure
- Subarachnoid - around the brain's surface and under its protective layer - Most commonly from aneurysm rupture
- Risk factors: hypertension, alcohol, drug abuse, anti-clotting medication and blood clotting disorders

Is the patient a thrombolytic candidate?

- Onset < 6 hrs
- CT negative for hemorrhage
- Not anticoagulated (INR < 1.5)
- Keep BP < 220/120
- ASA 325mg chewed
- DVT prophylaxis - Heparin 5000 SQ BID
- Keep BP < 185/110
- < 3 hrs - IV tPA
- 3-6 hrs - Intra-arterial t-PA

ACUTE ISCHEMIC STROKE (AIS) & TIA
LOW BLOOD FLOW TO FOCAL AREA OF BRAIN

- Pathophysiology:
  - Usually thrombembolism (blood clot forms in vascular system, travels downstream, plugs cerebral artery)

- Acute therapy:
  - Thrombolysis (or thrombectomy)
  - Do NOT lower BP
  - Avoid aspiration / IV glucose

- 2nd prevention:
  - Antithrombotic therapy
  - Vascular risk factor therapy
  - Possible carotid endarterectomy (CEA) or angioplasty (CAS)

TRANSIENT ISCHEMIC ATTACK (TIA) AND "ACUTE NEUROVASCULAR SYNDROME"

- Transient episode of neurologic dysfunction caused by focal brain, spinal cord, or retinal ischemia, without infarction
- Typically < 1 h, but time limit is no longer part of definition
- Risk of stroke = 5% w/in 2 d, 10% w/in 3 m
- Appropriate antithrombotic therapy based on cause
- Urgently evaluate for cause
  - MRI w/ DWI, intracranial MRA, carotid duplex, echo
  - Can admit to “observation status”

Discover cause, determine therapy, decrease risk!
TIAs - Transient Ischemic Attacks

The American Heart Association has calculated that people with TIAs have nine times the risk of stroke compared with those who have never had a TIA.

The Problem with TIA’s

- TIAs should not be ignored
- Patients need to seek immediate medical attention in order to prevent a possible full blown stroke
- MRI may be needed to determine TIA VS. Stroke

Time IS Brain!!!!

- Every second 32,000 neurons die
- Every minute 1.9 million neurons die
- Every hour 120 million neurons die
- Completed stroke: Loss of 1.2 billion neurons
- Blockage of one blood vessel will cause ischemia within 5 minutes
- There is interruption of the blood flow to the brain

Signs and Symptoms of Stroke

- Sudden numbness/weakness of the face, arm, or leg, especially on one side of the body
- Slurred speech/difficulty speaking/understanding
- Sudden change in vision (blurred or decreased vision) in one or both eyes
- Dizziness, loss of balance or coordination
- Acute onset severe headache
- Nausea or vomiting with any of the above symptoms
- Confusion or disorientation with above symptoms

Additional stroke symptoms

- Difficulty with swallowing and secretions
  - Respiratory distress
  - Pupil changes
  - Convulsions
- Decrease level of consciousness
Diagnostics

- The most common imaging procedure is the Head CT scan.
- A noncontrast CT scan is better than a MRI in discriminating between hemorrhagic and ischemic stroke.
- In ischemic stroke, may be normal in the first few hours but will usually show abnormalities after 12 hours.
- Hemorrhagic stroke - the head CT scan will be abnormal at presentation to the ER.

Other Labs

- Serum cholesterol level
- Anticardiolipin antibody level
- Toxicology screening
- Hemoglobin electrophoresis
- Fibrinogen
- Serum protein electrophoresis
- Antiphospholipid antibody level
- Serologic test for syphilis
- Protein C level
- Protein S level
- Antithrombin III level
- Lupus anticoagulant

Initial Management

- Assessment of the ABCs (Airway, Breathing and Circulation)
- Vital signs
- O2 via Nasal cannula, airway secured
- Cardiac monitor, Pulse Ox, IV access established
- PE done, 12 lead EKG, portable chest x-ray, lab tests
- Urgent noncontrast head CT scan
- If ischemic, thrombolytic therapy if the patient meets the criteria
- If hemorrhagic, consult neurosurgeon

Key Components of Taking Patient History (SAMPLE)

- S-Symptoms/onset (When was the person last seen normal?)
- A-Allergies
- M-Medications (anticoagulants [warfarin], antithrombotics, Insulin, antihypertensives, antiepileptics)
- P-Past Medical History - Hypertension, Diabetes (hypoglycemia patients may have symptoms that mimic stroke), seizures, prior stroke, aneurysms
- L-Last oral intake
- E-Events Prior - stroke, MI, trauma, surgery, bleeding

Other Diagnostics

- EKG
- Chest X-ray
- Pulse oximetry or ABGs
- CBC with platelets
- PT/PTT
- Serum glucose
- Creatinine, BUN, and electrolytes
- May need a CSF, lumbar puncture in NS involved
- EEG if there are seizures
- Carotid ultrasound
- Transesophageal echocardiogram/Holter monitor if embolism is suspected from the heart
**ISCHEMIC STROKE PATHOPHYSIOLOGY**  
*The First Few Hours*

"TIME IS BRAIN: SAVE THE PENUMBRA"

Penumbra is zone of reversible ischemia around core of irreversible infarction—salvageable in first few hours after ischemic stroke onset

Penumbra damaged by:
- Hypoperfusion
- Hyperglycemia
- Fever
- Seizure

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**Ischemic Penumbra**

The ischemic penumbra is the viable but threatened brain tissue between the normal tissue and the tissue of the infarct.

Acute stroke therapies focus on reversing or preventing ischemic damage. "Penumbral Salvage"

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**STROKE EMERGENCY BRAIN IMAGING: NONCONTRAST CT SCAN**

- **Intracerebral Hemorrhage**
  - CT detects all ICHs immediately
- **Subarachnoid Hemorrhage**
  - CT detects 90% of SAHs; if SAH suspected & CT negative, must LP

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**CT detects all ICHs immediately**

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**STROKE EMERGENCY BRAIN IMAGING: NONCONTRAST CT SCAN**

- **Acute (4 hours) Infarction**
  - Subtle blurring of gray-white junction & sulcal effacement
- **Subacute (4 days) Infarction**
  - Obvious dark changes & "mass effect" (e.g., ventricle compression)

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**AIS EMERGENCY THERAPY: IV TISSUE PLASMINOGEN ACTIVATOR (T-PA)**

- **< 3.0 Hours**
  - No upper age limit
  - No limit on stroke size
  - Can give if taking warfarin & INR ≤ 1.7

- **3.0 - 4.5 Hours**
  - Do NOT give if:
    - Pt > 80 yo
    - NIHSS > 25
    - DM w/ previous stroke
    - Taking warfarin at all
**AIS ED STROKE CARE 24/7:**

**I. Triage—10 min**
- Review t-PA criteria
- Page acute stroke team
- Draw pre-t-PA labs*

**II. Medical Care—25 min**
- Place O₂, 2 NS IVs
- Obtain BP, weight, NIHSS
- Obtain 12-lead ECG
- Send patient to CT

**III. CT & Labs—45 min**
- Obtain lab results
- Read CT
- Return pt to ED

**IV. Treatment—60 min**
- Start IV t-PA
- Monitor for ICH sxds
- HTN, headache
- N/V, ↓ neuro status

*CBC, platelets, PT/INR, PTT, chem 7, cardiac panel

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**THE AIS-BP RELATIONSHIP**

*In AIS, high BP is a response, not a cause—don’t lower it!*

- BP increase is due to arterial occlusion (i.e., an effort to perfuse penumbra)
- Failure to recanalize (w/ or w/o thrombolytic therapy) results in high BP and poor neuro outcomes
- Lowering BP starves penumbra, worsens outcomes

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**MAY LOWER BP SLIGHTLY PRE T-PA**

**MUST PICK AN UPPER LIMIT TO TREAT—220/120 IS ONE OPTION**

<table>
<thead>
<tr>
<th>SBP &gt; 220 or DBP &gt; 120</th>
<th>No BP med, No t-PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP &gt; 185 and &lt; 220 or DBP &gt; 115 and &lt; 120</td>
<td>Lower BP pre-t-PA</td>
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Avoid excessive lowering of BP just to give t-PA—“Don’t kill the penumbra to save the penumbra”

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**OTHER AIS THERAPIES:**
**MAYBE IA, YES ASA, NO HIGH-DOSE HEPARIN**

- Intra-arterial t-PA
  - Only preliminary evidence to date, not FDA approved
  - Theoretical window 6 h—but do NOT preclude IV t-PA w/in 4.5 h
  - Studies ongoing, esp. combined w/ IV t-PA
- MERCI or Penumbra device
  - Mechanical embolectomy devices
  - Theoretical window 8 h
  - Both FDA approved, but controlled trial results pending
- Aspirin
  - Aspirin 325 mg per day begun within 48 h of stroke onset decreases morbidity & mortality (may begin 24 h after t-PA)
- Heparin(s)
  - Insufficient evidence to recommend routine use of high-dose IV heparin, LMW heparin, or heparinoid as Rx for AIS per se

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**AIS IS NOT A HYPERTENSIVE EMERGENCY!**

- ASA/AHA AIS Guidelines tables no longer include recs for BP Rx in non t-PA patients
- Text of guidelines state “Do not Rx unless BP > 220/120,” but also state:
  - No data to suggest 220/120 is dangerous & requires Rx
  - Evidence that BP lowering worsens outcomes is concerning
  - Goal is to avoid overtreating pts until definitive data available
- Only definite indications to 📉 BP emergently in AIS:
  - AMI, CHF, Ao dissection, ARF, or HTN encephalopathy
  - Candidate for thrombolysis and BP > 185/120

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**Blood Pressure Management**

<table>
<thead>
<tr>
<th>Systolic BP 180–220 mm Hg and/or diastolic BP 105–140 mm Hg</th>
<th>do not treat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic BP &gt;220 mm Hg and/or diastolic BP 120–140 mm Hg</td>
<td>captopril 6.25–12.5 mg p.o./i.m.</td>
</tr>
<tr>
<td>labetalol 5–20 mg i.v. x 1</td>
<td>urapidil 10–50 mg i.v., followed by 4–8 mg/h i.v. x 2</td>
</tr>
<tr>
<td>clonidine 0.15–0.3 mg i.v. or s.c.</td>
<td>dihydralazine 5 mg i.v. plus metoprolol 10 mg</td>
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<tr>
<td>sodium nitroprusside 1–2 mg</td>
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Blood pressure management

- Use of sublingual calcium antagonists should be avoided because of their rapid absorption and sometimes precipitous decline in blood pressure.
- Blood pressure decline should be gradual and gentle
- Hypertension is the most important independent and modifiable risk factor

Blood Pressure Management in Acute Ischemic Stroke

**No thrombolytics**

- Labetalol 10-30 mg IV q 10-15min
- Enalapril 0.625-1.25 mg IV q 6-8hrs prn
- Nitroprusside 0.5-1.0 µg/kg/min cont. IV
- Nicardipine 2.5-15 mg/hr continuous IV
- DBP > 140

**Thrombolytics**

- BP > 185/110
  - Nitropaste 1-2 inches
  - Labetalol 10-30 mg IV q 10-15min
  - Enalapril 0.625-1.25 mg IV q 6-8hrs (watch for angioedema)

Lowering BP in T-PA patients

- Nicardipine 5 mg/h IV infusion
  - Increase 2.5 mg/h q5min to max 15 mg/h
  - Easily titratable without an arterial line
- Labetalol 10-20 mg IV
  - May repeat q 10-15 min
  - Pre-T-PA: only use a 2nd dose only if necessary

Note Different Target BPs Pre & Post T-PA

- Pre-T-PA: < 185/110
- Post T-PA: < 180/105

Complications of Stroke

- Aspiration Pneumonia
- Urinary infection
- DVT
- Pulmonary Embolus
- Shoulder subluxation
- Depression
- Malnourishment
- Pressure sores
- Falls
- Seizures

Aspirin is a treatment for acute ischemic stroke

- Give ASA 160-325mg for acute stroke

The optimum dose remains quite controversial

Worrying about the lungs: Aspiration, Dysphagia, & Oxygen

- Weak oropharyngeal muscles common
- Neurogenic dysphagia: liquids worse than solids (purees best)
- Stroke pts on ventilator: 2/3 mortality, most survivors disabled

Recommendations (science):

- Keep pt 100% NPO until evaluation
- Use NG feeding tube if necessary (IV NS 75-125 cc/hr)
- Evaluate with video fluoroscopy whenever possible
- Use continuous feed only if Dobhoff tip distal to pylorus

Recommendations (art):

- Maintain HOB > 30°
- Maintain O2 sat > 92 or 95% w/ 2-4L O2
HYPERGLYCEMIA & ACUTE STROKE / DIABETES & ° STROKE PREVENTION

- Acutely, peri-stroke hyperglycemia associated with worse clinical outcomes
- Inpatient goal BG < 150
- Chronically, each 1% ↓ in Hgb A1C results in significant ↓ in risk of death, MI, vascular complications, including 12% ↓ in stroke risk
- Outpatient goal Hgb A1C < 7.0

SECONDARY STROKE PREVENTION: RISK-FACTOR MODIFICATION

- Hypercholesterolemia
  - Do not discontinue statins on admission
  - Obtain LDL w/in 48 of stroke onset
  - If LDL ≥ 100, use hi-dose statin shown to ↓ stroke/MI/death risk
    - atorvastatin 20-80 mg/d
    - pravastatin 40-80 mg/d
    - simvastatin 40-80 mg/d
    - rosuvastatin 10-40 mg/d
  - If LDL < 100, use lower statin dose
  - Outpatient goal LDL < 70 (but give statin to all pts)

SECONDARY STROKE PREVENTION: RISK-FACTOR MODIFICATION

- Hypertension
  - Day 1 poststroke, start low-dose ACE-I or ARB
  - Slowly (days to weeks) ↑ dose, add diuretic, watch K+
  - Anti-HTN meds benefit those w/ and w/o HTN history
  - Evaluate for sleep apnea and treat w/ CPAP
  - Outpatient goal < 120/80—over weeks to months

- In stroke pts, ACE-Is & ARBs appear to decrease risk of stroke, MI & vascular death beyond effect on BP alone. Based on theory and animal models, ARBs may be more effective than ACE-Is.

SUPPORTIVE MEDICAL CARE: PREVENT COMPLICATIONS

- Aspiration (NPO until swallowing evaluation)
- Deep-vein thrombosis
  - Sequential compression devices (if stroke < 48 h)
  - Heparin 5000 q8h or enoxaparin 40 mg/d
- Urinary tract infection (avoid Foley catheters)
- Constipation (docusate sodium for all)
- Decubitus ulcers (move q2h, out of bed TID by day 2)
- UGI bleed (H2B, but not cimetidine)
- Fever (acetaminophen + antibiotics as indicated)

Patient Education

- Brain attack should carry the same urgency as heart attack
- A study by the American Heart Association revealed that nearly 2/3 of the people surveyed could not even identify one warning sign of a STROKE.
- Delay in treatment factors include lack of recognition of stroke signs and symptoms, calls made to the HCP not 911, living alone, onset while asleep, onset at home rather than at work and a milder severity of stroke.
- Rehab needs to begin within 48 hours of stabilization—may involve physical, occupational and psychological therapy for both the patient and the family

REHAB & OUTPATIENT PLANNING: BEGIN ON ADMISSION, DECREASE LENGTH OF STAY

- SP—swallowing evaluation before oral feedings
- PT, OT—bedside first, out of bed ASAP
- Social worker—plan based on level of care, pay source, caregiver support
- Communicate with primary-care clinician
- Educate pt, caregiver daily (not just on discharge)
  - Call 911
  - Follow-up after discharge
  - Medications
  - Risk Factors
  - Stroke Symptoms
Public Education - Reducing Risk

Lifestyle Modification
- Low fat diet/Controlling weight/Exercise
- Treating Atrial Fibrillation
- Monitoring Alcohol consumption
- Quit smoking

Medical Management
- Antihypertensive Medication - For blood pressure greater than 140/90. (Tighter control for diabetics)
- Cholesterol reducing medication for cholesterol > 200 mg/dl or LDL > 100 (statins)
- Clot prevention medication (Anticoagulants) - Warfarin
- Antiplatelet drugs - Aspirin, Aggrenox, Plavix, Ticlid

POSTSTROKE DEPRESSION
- Suspect if sxs persist 1-2 wks after stroke
- Is an “organic,” not “reactive” depression
- Occurs in ~ 50% of stroke pts
- May affect rehab and recovery
- Often resolves w/in one year
- SSRIs equally effective, but if pt takes warfarin:
  - Escitalopram (Lexapro) 5-10 mg qAM
  - Citalopram (Celexa) 10-20 mg qAM
  - Sertraline (Zoloft) 25-50 mg qAM

SECONDARY STROKE PREVENTION: RISK-FACTOR MODIFICATION

- Cigarette smoking cessation
  - Bupropion (Wellbutrin SR or XL, Zyban)
    - Start 150 mg daily x 3 days
    - Then 150 mg BID x 3 months
  - Nortriptyline (Pamolor)
    - Start 10-25 mg each night
    - Gradually to 75 mg each night
  - Nicotine patch/gum/inhaler
  - Concurrent with bupropion or nortriptyline
  - Varenicline (Chantix)
    - Start 0.5 mg daily x 3 days
    - Gradually to 1 mg BID x 11 wk

ISCHEMIC STROKE / TIA 2° PREVENTION SUMMARY

- Prescribe:
  - Antithrombotic agent based on cause
  - ARB or ACE-I regardless of BP
  - Statin regardless of cholesterol

- Maintain:
  - Hgb A1C < 7.0
  - BP < 120/80, including ARB or ACE-I
  - LDL < 70, including statin
  - Nutrition w/ fruits, Mediterranean diet
  - Alcohol intake < 2 oz/d (men) or < 1 oz/d (women)
  - BMI 18.5-24.9 kg/m²
  - Aerobic exercise > 20 min/d, > 3 d/wk

ISCHEMIC STROKE / TIA 2° PREVENTION SUMMARY

- Discontinue:
  - Cigarette smoking
  - Sympathomimetic agents (incl. decongestants)
  - Estrogens

- Treat:
  - Carotid stenosis 50/70-99% (CEA or CAS)
  - Sleep apnea (CPAP)
  - Sickle cell disease (monitor TCD, Hgb S < 30%)

Questions?