Is Carotid Atherosclerosis the next Ankle Brachial Index?

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Presenter Disclosure Information

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Speakers Bureau: Sanofi-Aventis/BMS Partnership

Consultant: NHSi, Inc
Is Carotid Atherosclerosis the next Ankle Brachial Index in CVD risk prediction?

YES

Yes, No, Maybe ....
Symptomatic Carotid Atherosclerosis
ISCHEMIC STROKE

Stroke is the leading cause of long-term disability and the third leading cause of death in the US.
Types of Stroke

Hemorrhagic Stroke: 15%

Intracerebral: 67%
Subarachnoid: 33%

Ischemic Stroke: 85%

Cardiac emboli: 20%
Atherosclerotic large vessel: 20%
Unknown cause: 30%
Lacunar or small vessel: 25%
Other causes: 5%

### Cumulative Risk of Recurrent Stroke by Ischemic Stroke Subtypes (NOMAS)

<table>
<thead>
<tr>
<th>Average Annual Risk</th>
<th>30-day</th>
<th>1-Year</th>
<th>3-Year</th>
<th>OVERALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>E LV</td>
<td>8 %</td>
<td>15 %</td>
<td>28 %</td>
<td>9 %</td>
</tr>
<tr>
<td>I LV</td>
<td>7 %</td>
<td>11 %</td>
<td>19 %</td>
<td>7 %</td>
</tr>
<tr>
<td>CEMB</td>
<td>2 %</td>
<td>10 %</td>
<td>25 %</td>
<td>8 %</td>
</tr>
<tr>
<td>LAC</td>
<td>&lt;1%</td>
<td>10 %</td>
<td>14 %</td>
<td>3 %</td>
</tr>
<tr>
<td>CRY</td>
<td>1 %</td>
<td>7 %</td>
<td>15 %</td>
<td>5 %</td>
</tr>
</tbody>
</table>
Carotid Stenosis Management to Prevent Stroke:

1. Surgery
   Symptomatic CAS (NASCET, ESCT)
   Asymptomatic CAS (ACAS, ACST-1)
2. Stenting (EVA-3S, SPACE, ICSS, CREST)
3. Medical Therapy (?)
Extracranial Carotid Stenosis
Symptomatic

Mild Stenosis
< 50%

Moderate Stenosis
50-69%

Severe Stenosis
≥ 70%

Less Severe Stenosis
Age < 75 years
Female Sex
Stroke >3 mo Earlier
Visual Symptoms Alone
No Intracranial Stenosis
Microvascular Ischemia

More Severe Stenosis
Age ≥ 75 years
Male Sex
Stroke >3 mo Earlier or Less
Hemispheric Symptoms Intracranial Stenosis
No Microvascular Ischemia

Lower Risk of Carotid Stroke

Higher Risk of Carotid Stroke

Endarterectomy

Medical Therapy
Risk Factor Control, Antiplatelets, Statins, ACE inhibitors

Sacco, N Engl J Med 2001;345:1113-18
Symptomatic Carotid Endarterectomy (TIA/Stroke) ASA 2006 Recommendations

- Ipsilateral severe (70-99%) carotid stenosis, CEA is recommended if complication <6% (Class I, Evidence A).
- Ipsilateral moderate (50-69%) carotid stenosis, CEA is recommended depending on age, gender, comorbidities, and the severity of symptoms (Class I, Evidence A).
- Stenosis <50%, there is no indication for CEA (Class III, Evidence A).
- Surgery within 2 weeks is suggested rather than delaying surgery (Class IIa, Evidence B).
- Among patients with symptomatic carotid occlusion, EC/IC bypass surgery is not routinely recommended (Class III, Level of Evidence A).
CAS reasonable alternative in high surgical risk (Class IIb, Evidence B), but uncertain if these patients should be revascularized.

CAS may be considered:
- Stenosis (>70%) difficult to access surgically
- Medical conditions that greatly increase the risk for surgery
- Other circumstances such as radiation-induced stenosis or restenosis after CEA

CAS is reasonable when performed by operators with periprocedural morbidity and mortality rates 4% to 6% (Class IIa, Evidence B).
Symptomatic Carotid Atherosclerosis

Selective screening restricted to symptomatic stroke patients:

1. Changes management
2. Improves survival
3. Improves quality of life
4. Substantially less expensive
Asymptomatic Carotid Atherosclerosis (Stenosis > 60%)
Screening for Asymptomatic Carotid Artery Stenosis

The actual stroke reduction from screening asymptomatic CAS patients and treatment with CEA is unknown.

The benefit is limited by a low overall prevalence of treatable CAS in general population.

Ann Intern Med 2007;147:860-70
Asymptomatic Carotid Ath
Prevalence in Adult General Population

>50%: 2-8%

>80%: 1-2%

<table>
<thead>
<tr>
<th></th>
<th>With CAD</th>
<th>With PAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-30%</td>
<td>25-50%</td>
</tr>
</tbody>
</table>

Asymptomatic Carotid Stenosis

Annual Risk Ipsilateral Stroke

<table>
<thead>
<tr>
<th>Stenosis</th>
<th>Annual Stroke Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>50-80%</td>
<td>0.8 - 2.4%</td>
</tr>
<tr>
<td>&gt;80%</td>
<td>1 - 5%</td>
</tr>
</tbody>
</table>

A Rijbroek et al. Eur Neurol 2006;56:139

Progression of Asymptomatic CS

Ipsilateral Stroke Risk: 2-10% per y
Asymptomatic Carotid Endarterectomy
AHA/ASA Guidelines

- CEA recommended in select patients with high-grade ACS with complication <3% (Class I, Evidence A)

- Patient selection should be guided by comorbidities, life expectancy, patient preference

Goldstein et al. Stroke. 2006; 37:1583-1633
Extracranial Carotid Stenosis
Asymptomatic

Stenosis < 60%

- Age >79 years
- Unstable Cardiac Disease
- Experienced Surgeon Unavailable
- Surgical Risk > 3%

Medical Therapy
Risk Factor Control, Antiplatelets, Statins, ACE inhibitors

Stenosis ≥ 60%

- Age ≤79 years
- Stable Cardiac Disease
- Experienced Surgeon Available
- Surgical Risk ≤ 3%

Endarterectomy

Clinical Definition of Carotid ATH?

Carotid Stenosis >50%

Blood Flow Velocity (Doppler)
Clinical Definition of Carotid ATH?

Carotid Plaque?
Carotid IMT?
Schematic Time Course of Atherogenesis

**SUBCLINICAL**
- Lesion initiation
- No symptoms
- Time (30-40 y)

**CLINICAL**
- Stroke
- Ischemic Heart Disease
- PVD
- Symptoms

Lesion Lesion initiation
## Surrogate Markers / Endpoints of Ath

<table>
<thead>
<tr>
<th>Soluble Biomarkers</th>
<th>Imaging Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflammatory</td>
<td>IMT, plaque, ABI, CAC</td>
</tr>
<tr>
<td>hrCRP, CD40, IL1,</td>
<td>IVUS, Angiography</td>
</tr>
<tr>
<td>IL6, TNF$\alpha$,</td>
<td>EBCT, PET, Vascular MR,</td>
</tr>
<tr>
<td>LDL, TG,</td>
<td>Spiral CT, Molecular</td>
</tr>
<tr>
<td>Genetic (ApoE, ACE,</td>
<td>Imaging,</td>
</tr>
<tr>
<td>ANGII, SNPs,...</td>
<td></td>
</tr>
</tbody>
</table>

- Easy available
- Mostly standardized
- Not always easy available
- Not always CVD specific
- Not completely standardized
- CVD specific
Carotid IMT and risk of MI, Stroke
Large population based studies

<table>
<thead>
<tr>
<th>Population</th>
<th>Mean Age, y</th>
<th>Event Rate for MI (per 1000 Person-Years)</th>
<th>Event Rate for Stroke (per 1000 Person-Years)</th>
<th>Mean IMT, mm</th>
<th>Maximal IMT, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARIC*</td>
<td>54</td>
<td>4.4</td>
<td>2.4</td>
<td>0.63±0.16</td>
<td>...</td>
</tr>
<tr>
<td>Rotterdam Study⁷,⁸</td>
<td>70</td>
<td>...</td>
<td>11.3</td>
<td>0.80±0.16</td>
<td>1.03±0.22</td>
</tr>
<tr>
<td>CHS⁵</td>
<td>73</td>
<td>9.6</td>
<td>10.2</td>
<td>...</td>
<td>1.03±0.20</td>
</tr>
<tr>
<td>Kitamura 2004⁹</td>
<td>66</td>
<td>...</td>
<td>5.9</td>
<td>...</td>
<td>1.03±0.43</td>
</tr>
<tr>
<td>MDCS¹⁰,¹¹</td>
<td>57</td>
<td>3.2</td>
<td>2.4</td>
<td>0.77±0.15††</td>
<td>...</td>
</tr>
<tr>
<td>CAPS¹²</td>
<td>50</td>
<td>10.7</td>
<td>5.0</td>
<td>0.73±0.16</td>
<td>...</td>
</tr>
</tbody>
</table>


CIMT > 75th percentile (>1mm) or presence of plaque are considered high and indicative of increased CVD/Stroke risk (2-5x)

ASE CONSENSUS STATEMENT (Soc Vas Med. JESI 2008)
Carotid Plaque- Risk of MI, Stroke
Large population based studies

Yes

Table 2 Prospective studies of carotid plaque presence and risk for cardiovascular disease events in individuals without known cardiovascular disease (N > 1000 participants each)

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Age (y); F</th>
<th>Follow-up (y)</th>
<th>Event</th>
<th>Plaque presence adjusted HR (95% CI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARIC(^{38})</td>
<td>12,375</td>
<td>45-64; 54%</td>
<td>7</td>
<td>MI, CHD death</td>
<td>With AS: 2.96 (1.54-3.30) Without AS: 2.02 (1.42-2.41)</td>
</tr>
<tr>
<td>KIHD(^{39})</td>
<td>1288</td>
<td>42-60; 0%</td>
<td>(&lt;2) y</td>
<td>MI</td>
<td>4.15 (1.50-11.47)</td>
</tr>
<tr>
<td>Yao City(^{22})</td>
<td>1289</td>
<td>60-74; 0%</td>
<td>4.5</td>
<td>Stroke</td>
<td>3.2 (1.4-7.1)†</td>
</tr>
<tr>
<td>MDSCS(^{23})</td>
<td>5163</td>
<td>46-68; 60%</td>
<td>7</td>
<td>MI, CHD death</td>
<td>1.81 (1.14-2.87)</td>
</tr>
<tr>
<td>Northern Manhattan(^{40})</td>
<td>1039</td>
<td>&gt;40; 59%</td>
<td>6.2</td>
<td>Stroke</td>
<td>3.1 (1.1-8.5)</td>
</tr>
<tr>
<td>Rotterdam(^{24})</td>
<td>6389</td>
<td>&gt;55; 62%</td>
<td>7-10</td>
<td>MI</td>
<td>Severe; 1.83 (1.27-2.62)</td>
</tr>
</tbody>
</table>

ASE CONSENSUS STATEMENT (Soc Vas Med). JASE 2008
Carotid Plaque and Vascular Events

Max Carotid Plaque Thickness (MCPT) >1.9 mm and Vascular Outcome (248 events / 2,149)

- ANY PLAQUE (58%, n=1247)
  - ICA Stenosis
    - 60-80%: 2%
    - > 80%: 1%
    - Occlusion: 0.5%

- MCPT
  - MCPT: 2.2
  - MCPTadj*: 2.1
  - MCPTadj**: 1.7

- Stroke
  - N=72
  - HR and 95% CI: 1.5

- MI
  - N=50
  - HR and 95% CI: 2.8

- Vasc. Death
  - N=58
  - HR and 95% CI: 2.5

* Adjusted for age, gender, race-ethnicity
** Adjusted for age, gender, race-ethnicity, HTN, DM, BMI, education, HDL, alcohol, smoking, and physical activity

Rundek T, Sacco RL, at al., Neurology 2008
### Carotid Plaque Reclassifies FRS Stroke Risk in General Population

<table>
<thead>
<tr>
<th></th>
<th>Low FRS</th>
<th></th>
<th>Moderate FRS</th>
<th></th>
<th>High FRS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (%)</td>
<td>10-year risk (%)</td>
<td>No (%)</td>
<td>10-year risk (%)</td>
<td>No (%)</td>
<td>10-year risk (%)</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>505 (26)</td>
<td><strong>11.4</strong></td>
<td>920 (47)</td>
<td><strong>15.6</strong></td>
<td>541 (27)</td>
<td><strong>26.0</strong></td>
</tr>
<tr>
<td><strong>No plaque</strong></td>
<td>285 (56)</td>
<td><strong>5.8</strong></td>
<td>402 (44)</td>
<td><strong>11.5</strong></td>
<td>178 (33)</td>
<td><strong>27.6</strong></td>
</tr>
<tr>
<td><strong>Plaque</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MCPT&lt;1.9mm</strong></td>
<td>220 (44)</td>
<td><strong>18.3</strong></td>
<td>518 (56)</td>
<td><strong>18.6</strong></td>
<td>364 (67)</td>
<td><strong>25.0</strong></td>
</tr>
<tr>
<td><strong>p Value</strong></td>
<td>0.001</td>
<td></td>
<td>0.020</td>
<td></td>
<td>0.325</td>
<td></td>
</tr>
<tr>
<td><strong>MCPT≥1.9 mm</strong></td>
<td>62 (12)</td>
<td><strong>24.7</strong></td>
<td>173 (19)</td>
<td><strong>25.1</strong></td>
<td>157 (29)</td>
<td><strong>30.7</strong></td>
</tr>
<tr>
<td><strong>p Value</strong></td>
<td>0.004</td>
<td></td>
<td>0.002</td>
<td></td>
<td>0.319</td>
<td></td>
</tr>
</tbody>
</table>

## Screening for Nontraditional Markers

**US Preventive Services Task Force**

- cIMT, CAC, ABI
- hsCRP, Leu, Homocysteine, lipoprotein(a)
- periodontal disease

**Insufficient evidence to support their routine use!**

**Insufficient evidence that reducing levels of these markers prevents CHD events**

Screening for Nontraditional Markers- Interpretation

US Preventive Services Task Force interpretation of the evidence:
There is very little evidence that their use results in improving health!

Physician’s interpretation:
For an individual patient at intermediate risk adding another test might help decide to intensify treatment and reduce risk.
Traditional risk factor control NOT enough to prevent CHD/stroke!

...as many as 20% of all coronary events occur in the absence of the traditional RF!

...... 50% with 1 RF!
Screening for Nontraditional Markers

The Gold Standard for risk assessment: Framingham Risk Scoring system
(individual’s 10-y % risk of MI or death based on age, sex, Total Chol, HDL, smoking)

For those at intermediate FRS screening may be of value.

Who should be screened for Carotid ATH?

**Intermediate risk:**
6%-20% 10-year risk of CHD

<table>
<thead>
<tr>
<th>Prevalence in the US adult population over age 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Risk &lt;10%</td>
</tr>
<tr>
<td><strong>Intermediate 10-20%</strong></td>
</tr>
<tr>
<td>High &gt;20%</td>
</tr>
</tbody>
</table>

ASE CONSENSUS STATEMENT (Soc Vas Med)
NHANCE III
# Framingham Model - Stroke

## TABLE 5. Modified Framingham Stroke Risk Profile

<table>
<thead>
<tr>
<th>Points</th>
<th>0</th>
<th>+1</th>
<th>+2</th>
<th>+3</th>
<th>+4</th>
<th>+5</th>
<th>+6</th>
<th>+7</th>
<th>+8</th>
<th>+9</th>
<th>+10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
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<tr>
<td>History of diabetes</td>
<td>No</td>
<td>Yes</td>
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<td></td>
<td></td>
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<tr>
<td>Cigarette smoking</td>
<td>No</td>
<td>Yes</td>
<td></td>
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<tr>
<td>Cardiovascular disease</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Atrial fibrillation</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Left ventricular hypertrophy on electrocardiogram</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td><strong>Women</strong></td>
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<tr>
<td>History of diabetes</td>
<td>No</td>
<td>Yes</td>
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</tr>
<tr>
<td>Cigarette smoking</td>
<td>No</td>
<td>Yes</td>
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<td>Yes</td>
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<tr>
<td>Atrial fibrillation</td>
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<td>Yes</td>
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</tbody>
</table>
# TABLE 1. ATP III LDL-Cholesterol Goals and Cut Points for Therapeutic Lifestyle Changes (TLC) and Drug Therapy in Different Risk Categories and Proposed Modifications Based on Recent Clinical Trial Evidence

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>LDL-C Goal</th>
<th>Initiate Therapeutic Lifestyle Changes (TLC)</th>
<th>Consider Drug Therapy∗†</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHD* or CHD Risk Equivalents† (10-year risk &gt;20%)</td>
<td>&lt;100 mg/dL (&lt;optional goal: &lt;70 mg/dL)†</td>
<td>≥100 mg/dL**</td>
<td>≥100 mg/dL‡‡</td>
</tr>
<tr>
<td>High Risk</td>
<td></td>
<td>(&lt;100 mg/dL: consider drug options)‡‡</td>
<td></td>
</tr>
<tr>
<td>2+ Risk Factors‡ (10-year risk 10%–20%)</td>
<td>&lt;130 mg/dL†</td>
<td>≥130 mg/dL**</td>
<td>≥130 mg/dL</td>
</tr>
<tr>
<td>Moderately High Risk</td>
<td></td>
<td>(100–129 mg/dL; consider drug options)‡‡</td>
<td></td>
</tr>
<tr>
<td>2+ Risk Factors‡ (10-year risk &lt;10%)</td>
<td>&lt;130 mg/dL</td>
<td>≥130 mg/dL</td>
<td>≥160 mg/dL</td>
</tr>
<tr>
<td>Moderate Risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–1 Risk Factor§</td>
<td>&lt;160 mg/dL</td>
<td>≥160 mg/dL</td>
<td>≥190 mg/dL (160–189 mg/dL: LDL-lowering drug optional)</td>
</tr>
</tbody>
</table>

*Coronary heart disease (CHD) includes history of myocardial infarction, unstable angina, stable angina, coronary artery procedures (angioplasty or bypass surgery), or evidence of clinically significant myocardial ischemia.

†CHD risk equivalents include clinical manifestations of noncoronary forms of atherosclerotic disease (peripheral arterial disease, abdominal aortic aneurysm, and carotid artery disease [transient ischemic attacks or stroke of carotid origin or >50% obstruction of a carotid artery]), diabetes, and 2+ risk factors with 10-year risk for hard CHD >20%.

‡Risk factors include cigarette smoking, hypertension (BP ≥140/90 mm Hg or on antihypertensive medication), low HDL cholesterol (<40 mg/dL), family history of premature CHD (CHD in male first degree relative <55 years; CHD in female first degree relative <65 years), and age (men ≥45 years; women ≥55 years).

§Almost all people with 0–1 risk factor have a 10-year risk <10%, and 10-year risk assessment in people with 0–1 risk factor is thus not necessary.

**Very high risk favors the optional LDL-C goal of <70 mg/dL.

†Optional LDL-C goal <100 mg/dL.

**Any person at high-risk or moderately high risk who has lifestyle-related risk factors (eg, obesity, physical inactivity, elevated triglyceride, low HDL-C, or metabolic syndrome) is a candidate for therapeutic lifestyle changes to modify these risk factors regardless of LDL-C level.

††When LDL-lowering drug therapy is used, it is advised that intensity of therapy be sufficient to achieve at least a 30%–40% reduction in LDL-C levels.

‡‡If baseline LDL-C is <100 mg/dL, institution of an LDL-lowering drug is a therapeutic option based on available clinical trial results. If a high-risk person has high triglycerides or low HDL-C, combining a fibrate or nicotinic acid with an LDL-lowering drug can be considered.

‡‡For moderately high-risk persons, when LDL-C level is 100–129 mg/dL, at baseline or on lifestyle therapy, initiation of an LDL-lowering drug to achieve an LDL-C level <100 mg/dL is a therapeutic option based on available clinical trial results.
Improving Global Vascular Risk Prediction With Behavioral and Anthropometric Factors

The Multiethnic NOMAS (Northern Manhattan Cohort Study)

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| **Global Vascular Risk Score Calculator**  
<table>
<thead>
<tr>
<th><strong>Northern Manhattan Study</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Age</strong> : [ ] Years</td>
</tr>
<tr>
<td><strong>Gender</strong> : Select.</td>
</tr>
<tr>
<td><strong>African American</strong> : Select.</td>
</tr>
<tr>
<td><strong>Hispanic Ethnicity</strong> : Select.</td>
</tr>
<tr>
<td><strong>High School Graduate or greater</strong> : Select.</td>
</tr>
<tr>
<td><strong>Waist</strong> : [ ] inches</td>
</tr>
<tr>
<td><strong>Alcohol Consumption</strong> : Select.</td>
</tr>
<tr>
<td><strong>Former Smoker</strong> : Select.</td>
</tr>
<tr>
<td><strong>Current Smoking</strong> : Select.</td>
</tr>
<tr>
<td><strong>Physical Activity</strong> : Select.</td>
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**Light physical activity** (i.e. walking, calisthenics, dancing, golf, bowling, horseback riding, or gardening)

**Moderate-to-heavy physical activity** (i.e. hiking, tennis, swimming, bicycle riding, jogging, aerobic dancing, handball, racquetball, squash)

| **Systolic Blood Pressure** : [ ] (mm Hg) |
| **Diastolic Blood Pressure** : [ ] (mm Hg) |
| **Anti-hypertensive Medication** : Select. |
| **Cardiac Disease** : Select. |

(history of congestive heart failure, angina, coronary artery disease, atrial fibrillation or valvular heart disease )

| **Cardiac Medications** : Select. |
| **Peripheral Vascular Disease** : Select. |

(Pain in the back of their legs with walking or exercise, or a history of peripheral vascular disease )

| **Fasting Blood Sugar** : [ ] mg/dl |
| **HDL** : [ ] mg/dl |
GVRS Model Calibration

Figure 4  Calibration by Decile for NOMAS GVRS

Comparison of 10-year Kaplan-Meier-based (blue bars) and NOMAS model-based (decile-specific means, brown bars) predicted probabilities of stroke, myocardial infarction, or vascular death events by deciles of the NOMAS GVRS. Abbreviations as in Figure 1.
Circle of Willis
Continuation of Carotid Artery
CEA/CAS vs. Best Medical Rx in patients with Asymptomatic CAS

Role of TCD in patients with CAS:
- Risk stratification/reclassification
- Rx decisions/change in Rx
- Rx follow-up/improve outcome
The Role of TCD:
Patient selection for CEA/CAS-redefined ......

- Severity stenosis
- Age
- Life expectancy
- Contralateral CAS
- Comorbidities

<table>
<thead>
<tr>
<th>Test</th>
<th>Procedure</th>
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</thead>
<tbody>
<tr>
<td>Plaque morphology</td>
<td>Duplex MR</td>
</tr>
<tr>
<td>Collateral Flow</td>
<td>TCD</td>
</tr>
<tr>
<td>Cerebral MES</td>
<td>MR</td>
</tr>
<tr>
<td>Cerebral VMR</td>
<td>MR</td>
</tr>
<tr>
<td>Silent brain ischemia</td>
<td>MR</td>
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</tbody>
</table>
Analytic framework for screening for Asymptomatic CAS

Key question 1: Is there direct evidence that US screening for asymptomatic CAS reduces stroke?

Key question 2: What is the accuracy of duplex US to detect CAS?

Key question 3: Does intervention with CEA reduce CAS-related morbidity (60-99%)?

Key question 4: Does screening or CEA for asymptomatic CAS 60% -99% result in harm?

The best Intervention is Prevention and the best Prevention is Noninvasive!
CAROTID ATH
Direct visualization of ATH plaque
Brain MES, VMR

CVD Risk Assessment

Screening Cost-Utility

CVD Risk Stratification beyond RF

Change in Management: Change in outcome Improving survival and quality of life

Cost-Utility?
Is Carotid Atherosclerosis the next Ankle Brachial Index?

YES and MORE ....