Vertebral Artery Origin Stenosis: Epidemiology and Natural History

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Disclosure Information

• Financial Disclosures
  - Consultant for Boehringer Ingelheim,
Noninvasive imaging by CTA or MRA for detection of vertebral artery disease

- should be part of the initial evaluation of patients with neurological symptoms referable to the posterior circulation (Level of Evidence: C)
- should be performed in patients with asymptomatic bilateral carotid occlusions or unilateral carotid artery occlusion and incomplete circle of Willis. (Level of Evidence: C)
- Antiplatelet drug therapy is recommended … ischemic stroke or TIA associated with extracranial vertebral atherosclerosis. (Level of Evidence: B)
ACCF/AHA/ASA Guidelines 2011

• Percutaneous endovascular angioplasty and stenting is reasonable for patients with symptomatic posterior cerebral or cerebellar ischemia caused by **subclavian artery stenosis** (subclavian steal syndrome) who are at high risk of surgical complications. (Level of Evidence: C)

• Asymptomatic patients with asymmetrical upper-limb blood pressure, periclavicular bruit, or flow reversal in a vertebral artery caused by **subclavian artery stenosis should not undergo** revascularization unless the internal mammary artery is required for myocardial revascularization. (Level of Evidence: C)
Proximal atherothrombosis prevalence

Common carotid stenoses >30%: 5%

Subclavian stenoses >30%: 6%

Vertebral origin stenoses >30%: 13%

Mazighi et al. Stroke 2009
Proximal atherothrombosis Association with other locations

- Intracranial Stenoses*
- Carotid stenoses*
- Coronary stenosis *
- Silent MI *
# Autopsy Prevalence of Proximal Extracranial Atherosclerosis in Patients with Fatal Stroke

- 339 consecutive autopsies of fatal stroke patients

<table>
<thead>
<tr>
<th>Severity</th>
<th>Any Artery</th>
<th>CCA</th>
<th>I/SA</th>
<th>VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>180 (53.1)</td>
<td>260 (76.7)</td>
<td>271 (79.9)</td>
<td>259 (76.4)</td>
</tr>
<tr>
<td>Non stenotic plaques</td>
<td>92 (27.1)</td>
<td>61 (18.0)</td>
<td>48 (14.2)</td>
<td>37 (10.9)</td>
</tr>
<tr>
<td>Stenosis 30–74%</td>
<td>42 (12.4)</td>
<td>18 (5.3)</td>
<td>14 (4.1)</td>
<td>22 (6.5)</td>
</tr>
<tr>
<td>Stenosis 75–99% or with occlusion</td>
<td>25 (7.4)</td>
<td>0 (0.0)</td>
<td>6 (1.8)</td>
<td>21 (6.2)</td>
</tr>
</tbody>
</table>

Mazighi et al, Stroke 2009
Proximal atherothrombosis and brain infarction risk

Infarctions with an adjusted OR of 1.20 (95% CI, 0.72 to 2.00) for proximal extracranial plaques and 1.25 (95% CI, 0.67 to 2.36) for proximal extracranial stenosis. However, PEA did occur more frequently in patients with BI involving the BA, posterior inferior cerebellar artery, superior cerebellar artery, and VA vascular territories (Figure 2) with adjusted ORs of 2.19 (95% CI, 1.18 to 4.05) for proximal extracranial plaques and 1.93 (95% CI, 0.98 to 3.81) for proximal extracranial stenosis. Figure 3 shows that the association between PEA and posterior circulation infarctions differed according to the arterial site involved; only atherosclerosis in the proximal VA was significantly associated with posterior circulation infarction with an age- and sex-adjusted OR of 2.31 (95% CI, 1.28 to 4.17) for plaques and 2.10 (95% CI, 1.01 to 4.38) for stenosis using patients with isolated anterior circulation infarction as the control group. Among the 36 patients with proximal VA lesions, 31 had posterior or anterior tandem lesions, mainly BA and ICAO for the posterior and anterior circulation, respectively (see Figure 4).

Discussion

This autopsy study is the first to show that PEA occurs frequently (with a prevalence of almost 50%) in patients with fatal stroke. Proximal VA plaques and stenosis were significantly associated with posterior circulation infarctions. PEA also occurred more frequently in patients with brainstem and cerebellar ischemic strokes (ie, involving the superior cerebellar artery, BA, and posterior inferior cerebellar artery territories), but not in those with PCA territory infarctions. Atherosclerosis is a widespread process as illustrated by the positive association we found between atherosclerosis in the proximal arteries and atherosclerosis in the ICAO and the coronary artery. In patients with PEA and stenotic lesions, ICAO stenosis was documented in more than 53.7% of cases, and similar findings were obtained for coronary atherosclerosis with coronary stenosis present in 50.8% of patients with stenotic lesions in proximal arteries. Like in other studies, we found a male predominance in patients with PEA.

14,15

In previous autopsy studies, patients with PEA were
Proximal atherothrombosis and brain infarction risk

Mazighi et al. Stroke 2009

OR 2.31, (1.28-4.17)

OR 2.10, (1.01-4.38)
Oxford Vascular Study

- 538 TIA or minor stroke patients
- 141 VB TIA/ischemic stroke
- 37 (26.2%) with vertebral or basilar artery stenosis ≥ 50%:
  - 23 (62%) : extracranial vertebral artery (V1:16)
  - 11 (30%) : intracranial vertebral artery
  - 3 (8%) : basilar artery

Marquardt et al, Brain 2009
141 VB TIA/ischemic stroke patients: 37 (26.2%) with vertebral or basilar artery stenosis ≥ 50%

OR: 9.29, 2.31-37.27

Marquardt et al, Brain 2009
New England Medical Center Posterior Circulation Registry

- 407 patients,
  - 59%: strokes without TIAs
  - 24%: TIAs then strokes,
  - 16%: only TIAs
- 148 patients: stenosis>50%

NEMC Posterior Circulation Registry

- 407 TIA or VB stroke patients
- 148 patients with 50% Luminal Stenosis

<table>
<thead>
<tr>
<th>Artery</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innominate</td>
<td>2</td>
</tr>
<tr>
<td>Subclavian</td>
<td>5</td>
</tr>
<tr>
<td>Vertebral artery origin</td>
<td>131 (29 bilateral)</td>
</tr>
<tr>
<td>Intracranial vertebral artery</td>
<td>132 (36 bilateral)</td>
</tr>
<tr>
<td>Basilar artery</td>
<td>109</td>
</tr>
<tr>
<td>Posterior cerebral artery</td>
<td>38 (4 bilateral)</td>
</tr>
<tr>
<td>Anterior inferior cerebellar artery</td>
<td>2</td>
</tr>
<tr>
<td>Superior cerebellar artery</td>
<td>10</td>
</tr>
</tbody>
</table>

Caplan et al, Ann Neurol 2004
• Vertebral Artery Origin stenosis (50%)
  • 131 patients, bilateral in 29
  • Dissections: 6

• Artery-to-artery embolism

• Commonest recipient site intracranial VA
« benignity » of vertebral origin lesions

• Collateral reconstitution of extracranial VA
• Two viable arteries that join together intracranially, with contralateral compensation if necessary
• Slow development of luminal compromise by atherosclerotic plaques allowing time for collateral development.

BUT

• observation of VA origin specimen showing ulcerated plaque in patient with repeated posterior circulation TIAs

From 1988 to 1996, computed tomography (CT) and magnetic resonance imaging (MRI). Precise definition of circulation disease.

Known about anterior circulation than about posterior territory ischemia seldom have extensive cardiac or vascular investigations. Be-...
NEMC Posterior Circulation Registry: outcome

- 30-day mortality: 3.6%
- Poor outcome (mortality or severe disability at 30 days): BA disease
  - 30% had poor outcomes, RR: 3.64 (95% CI, 1.9 – 7.0)
- Worst outcomes: BA embolism (58% major deficits)
- Extracranial VA had better outcomes than those with Intracranial VA and BA disease
  - RR: 0.62 for death or severe disability
NEMC Posterior Circulation Registry

- Significant frequency of cardiac embolism: 24%.
- Poor outcome associated with cardiac embolism, RR: 1.89
- Coexistent coronary artery disease: 35%

Caplan et al, Ann Neurol 2004
Long-Term Outcome After Angioplasty and Stenting for Symptomatic Vertebral Artery Stenosis Compared With Medical Treatment in the Carotid And Vertebral Artery Transluminal Angioplasty Study (CAVATAS)

• 16 patients with symptomatic vertebral artery stenosis (n=8, n=8)
• No deaths or strokes within the first 30 days.
• Mean follow-up: 4.7 years,
  o No vertebrobasilar territory stroke,
  o 3 patients in each treatment arm died of myocardial infarction or carotid territory stroke.

Coward et al Stroke. 2007;38:1526-1530.)
key points: vertebral artery origin lesions

• Vertebral origin lesions are frequent and significantly associated with vertebro-basilar strokes.
• Artery-to-artery embolism
• Importance of systematic work-up including the evaluation of vertebral origin lesions
• VA origin lesions have better outcomes compared to intracranial VA or BA ones
• Cardiac investigations (cardiac and aortic sources of embolism)