Vertebral Basilar Insufficiency
Indications, Technique and Outcomes

J. Stephen Jenkins MD FACC, FSCAI, FSVM
Ochsner Heart and Vascular Institute
I proctor for:
  • Abbott Vascular
  • AGA Medical
  • Trivascular/Endologix
  • Toray Industries

I speak for:
  • Abbott Vascular
  • Angiovac
Conflicts of Interest

Vertebral stenting is an OFF label use of an approved device.

Vertebral artery stenting is not:
CMS reimbursed or FDA approved procedure.
Conclusions

• Rx = Dual Anti-platelet therapy.
THANK YOU
Occipital branch of ECA collateral
Posterior circulation territory

- Midbrain
- Pons
- Medulla
- Visual cortex
  - Parts of occipital and temporal lobe

- Sensory
  - Cranial nerve V
  - Spinal thalamic tract
  - Medial lemniscus tract

- Descending motor
  - Corticospinal tract
Incidence
Vertebral artery disease

- 3,800 patients with symptomatic cerebral disease presenting for angiography\(^1\)
  - 40% incidence of vertebral stenosis
  - 10% incidence of vertebral occlusion.
- Patients with documented PVD\(^2\)
  - 40% incidence of VAS.

---
Posterior Circulation Stroke

Factoids

• ~25% of ischemic strokes are the result of posterior circulation disease.¹,²
• Vertebral artery stenosis (VAS) in 20-40% of patients
  signs/symptoms of posterior circulation ischemia.³
• Symptomatic VAS
  5-year stroke rate of 30-35%.⁴-⁶
• Mortality with posterior circulation strokes = 20-30%.⁶
Intracranial Vertebral Disease
Natural History

• Stroke-Free Survival........
  • Ziai et al
  • 102 patients with symptomatic intracranial vertebral basilar disease
  • Mean age 64 +/- 12
  • Follow up 15 +/- 16 mo (1-60)
  • MORTALITY 21% (1yr)  52% (5yr)
  • Stroke Free survival  76% (12mo)  48% (5yr)

This is a Lethal Disease

ASITN Feb 2003
Incidence not truly appreciated

1. "Stroke" etiology and prevention thought of in terms of carotid disease.
2. Brain stem infarct survivors - too sick.
3. Episodic dizziness - not sick enough.
4. Posterior circulation symptoms not as well defined as anterior symptoms.
Vertebrobasilar Insufficiency

- Most common culprit - bilateral vertebral artery stenosis
- Ligature of one vertebral artery well tolerated in man
- Other combinations possible:
  - Innominate
  - Carotid
  - Subclavian
<table>
<thead>
<tr>
<th>Comorbidities</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD</td>
<td>69</td>
<td>66</td>
</tr>
<tr>
<td>Hypertension</td>
<td>89</td>
<td>86</td>
</tr>
<tr>
<td>Diabetes</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>83</td>
<td>83</td>
</tr>
<tr>
<td>Tobacco use</td>
<td>51</td>
<td>53</td>
</tr>
<tr>
<td>Carotid dz</td>
<td>71</td>
<td>69</td>
</tr>
<tr>
<td>Subclavian dz</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>Bilateral Vertebral dz</td>
<td>57</td>
<td>54</td>
</tr>
<tr>
<td>Prior CVA</td>
<td>43</td>
<td>41</td>
</tr>
</tbody>
</table>

Circle of Willis

- Anterior Cerebral a.
- Anterior Communicating a.
- Posterior Communicating a.
- Internal Carotid a.
- Posterior Cerebral a.
- Basilar a.
## VBI Symptoms
### Vertebrobasilar Insufficiency

<table>
<thead>
<tr>
<th>Classical</th>
<th>Less common</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Dizziness</td>
<td>- Confusion</td>
</tr>
<tr>
<td>- Ataxia</td>
<td>- Global amnesia</td>
</tr>
<tr>
<td>- Drop attacks</td>
<td>- Syncope</td>
</tr>
<tr>
<td>- Diplopia</td>
<td>- Occipital headaches</td>
</tr>
<tr>
<td>- Dysphagia</td>
<td>- Nausea &amp; vomiting</td>
</tr>
<tr>
<td>- Bilateral Hemianopia</td>
<td>- Nystagmus</td>
</tr>
<tr>
<td></td>
<td>- Bilateral facial numbness</td>
</tr>
<tr>
<td></td>
<td>- Cortical blindness</td>
</tr>
<tr>
<td></td>
<td>- Altered mental status</td>
</tr>
</tbody>
</table>
Initial Management

- Antiplatelet therapy.
- Anticoagulant therapy.
- If failure to improve symptoms:
  - Aortic arch and 4-vessel study or MRA or CTA.
  - Intracranial angiography.
Surgical Treatment

- Transection and reimplantation into the ipsilateral subclavian or carotid artery.
- Vertebral artery endarterectomy.
- Vein patch angioplasty.

Berguer R. Appleton & Lange. 1993; 69.
<table>
<thead>
<tr>
<th>Surgical Morbidity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent Laryngeal nerve palsy</td>
<td>8%</td>
</tr>
<tr>
<td>Horner’s syndrome</td>
<td>22%</td>
</tr>
<tr>
<td>Lymphocele</td>
<td>4%</td>
</tr>
<tr>
<td>Chylothorax</td>
<td>5%</td>
</tr>
<tr>
<td>Thrombosis</td>
<td>1%</td>
</tr>
<tr>
<td>MI</td>
<td>3%</td>
</tr>
</tbody>
</table>
### Table 1 – Vertebral artery stenting with greater than 30 patients.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Patients (n)</th>
<th>Lesions (n)</th>
<th>Technical Success Rate (%)</th>
<th>Procedural Complications</th>
<th>Improvement in Symptoms</th>
<th>Mean Follow-up (mo)</th>
<th>Late Stroke (%)</th>
<th>Restenosis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chastain (1999)</td>
<td>50</td>
<td>55</td>
<td>98</td>
<td>None</td>
<td>36/39</td>
<td>25</td>
<td>2/50</td>
<td>10</td>
</tr>
<tr>
<td>Albuquerque (2003)</td>
<td>33</td>
<td>33</td>
<td>98</td>
<td>None</td>
<td>28/29</td>
<td>16</td>
<td>1/33</td>
<td>43</td>
</tr>
<tr>
<td>Weber (2005)</td>
<td>36</td>
<td>38</td>
<td>100</td>
<td>Dissection (2), TIA (1)</td>
<td>23/26</td>
<td>11</td>
<td>0/26</td>
<td>36</td>
</tr>
<tr>
<td>Lin (2006)</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>CVA (3), TIA (2), bleeding (1), access site (1)</td>
<td>75/80</td>
<td>12</td>
<td>0/80</td>
<td>28</td>
</tr>
<tr>
<td>Taylor (2008)</td>
<td>72</td>
<td>77</td>
<td>100</td>
<td>Dissection (2), TIA (1), MI (1), CIN (1), access site (1)</td>
<td>48/59</td>
<td>9</td>
<td>4/72</td>
<td>48</td>
</tr>
<tr>
<td>Vajda (2009)</td>
<td>48</td>
<td>52</td>
<td>100</td>
<td>None</td>
<td>48/48</td>
<td>7</td>
<td>0/48</td>
<td>12</td>
</tr>
<tr>
<td>Zhou (2011)</td>
<td>61</td>
<td>63</td>
<td>100</td>
<td>CVA (1)</td>
<td>58/61</td>
<td>12</td>
<td>0/61</td>
<td>27</td>
</tr>
<tr>
<td>Ogilvy (2010)</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>None</td>
<td>41/43</td>
<td>21</td>
<td>–</td>
<td>31</td>
</tr>
<tr>
<td>Jenkins (2010)</td>
<td>105</td>
<td>112</td>
<td>100</td>
<td>TIA (1), dissection (1), bleeding (2), access site (1)</td>
<td>95/105</td>
<td>29</td>
<td>5/105</td>
<td>33</td>
</tr>
<tr>
<td>Chen (2011)</td>
<td>47</td>
<td>49</td>
<td>100</td>
<td>None</td>
<td>45/47</td>
<td>28</td>
<td>0/47</td>
<td>5</td>
</tr>
<tr>
<td>Hatano (2011)</td>
<td>117</td>
<td>117</td>
<td>99</td>
<td>TIA (2)</td>
<td>103/108</td>
<td>48</td>
<td>3/117</td>
<td>12</td>
</tr>
<tr>
<td>Kojuri (2011)</td>
<td>81</td>
<td>81</td>
<td>99</td>
<td>Dissection (2), access site (5), CVA (1)</td>
<td>70/71</td>
<td>140</td>
<td>0/73</td>
<td>–</td>
</tr>
<tr>
<td>Song (2012)</td>
<td>206</td>
<td>219</td>
<td>99</td>
<td>TIA (1), access site (4), MI (1), CIN (1)</td>
<td>193/206</td>
<td>44</td>
<td>12/206</td>
<td>–</td>
</tr>
<tr>
<td>Edgell (2013)</td>
<td>148</td>
<td>148</td>
<td>100</td>
<td>None</td>
<td>88/96</td>
<td>3</td>
<td>1/120</td>
<td>15</td>
</tr>
<tr>
<td>Li (2014)</td>
<td>32</td>
<td>32</td>
<td>100</td>
<td>None</td>
<td>37/32</td>
<td>18</td>
<td>0/32</td>
<td>3</td>
</tr>
<tr>
<td>Langwieser (2014)</td>
<td>35</td>
<td>35</td>
<td>100</td>
<td>Access site (3)</td>
<td>29/30</td>
<td>18</td>
<td>0/30</td>
<td>23</td>
</tr>
<tr>
<td>Radak (2014)</td>
<td>73</td>
<td>73</td>
<td>93</td>
<td>TIA (1), access site (2), dye allergy (1)</td>
<td>60/64</td>
<td>44</td>
<td>0/68</td>
<td>10</td>
</tr>
<tr>
<td>Sun (2015)</td>
<td>188</td>
<td>202</td>
<td>100</td>
<td>None</td>
<td>154/188</td>
<td>16</td>
<td>0/188</td>
<td>21</td>
</tr>
<tr>
<td>Geng (2015)</td>
<td>127</td>
<td>136</td>
<td>98</td>
<td>None</td>
<td>113/127</td>
<td>18</td>
<td>–</td>
<td>13</td>
</tr>
</tbody>
</table>

CAVATAS

Randomized Trial

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)

A Randomized Trial

Lucy J. Coward, MRCP; Dominick J.H. McCabe, PhD; Joerg Ederle, MD; Roland L. Featherstone, PhD; Andrew Clifton, FRCR; Martin M. Brown, MD, FRCP; on behalf of the CAVATAS Investigators*

CAVATAS

Methods

- International multicenter randomized trial.
- Symptomatic vertebral artery stenosis.
- n=16
- Randomized to Endovascular vs Medical therapy.
- Independent neurologic followup x 8 yrs.

CAVATAS results

- Endovascular success in all 8 patients.
- **TWO** procedural TIA's in endovascular arm (25% morbidity).
- Mean f/u 4.7 years.
- No Vertebrobasilar Stroke in either group.
- MI/Stroke/Death at f/u.
  - endovascular = 4
  - medical = 3

• No benefit of endovascular therapy.
• Carotid strokes and MI’s more common than Vert stroke in follow-up.
• Global risk reduction.
• Large Randomized trials needed.

Meta-Analysis
Vertebral Stenting

Cochran Review

- \( n = 313 \) vertebral interventions
- 30 day follow-up
- Major stroke and death
  - 3.2%
- Minor stroke and TIA
  - 3.2%

Endovascular Stenting for Vertebral Artery Stenosis

J. Stephen Jenkins, MD, Samir N. Patel, MD, Christopher J. White, MD, Tyrone J. Collins, MD, John P. Reilly, MD, Paul W. McMullan, MD, Mark A. Grise, MD, Arthur G. Grant, MD, Stephen R. Ramee, MD

New Orleans, Louisiana
Methods

• Retrospective chart review of stent placement for VAS between 1995-2006.

• 105 consecutive symptomatic patients.
  • arteries n=112
  • 71% male

• Lesions both extracranial (91%) and intracranial (9%).
  • bilateral VAS n=57
  • concomitant carotid dz. n=71
  • prior stroke n=43

### Long Term Results

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedural Success</td>
<td>99.1%</td>
</tr>
<tr>
<td>Clinical Success</td>
<td>91.4%</td>
</tr>
<tr>
<td>Asx at (median 2.5 yr)</td>
<td>71.6%</td>
</tr>
<tr>
<td>TVR</td>
<td>13.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedural Complications</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TIA</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dissection</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hematoma/transfusion</td>
<td>2</td>
<td>1.9</td>
</tr>
<tr>
<td>Access site complication</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>All complications</td>
<td>5</td>
<td>4.8</td>
</tr>
</tbody>
</table>

(n = 105)

Conclusions

- Vascular disease involving the intracranial posterior circulation is a *lethal* disease.
- The *Circle of Willis* and *proximal anatomy* have to be defined if revascularizations decisions are to be made.
- Endovascular stenting of the vertebral artery:
  - successfully performed with periprocedural stroke/death \( \leq 1\% \).
  - sustained symptom resolution of 80% at 1 year.
Conclusions

- Procedural morbidity is lower compared to surgical reconstruction.
- Vertebral artery stent placement, when performed in experienced hands, is the procedure of choice for the treatment of symptomatic vertebral vascular disease.
THANK YOU

John Ochsner
Heart & Vascular Institute