Why Are Carotid Stenoses Under- And Over-Estimated By Duplex Ultrasonography: How To Prevent These Problems

Nicos Labropoulos
Professor of Surgery and Radiology
Director, Vascular Laboratory
Division of Vascular Surgery
Stony Brook Medicine
Stony Brook, NY
nlabrop@yahoo.com

Falsely high velocities
Contralateral tight stenosis or occlusion
High blood pressure
Tumor fed by the carotid
Inflammation
Arteriovenous fistula or malformation

Overestimation of ICA stenosis due to CCA + ICA occlusion
It is also seen in cases of tight stenosis

Instent stenosis
Higher velocities due to stent

Internalized ECA due to ICA occlusion
It occurs in about a third of patients with ICA occlusion.
**Internalized ECA due to a carotid body tumor**

**Bilateral ICA tortuosity**
Increased ICA velocities – no plaque

<table>
<thead>
<tr>
<th>RICA</th>
<th>Before</th>
<th>Tortuosity</th>
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<tbody>
<tr>
<td>PSV</td>
<td>58cm/s</td>
<td>148cm/s</td>
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<tr>
<td>EDV</td>
<td>27cm/s</td>
<td>47cm/s</td>
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<table>
<thead>
<tr>
<th>LICA</th>
<th>Before</th>
<th>Tortuosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSV</td>
<td>49cm/s</td>
<td>131cm/s</td>
</tr>
<tr>
<td>EDV</td>
<td>21cm/s</td>
<td>39cm/s</td>
</tr>
</tbody>
</table>

**Bilateral ICA FMD – Mild FMD easy to miss**

**AV Fistula**
Muscular branch AVF

**Falsely low velocities**

- Proximal stenosis
- Ipsilateral CCA, BCA
- Low blood pressure
- Low cardiac output, valve stenosis or insufficiency
- Stroke
- ICA distal stenosis or occlusion
- ICA recanalization

**ICA 99% stenosis**

Low ICA velocities due to high energy loss in the stenosis

PSV: 23cm/s  EDV: 7cm/s
PSV ratio: 0.64

Stenosis >95% diameter reduction - the velocity is low due to huge energy loss
CCA thrombus with patent ICA and ECA
Low ICA velocities

CCA occlusion
ECA reversed flow
Low ICA velocities

Recanalized ICA
PSV: 23 cm/s    EDV: 8 cm/s

Distal ICA dissection

Brachiocephalic artery instent stenosis
Low velocities in RT CCA, SCA and VA

Brachiocephalic artery occlusion
Takayasu’s Arteritis

Low velocities may be seen in the ICA due to extensive narrowing in the BCA and CCA

Takayasu’s Arteritis - BCA tight stenosis

No plaque
Compensatory velocity increase

75% area

ICAa stenosis

= (D1+D2+D3)/3
= (30%+50%+70%)/3
= 50%

What to do

Note all the factors that may affect velocities
Planimetric evaluation of the stenosis
Use PSV ratio
For stents use the instent PSV ratio when possible
Use CTA or MRA
- Direct evaluation by ultrasound is not possible
- Technically inadequate assessment
- Erroneous findings

In 95% of the cases or more ultrasound is adequate to provide the answers.
Recognize limitations and use other techniques