Beyond Stenosis Severity: Top 5 Important Duplex Characteristics to Identify in a Patient with Carotid Disease

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Disclosures
None
Introduction

Defining the severity of stenosis by duplex is only half of the carotid story. There’s more than just the PSV and EDV.
Carotid Disease

- Zebras
- Plaque Characterization
- Vessel Tortuosity
- String Sign
- Post CEA Evaluation
Plaque Characterization

Plaque morphology includes:

• “Surface” (smooth vs. irregular)

• “Structure” (heterogeneous, echolucent, ulcerated, hemorrhagic, homogeneous, or calcified)

• Combination of “surface” and “structure” defines plaque stability

• One or more of these qualities increases the patient’s risk for ischemic stroke
Homogeneous Plaque

Uniform echotexture and smooth surface
Calcified Plaque with Acoustic Shadowing
Heterogeneous Plaque

Mixed echo pattern with high and low levels of echogenicity
Heterogeneous Plaque

Focal anechoic area, which is the hallmark of intra-plaque hemorrhage
Echolucent Plaque

Independent risk factor for ischemic event; whether or not stenosis is hemodynamically significant
Echolucent lesions appear to be more likely to result in emboli post CAS vs. post CEA.
Calcified Plaque with Mobile Atheroma
Zebras

Plaque Characterization

Carotid Disease

String Sign

Vessel Tortuosity

Post CEA Evaluation
String Sign

- The ICA is typically long and tapers distally
- Post stenotic segment with markedly reduced vessel caliber size and low amplitude antegrade flow distally

Radiographic's 2005 Sonographic Examination of the Carotid Arteries
Hamid R. Tahmasebpour, BSc, RDMS, Anne R. Buckley, MD, Peter L. Cooperberg, MD, and Cathy H. Fix, RDMS
JACC Cardiovasc Interv. 2010
Carotid artery stenting with proximal cerebral protection for patients with angiographic appearance of string sign.
Nikas DN1, Ghany MA, Stabile E, Sorropago G, Saccá S, Favero L, Zakaryan N, Reimers B, Rubino P.
Optimizing Image Settings for Low Flow Detection

- **Color Flow**
  - Decrease scale
  - Increase gain
  - Increase persistence
  - Low wall filter
  - Steer & adjust box size

- **Spectral Doppler**
  - Decrease scale
  - Increase gain
  - Low wall filter
  - Utilize 60°

**ICA Occlusion**

ICA

Trickle flow
String Sign

• It’s important to distinguish between ICA near occlusion vs. total occlusion

• Diagnosing an ICA as occluded when patent, but significantly stenotic could result in stroke or total occlusion

Post CEA Evaluation

• Annual incidence of restenosis or occlusion
  ~1%-4.5%

• Early recurrent stenosis usually develops within 2 years of CEA and represents scar/neointimal hyperplasia

• After 3 years, new post CEA lesions must be evaluated for the possibility of neo-atherosclerosis

• Both diseases have a distinctly different natural history, with interventional outcomes

• Neo-atherosclerosis has a less benign course
Post CEA Evaluation

Intra-op injury, i.e., arterial clamping, intraluminal shunt insertion or suture placement may cause intimal hyperplasia.
Post CEA Evaluation
CDU of CEA Restenosis

- Common 1-35%; < 8% symptomatic

- Type of closure: primary vs. patch angioplasty (decreased rates)

- Debatable whether clinically significant to continue CDU surveillance due to low recurrent rate of restenosis
Proximal CCA Tortuosity

Tortuosity of the CCA increases the difficulty of axis in CAS, increases the risk of complication with vessel injury, and loss of guide support, etc.
Distal ICA tortuosity may present challenges that complicate placement of a distal embolic protection device and stent.
ICA Tortuosity

Kinking 5%

~27% of which is bilateral
ICA Tortuosity

Coiling 6%

~53% of which is bilateral
ICA Tortuosity
S-Shaped Curve

Not specific to FMD, though when noted on CDU < 70 YO -> high suspicion for the presence of FMD
Takayasu’s Arteritis

Diffuse concentric heterogeneous thickening of the intima and media of the CCA

Appearance of a stuffed macaroni: “Macaroni Sign”

Aortitis - Circulation by HL Gornik- 2008
Carotid Artery Aneurysm

- Defined as:
  Bulb dilatation > 200% of the diameter of the ICA or 150% of the diameter of the CCA

- Epidemiology:
  Rare < 1% of all carotid pathologies

- Male:female=2:1, Age>60
Carotid Artery Aneurysm

• Clinical Presentation: Horner's syndrome, pulsatile mass, neurologic symptoms, cranial nerve dysfunction, dysphagia, hemorrhage, and rupture

• Duplex characteristics: saccular dilation with mural thrombus measuring 2 x 2.5 cm
Carotid Artery Dissection

Duplex characteristics: dissection flap, true and false lumens and differential flow patterns

True lumen: forward flow with normal peak and end diastolic velocities

False lumen: reflects a high resistance bidirectional flow pattern with minimal diastolic flow
Carotid FMD

Gray Scale  Color Flow  Spectral Doppler

Mid and Distal ICA FMD Power Doppler

Fibromuscular Dysplasia: State of the Science and Critical Unanswered Questions
A Scientific Statement From the American Heart Association
Jeffrey W. Olin, DO, FAHA, Co-Chair; Heather L. Gornik, MD, MHS, FAHA, Co-Chair;
Carotid Disease

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Thank You