Carotid disease
How to use imaging ?

Mohammed Chamsi-Pasha, MD, FACC, FASE

Assistant Professor, Weill Cornell Medical College

Houston Methodist DeBakey Heart & Vascular Center

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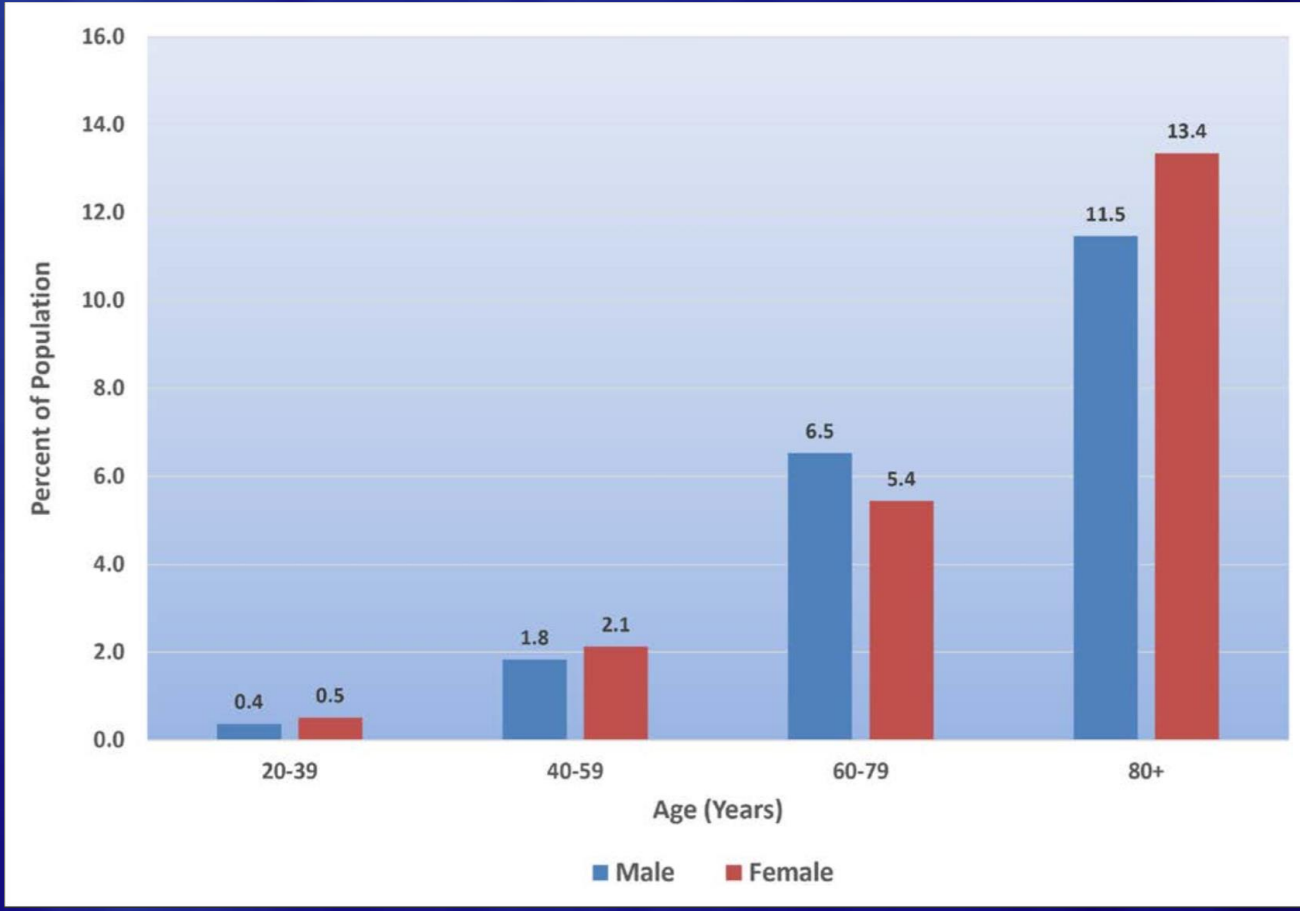
Stroke Prevalence

- 2nd common cause of death
- Carotid artery disease causes 18-25% of all strokes



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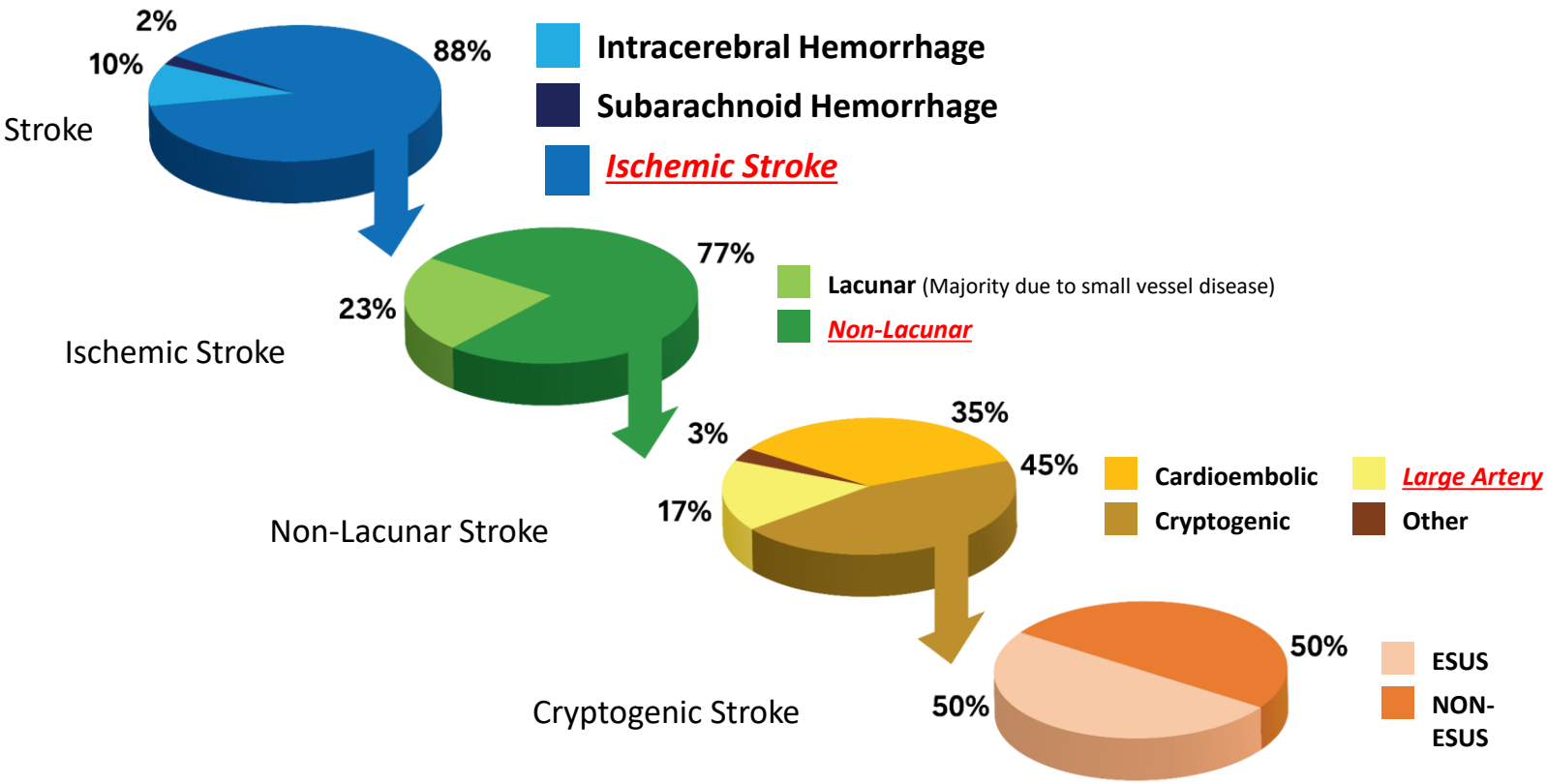
Circulation. 2019;139:e56–e528.

Figure 1. Conceptual Representation of Ischemic Stroke Subtypes



Abbreviations: ESUS indicates embolic stroke of undetermined source; and non-ESUS, non-embolic stroke of undetermined source.

American Heart Association.

Diagnostic Workup

- Carotid US
- Carotid CTA or MRA
- Invasive angiography

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Carotid intimal medial thickness

- Significantly associated with risk for MI, stroke, CHD death
- Indications:
  - FH of premature CVD
  - <60 years with severe dyslipidemia
  - Intermediate FRS 6-20%

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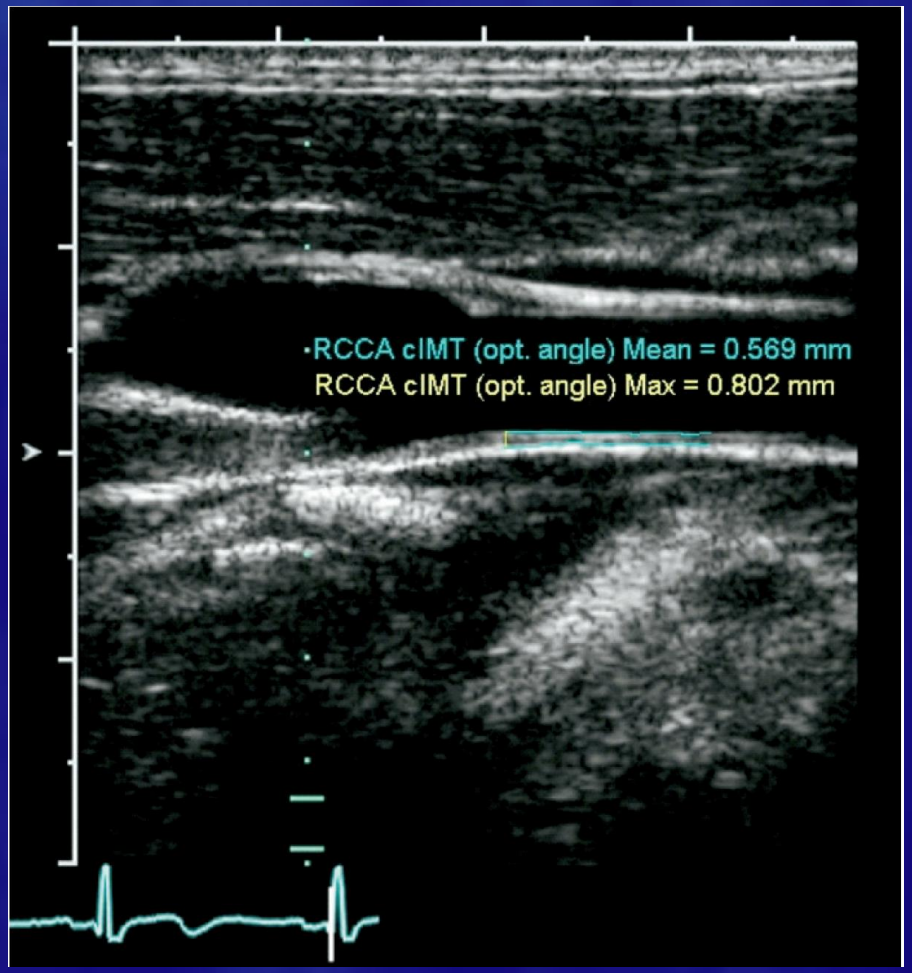
J Am Soc Echocardiogr. 2008;21(2):93–190.

Distal CCA intimal wall measurement



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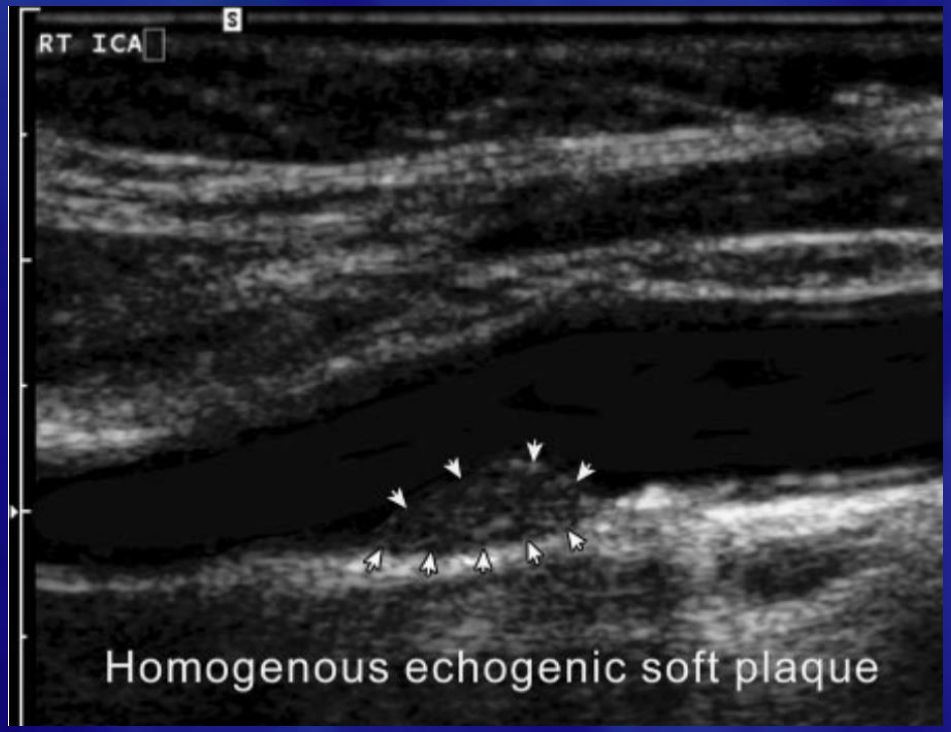
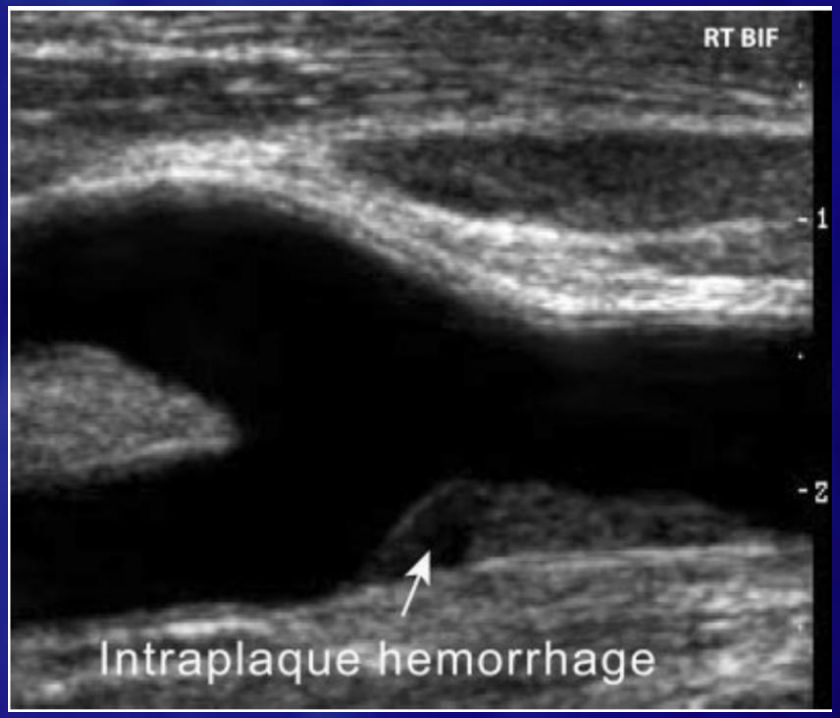
J Am Soc Echocardiogr. 2008;21(2):93–190.

Plaque visualization





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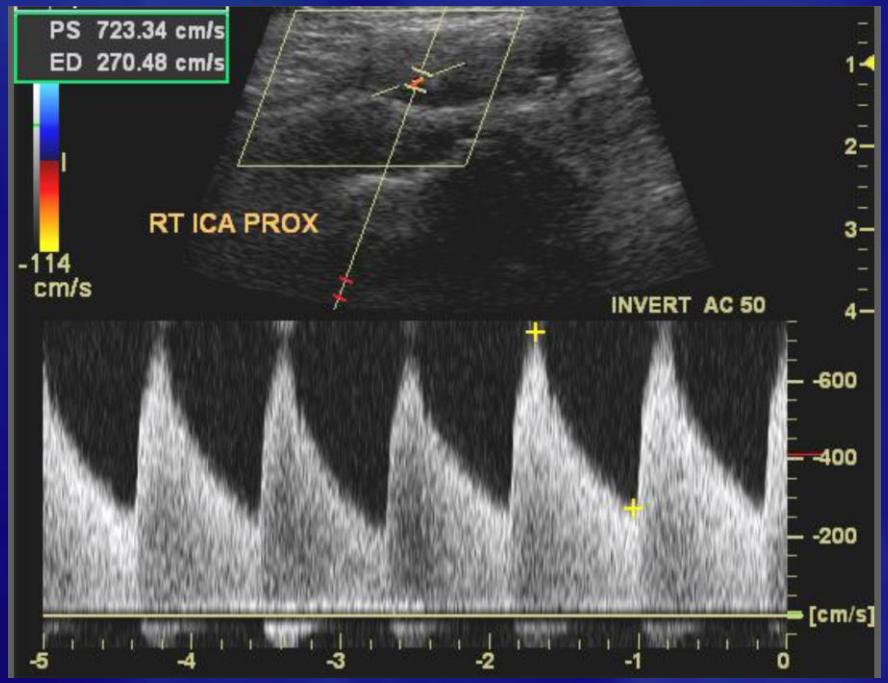
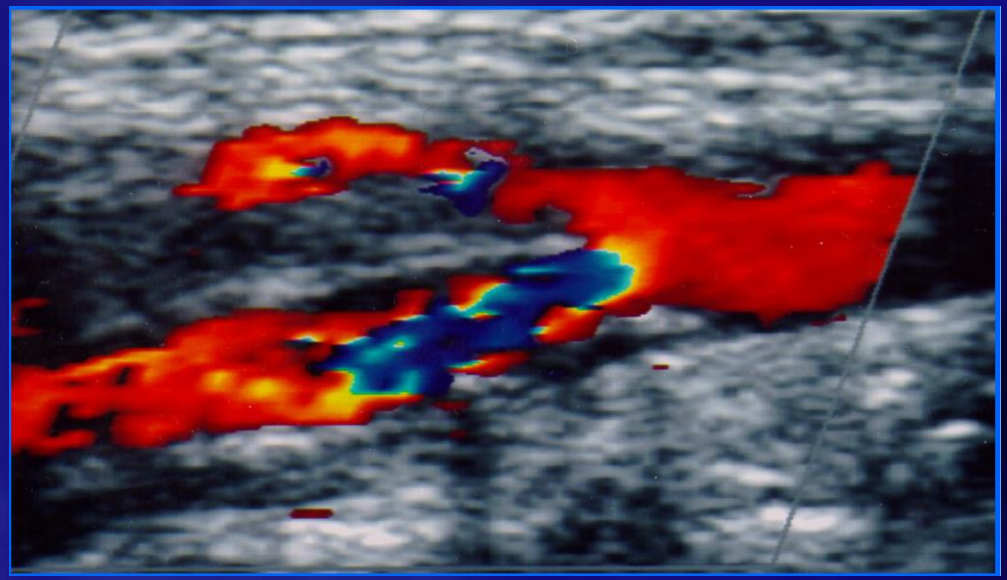
Carotid Duplex US





- High PSV and EDV
- Broadening of PW spectral Doppler

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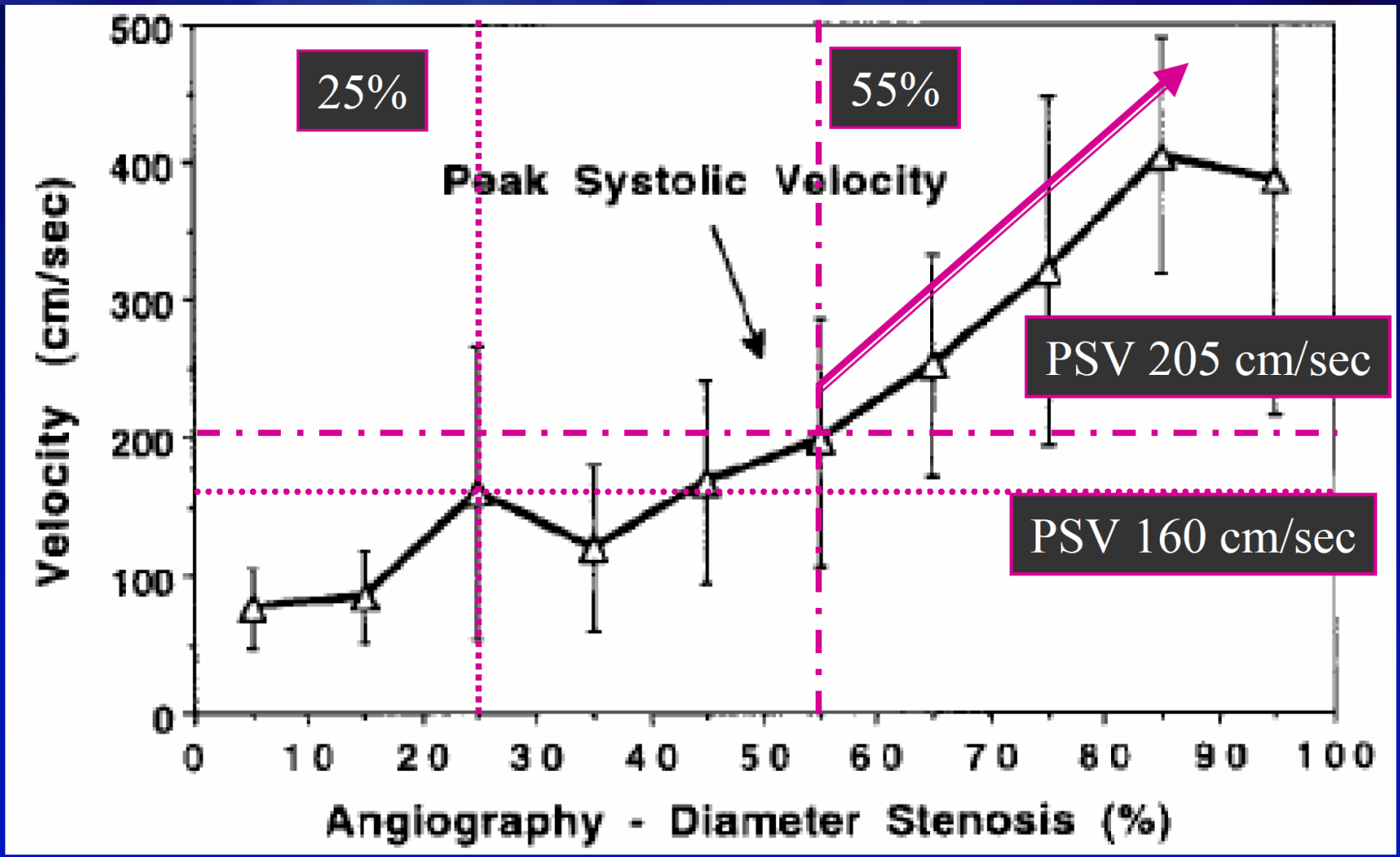
TABLE 3
Consensus Panel Gray-Scale and Doppler US Criteria for Diagnosis of ICA Stenosis

	Primary Parameters		Additional Parameters	
Degree of Stenosis (%)	ICA PSV (cm/sec)	Plaque Estimate (%)*	ICA/CCA PSV Ratio	ICA EDV (cm/sec)
Normal	<125	None	<2.0	<40
<50	<125	<50	<2.0	<40
50–69	125–230	≥50	2.0–4.0	40–100
≥70 but less than near occlusion	>230	≥50	>4.0	>100
Near occlusion	High, low, or undetectable	Visible	Variable	Variable
Total occlusion	Undetectable	Visible, no detectable lumen	Not applicable	Not applicable

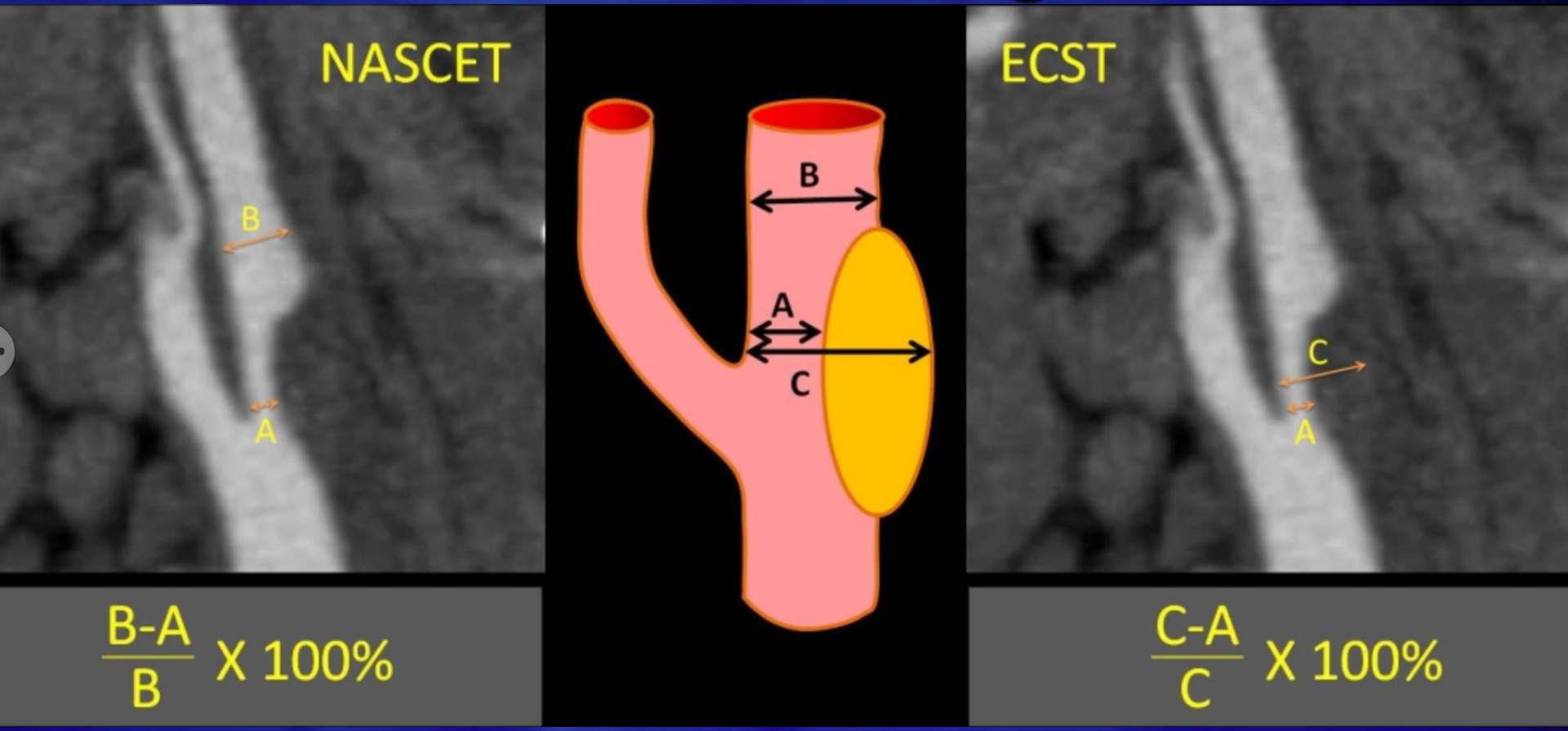
* Plaque estimate (diameter reduction) with gray-scale and color Doppler US.

PSV and angiographic stenosis



Radiology 2000;214:247-252

Methods of assessing stenosis



NASCET	ECST
30	65
40	70
50	75
60	80
70	85
80	91
90	97

Approximate equivalent degrees of internal carotid artery stenosis used in NASCET and ESCT according to recent direct comparisons

European Society of Radiology

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Indications for Carotid US

- Cervical bruit / asymptomatic pt
- TIA
- Stroke in a potential candidate for endarterectomy or stenting
- Follow-up of known stenosis (>20%) in asymptomatic individuals

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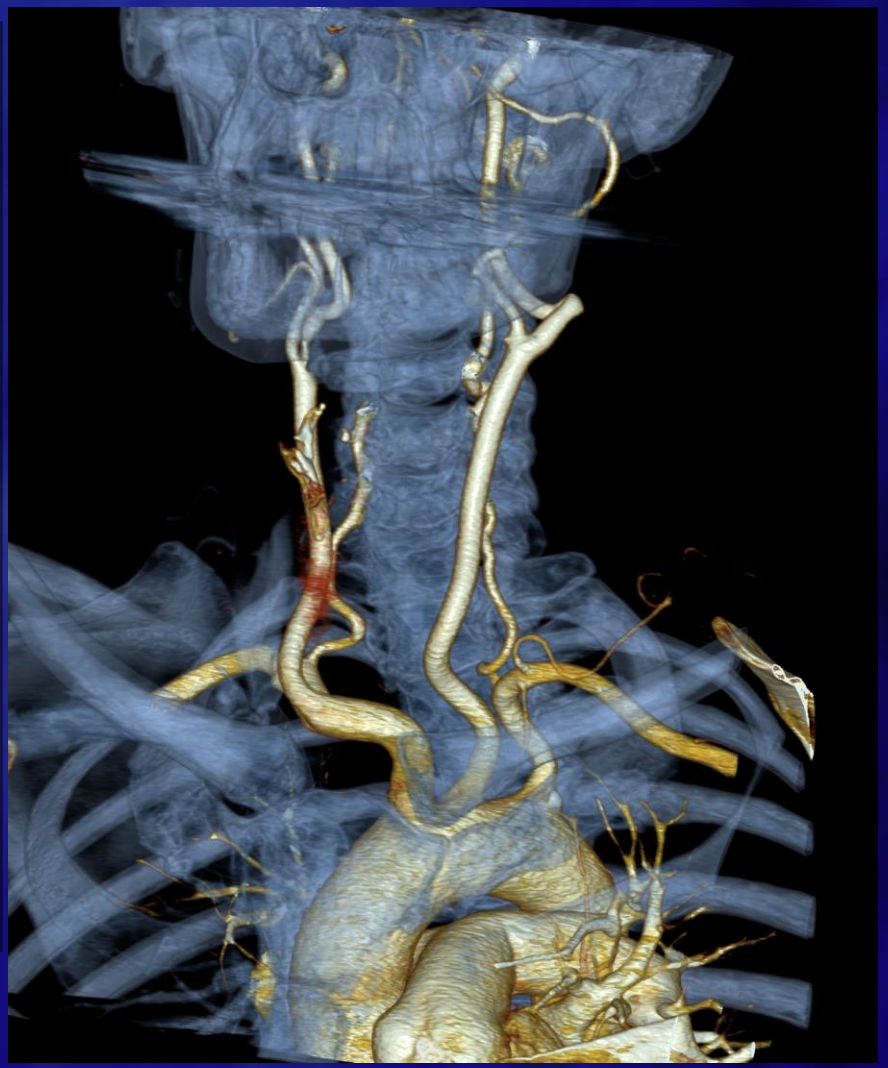
Carotid CTA

- Non-invasive
- Extra and intra-cranial 3D view
- Excellent spatial resolution
- Calcium creates blooming artifact
- Contrast load



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CTA for Carotid disease

- Meta-analysis of 28 studies
- 70-99% stenosis
  - Sensitivity 85%
  - Specificity 93%
- Totally occluded vessel
  - Sen 97%
  - Spec 99%

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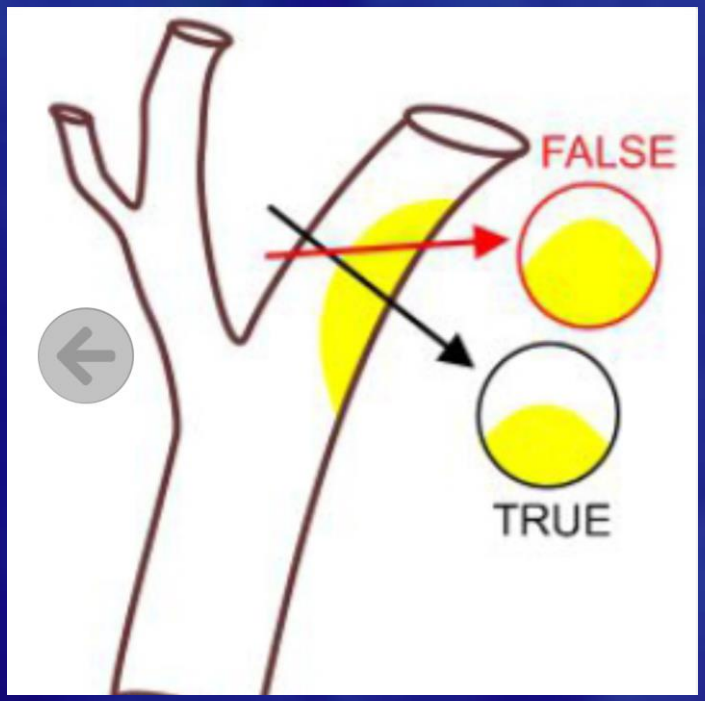
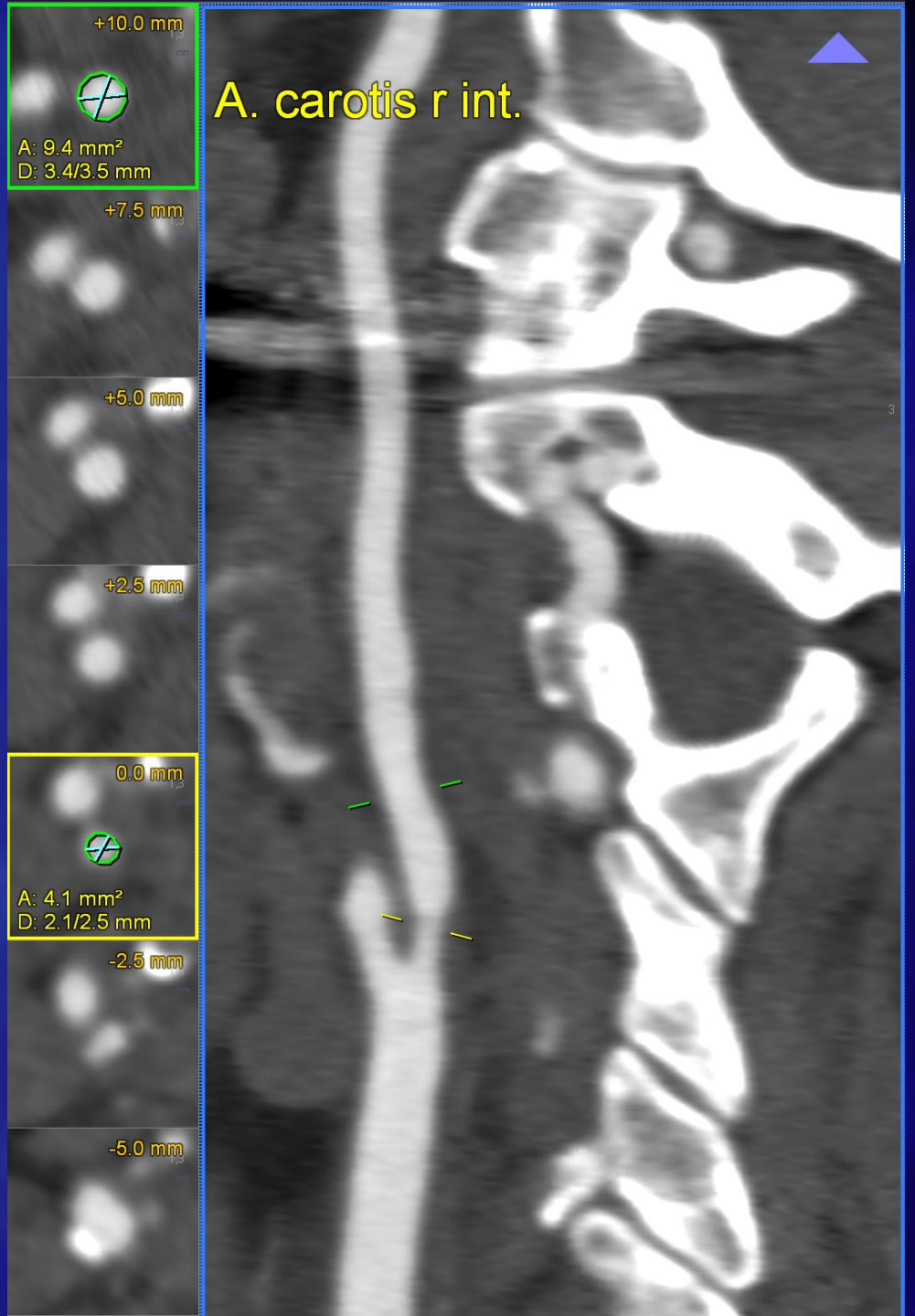
Stroke. 2004;135:2306.





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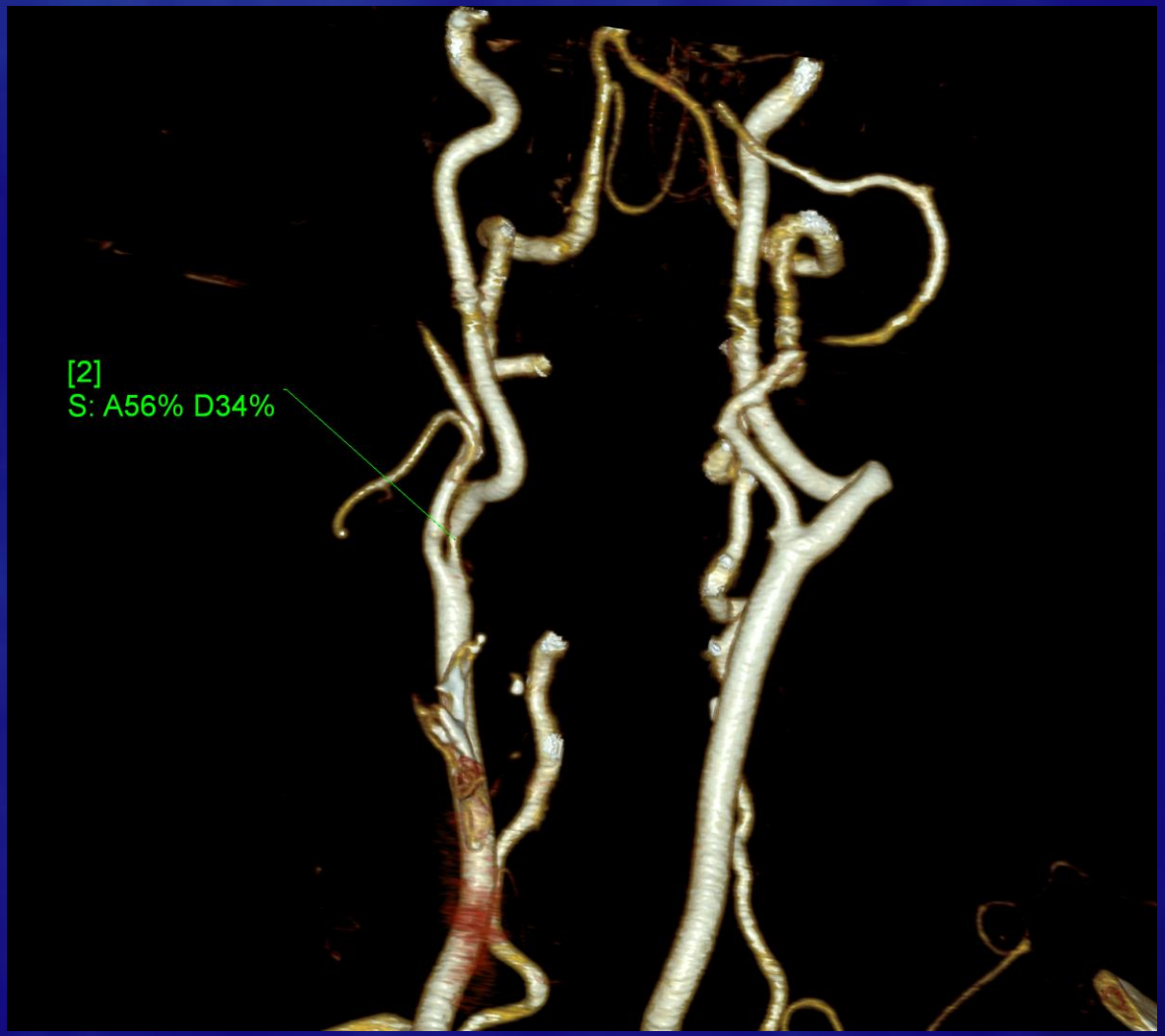
Diameter vs. area stenosis is different



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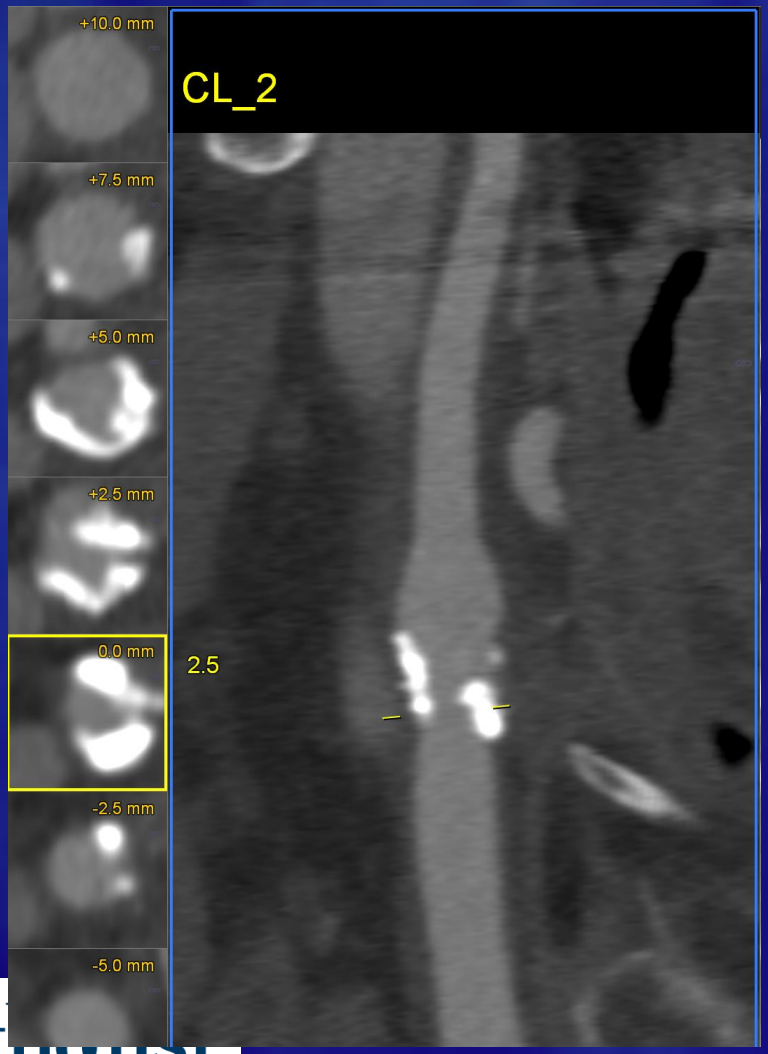
Calcified Internal carotid artery
Calcification : Achilles' heel of CT



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Carotid MRA

- Non-invasive
- No ionizing radiation
- Extra and intra-cranial 3D view
- ↑ spatial resolution
- Calcification doesn't cause artifact

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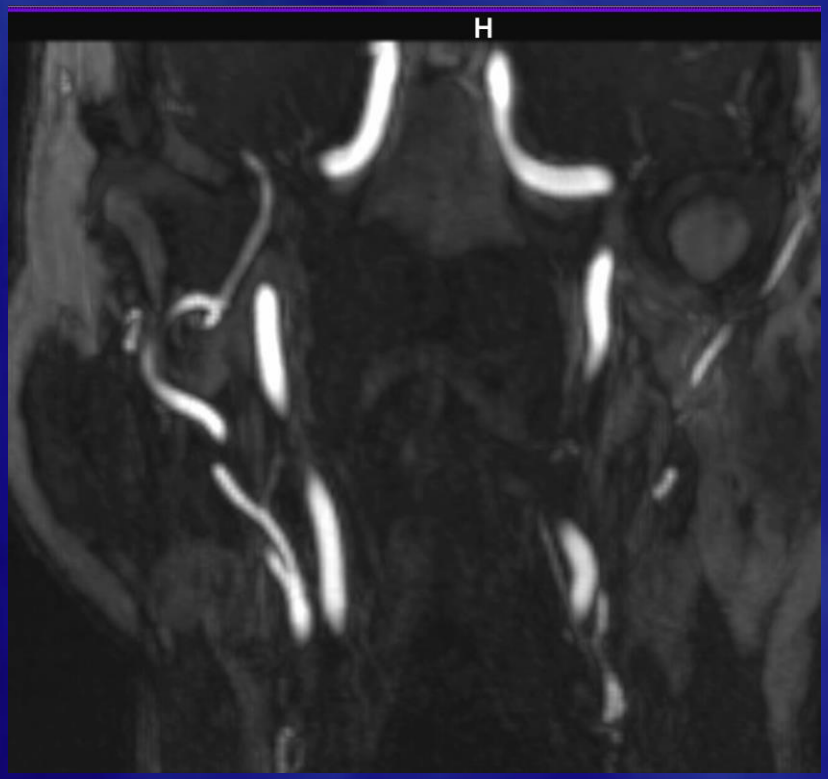
Carotid MRA



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Carotid Plaque Characterization

- Strokes occur in non-obstructive carotid disease
- CT/MR and PET has potential to characterize plaque composition and disease activity

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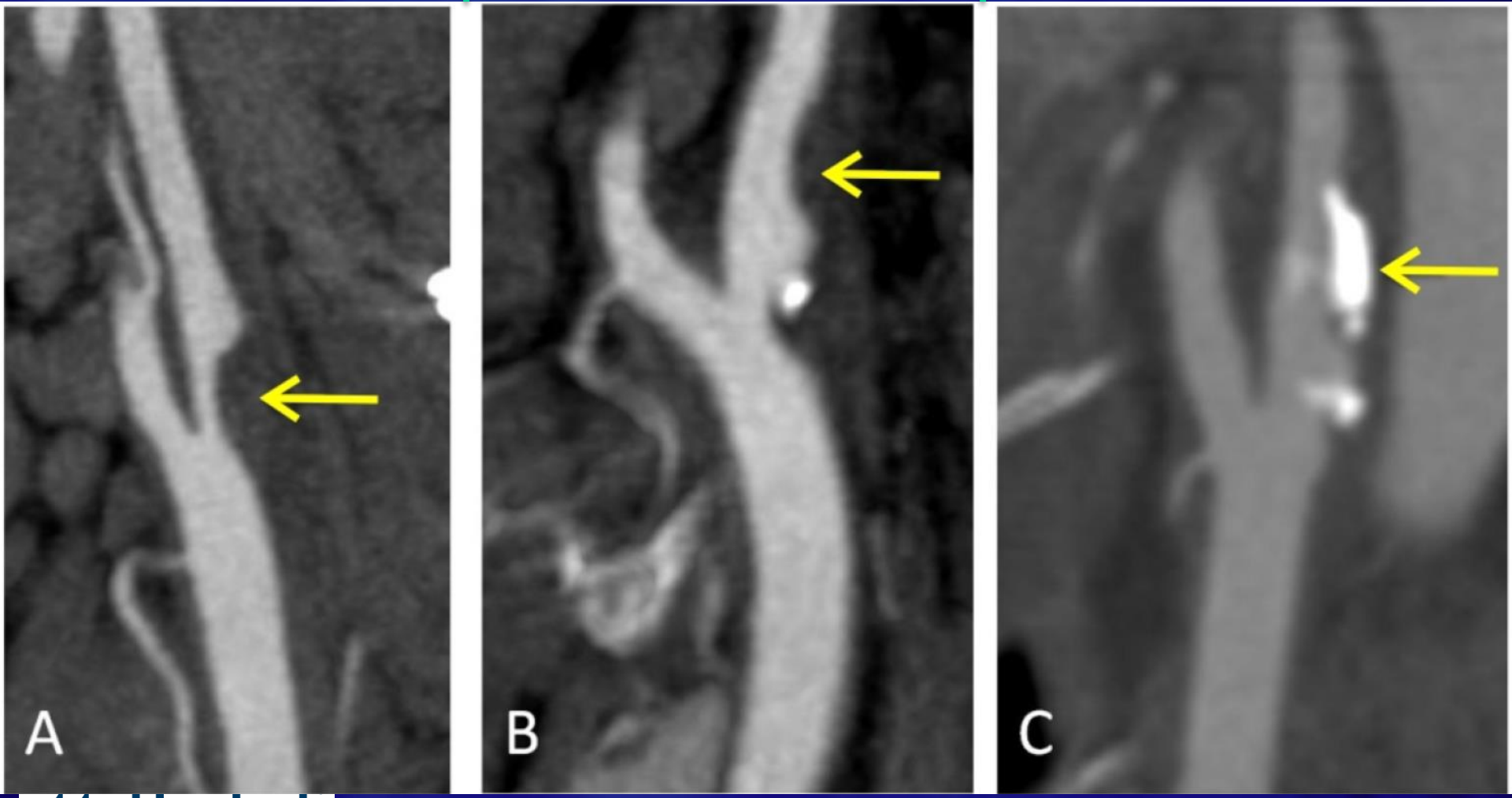
J Am Coll Cardiol Img 2019

Lipid (<60 HU) Plaque

Fibrous (60-130 HU) Plaque

Calcified (>130 HU) Plaque



Beyond stenosis .. Unstable Plaque

- Thin cap, large lipid core = high risk plaque
- >70% agreement with histology after endarterectomy

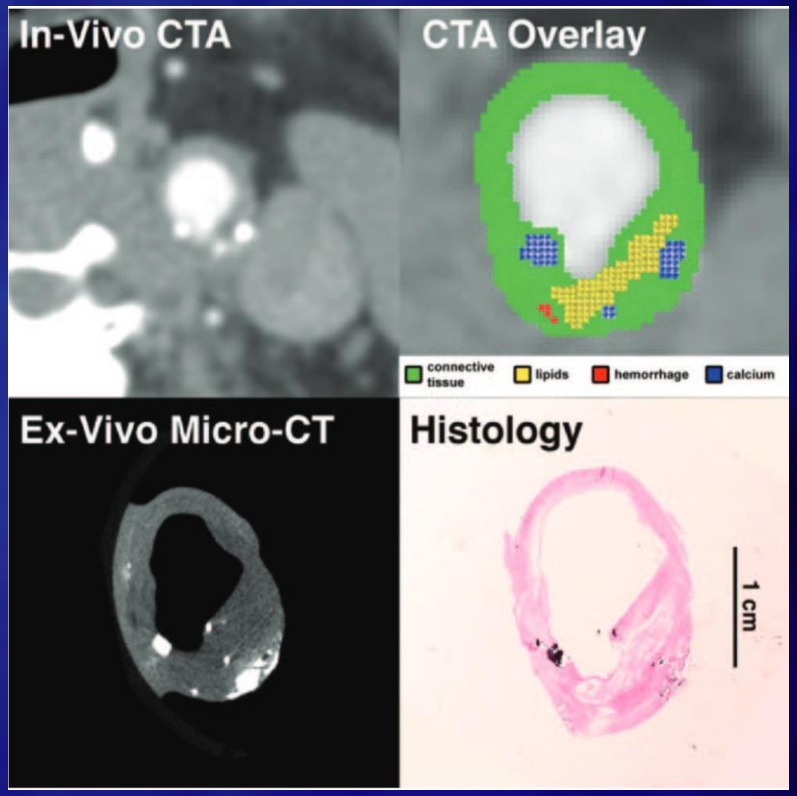


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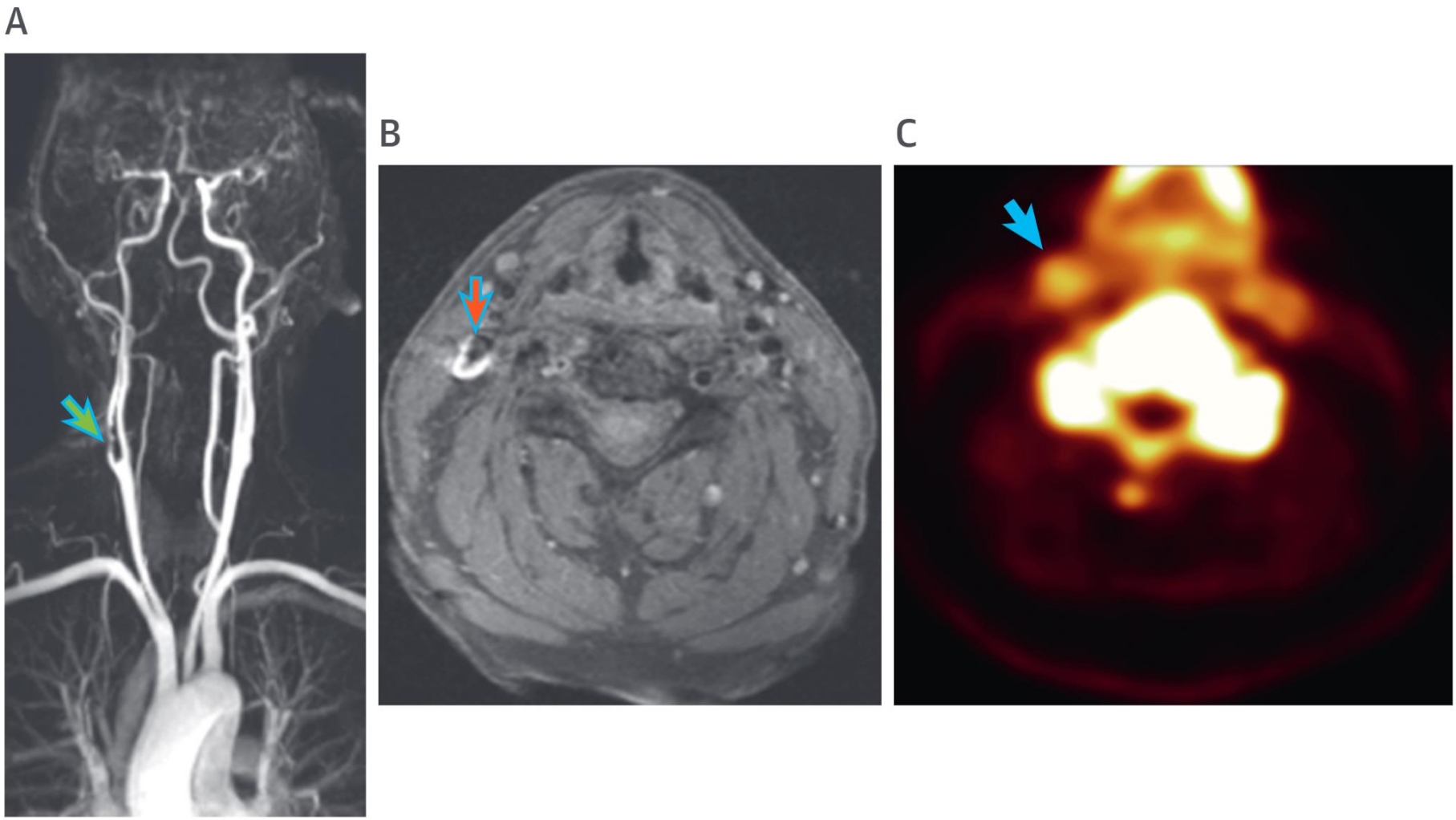
FIGURE 2 Multiparametric Assessments of the Carotid Arteries in a Patient Post- Transient Ischemic Attack



Complex ECA plaque

MRI : high T1 signal = fresh thrombus.

PET with Sodium florid: high SI

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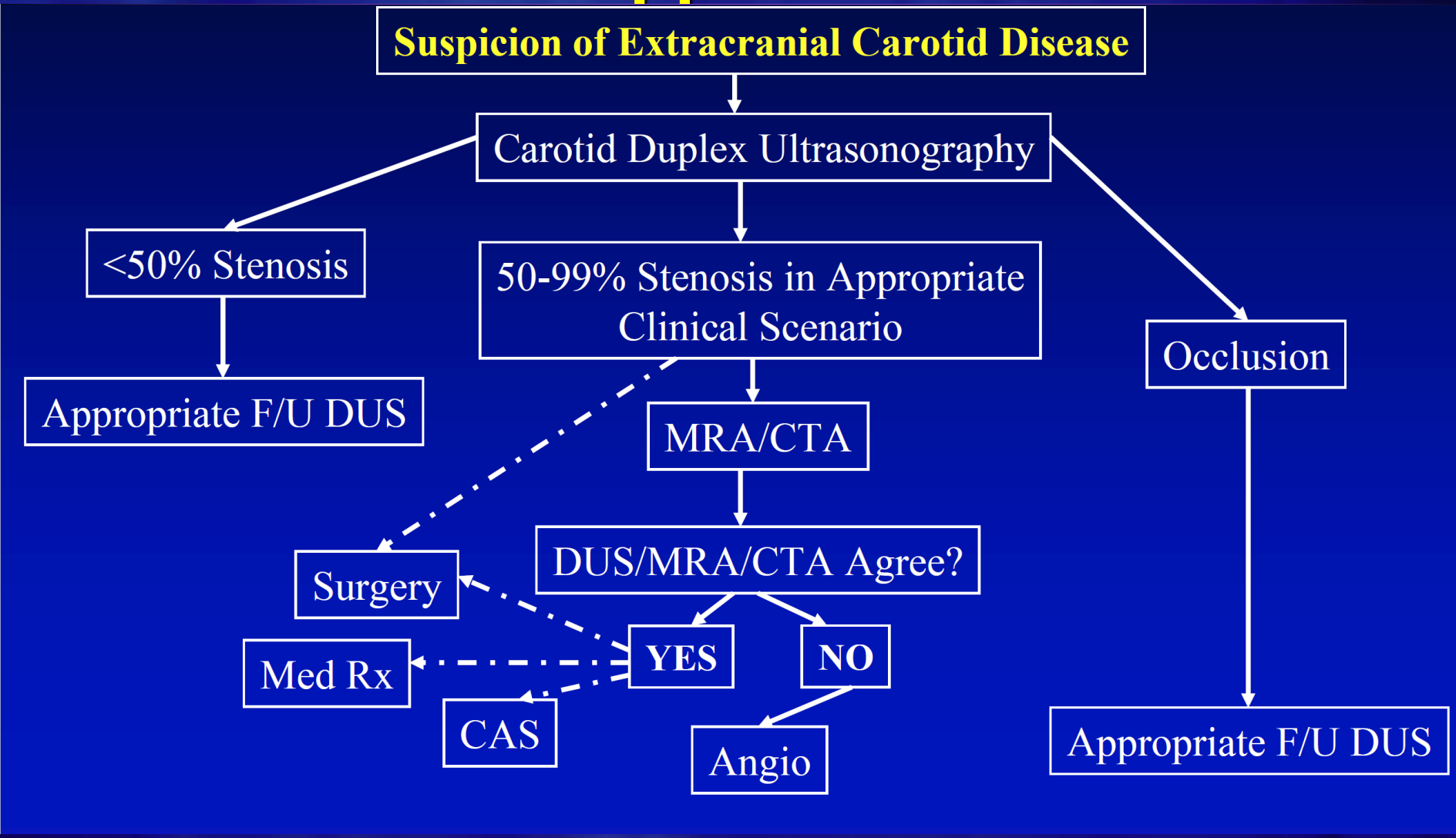
Approach



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