# Asymptomatic Carotid Stenosis

## *Who Is The High Stroke Risk?*

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# Carotid Stenosis & Stroke

- Depends on mainly
  - The degree of stenosis
  - Symptomatic or Asymptomatic

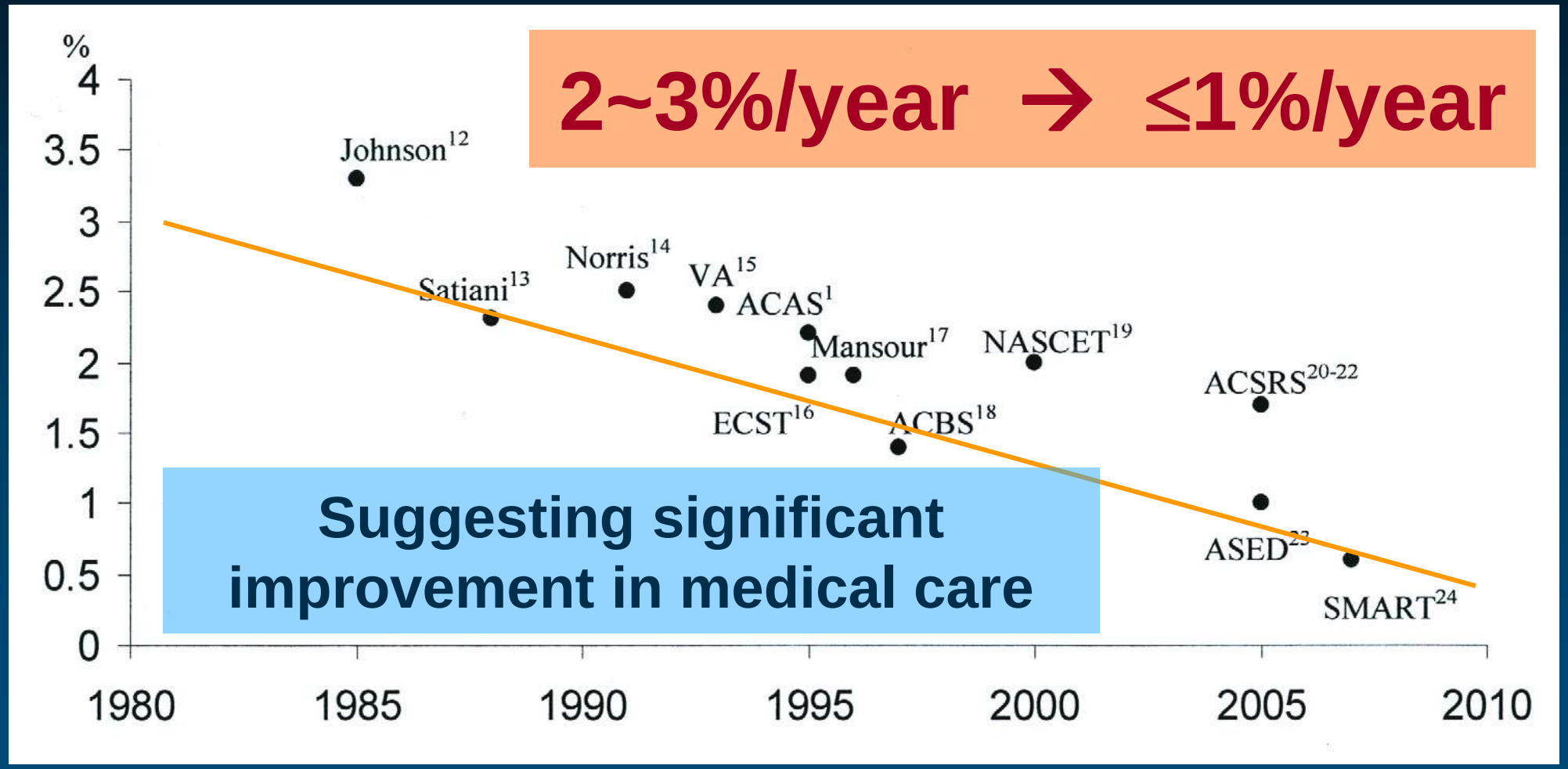
- Asymptomatic >60% carotid stenosis
  - 5% / 2 years

- Symptomatic >70% carotid stenosis
  - 26% / 2 years

Data before 2003

# Asymptomatic Carotid Stenosis

## *Annual Risk of Ipsilateral and Any Stroke*



- **Medical management has improved**
  - **Annual stroke risk < 1.0%/yr**
- **CAS & CEA have also improved**
  - **Procedure-related complication**
    - **<3% for symptomatic**
    - **<6% for asymptomatic**

# Asymptomatic Carotid Stenosis

- **In my opinion, most asymptomatic patients with carotid stenosis are best treated medically,**

  ***NOT BY CEA or CAS***

- **However, in the real world…**

  ***most (80-90%) of CEA & CAS patients are ASx***

  *92% CAS/CEA are asymptomatic in 2005 US, McPhee JT, JVS2008;48:142*

- **CREST II will give the answer…**

  **But, results years away**

# One Question for Surgeon and Interventionalist

*Have you given the patient your best shot?*

*- We have to more aggressive for doing OMT -*

## Pharmacologic treatment

- Antiplatelet Therapy
- Antihypertensive Therapy
- Lipid Lowering Therapy
- Aggressive Glycemic Control

## Lifestyle modification

- Smoking cessation
- Exercise program
- Nutrition counseling
- Rehabilitation

**However, some patients with asymptomatic carotid stenosis will have a stroke!!!**

***Can We Pick Them Up In Advance?***

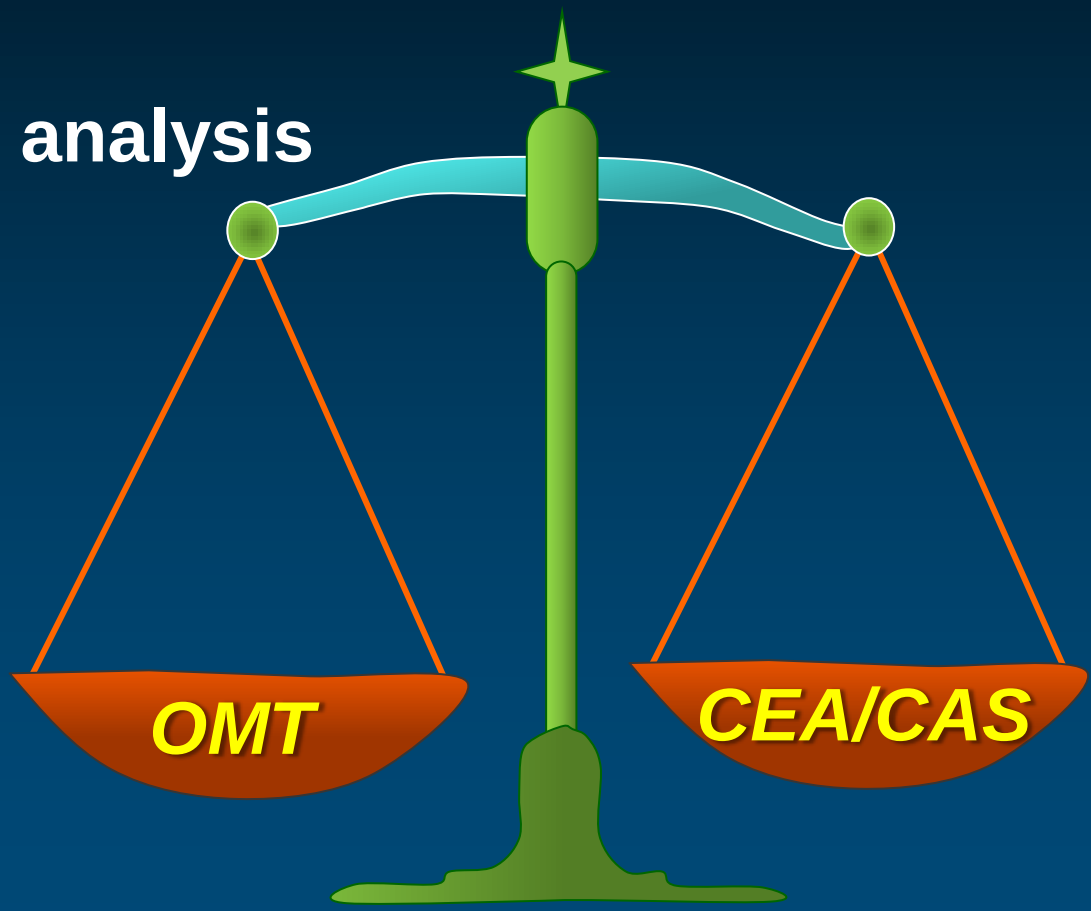
# Stroke Prediction

*In Patients With Asymptomatic Carotid Stenosis*

## Who is at the Greatest Risk?

# Risk Stratification

- Clinical features – CEA/CAS risk, Life expectancy
- Stenosis severity
- Stenosis progression
- Plaque area & computerized plaque analysis
- Plaque echolucency
- Plaque hemorrhage
- Plaque micro-ulcers
- Spontaneous embolization on TCD
- ‘Silent’ ipsilateral infarction on CT
- Contralateral carotid occlusion
- Impaired cerebral vascular reserve



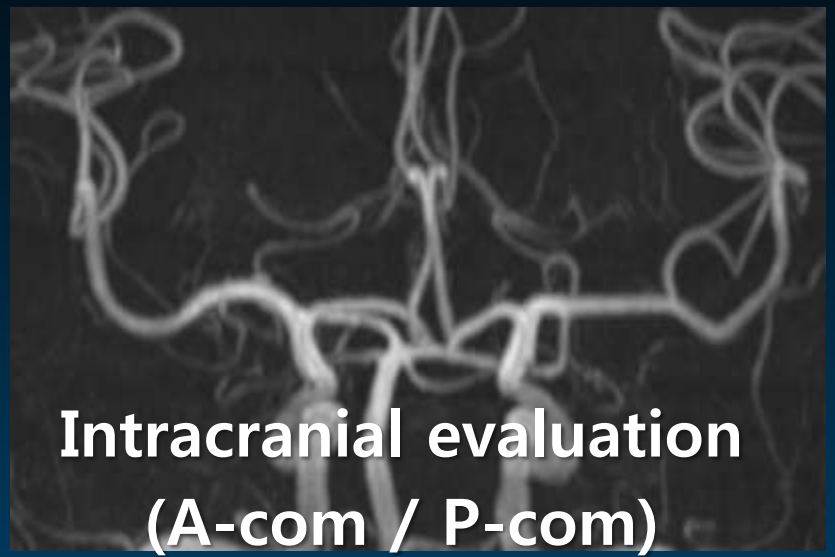
# Evaluation for

# *Carotid Stenosis*

# Current options for imaging

- Doppler ultrasound
- Trans-cranial Doppler
- Computed tomography angiography (CTA)
- Magnetic resonance angiography (MRA)
- Digital subtraction angiography

# MR angiogram



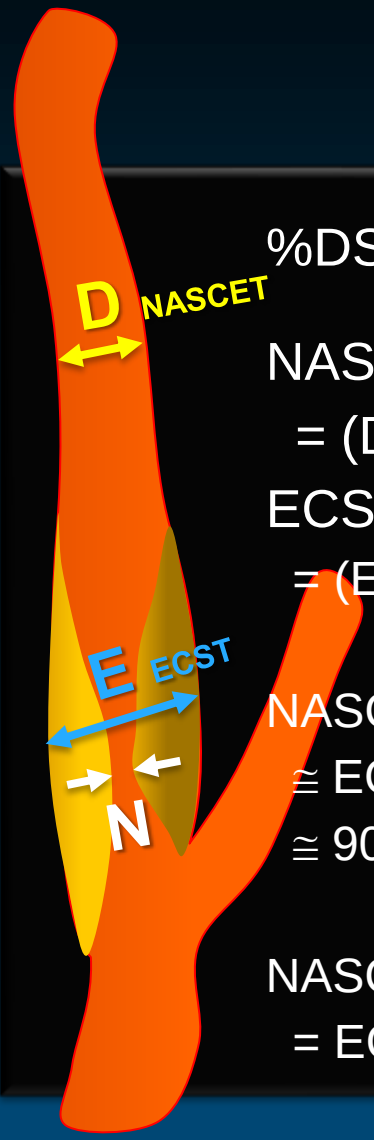
Intracranial evaluation
(A-com / P-com)

Target lesion evaluation

Proximal vessel evaluation

Aortic arch evaluation
→ skip aortogram

# Duplex Ultrasonography
## *Quantitative Analysis*




%DS

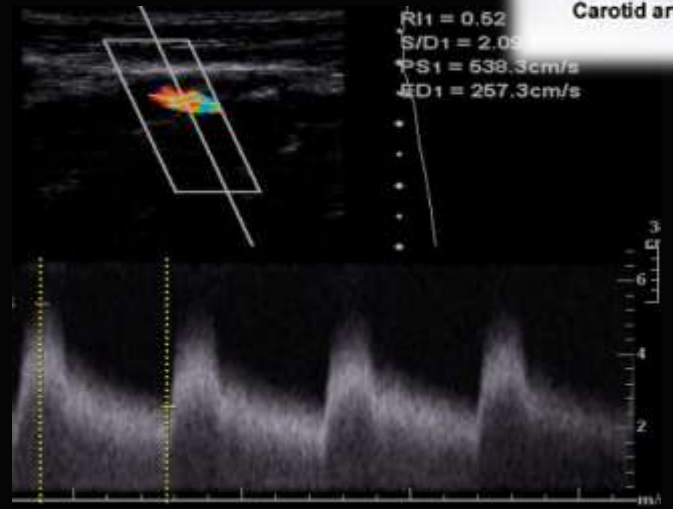
NASCET
= (D-N)/D×100

ECST
= (E-N)/E×100

NASCET 50%DS
≅ ECST 70%DS
≅ 90% AS

NASCET 70%DS
= ECST 85%ES

Degree of stenosis
by area stenosis
by Doppler velocity



| Criteria for | 50-69% | vs. | ≥70% DS |
|---|---|---|---|
| PSV: | 125-230 | | >230 cm/sec |
| EDV: | 40-100 | | >100 cm/sec |

**Visually estimated ≅70% ASx carotid stenosis**
**≅NASCET 50% → not a candidate for CEA/CAS**

# Duplex Ultrasonography

## *Practice Guidelines and Diagnostic Criteria*

| Diameter stenosis (%) | PSV (cm/sec) | EDV (cm/sec) | ICA/CCA PSV ratio |
|---|---|---|---|
| Normal | <125 | <40 | <2.0 |
| <50 | <125 | <40 | <2.0 |
| 50–69 | 125–230 | 40–100 | 2.0–4.0 |
| ≥70 | >230 | >100 | >4.0 |
| Near total occlusion | Variable | Variable | Variable |
| Total occlusion | Undetectable | Undetectable | Not applicable |

RSNA

# Which Parameters To Use?

- ***PSV and Plaque*** **are primary parameters**
  - **PSV is single most accurate predictor of degree of stenosis**
  - **Plaque burden/area should be present with stenosis**
- ***ICA/CCA ratio and EDV*** **are helpful when;**
  - **Low or high flow states**
  - **Tandem lesions**
  - **Contralateral stenosis or occlusion**

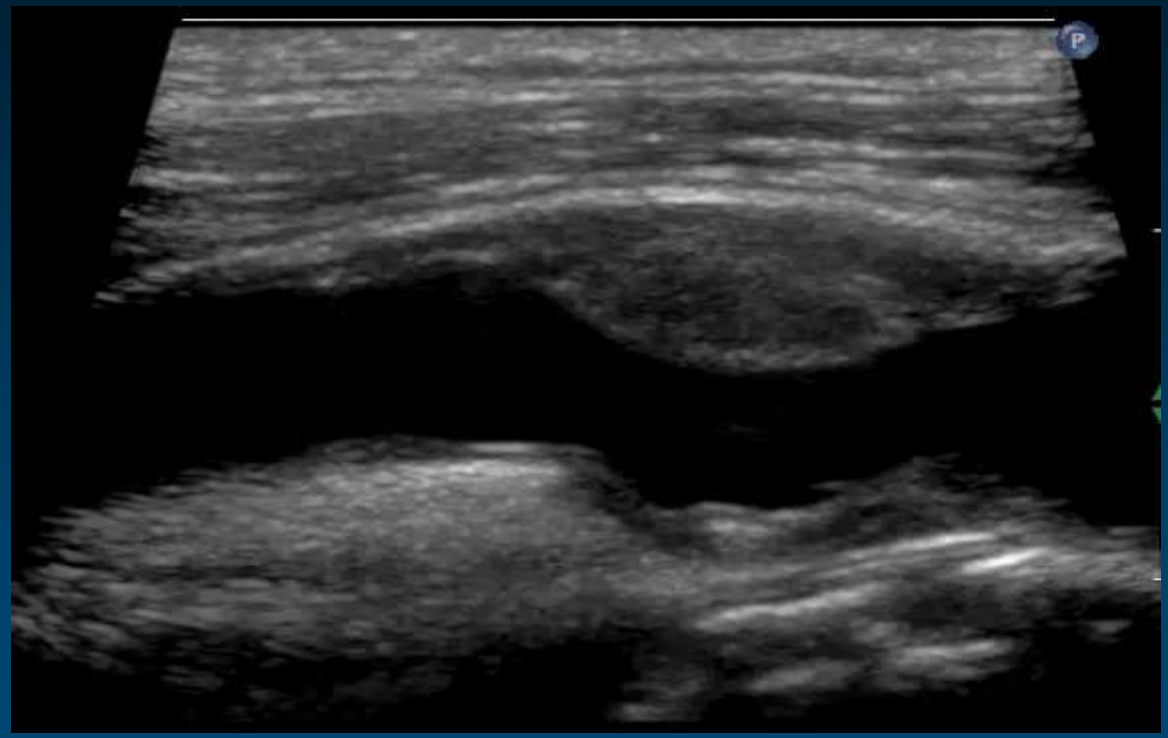
# Duplex Ultrasonography

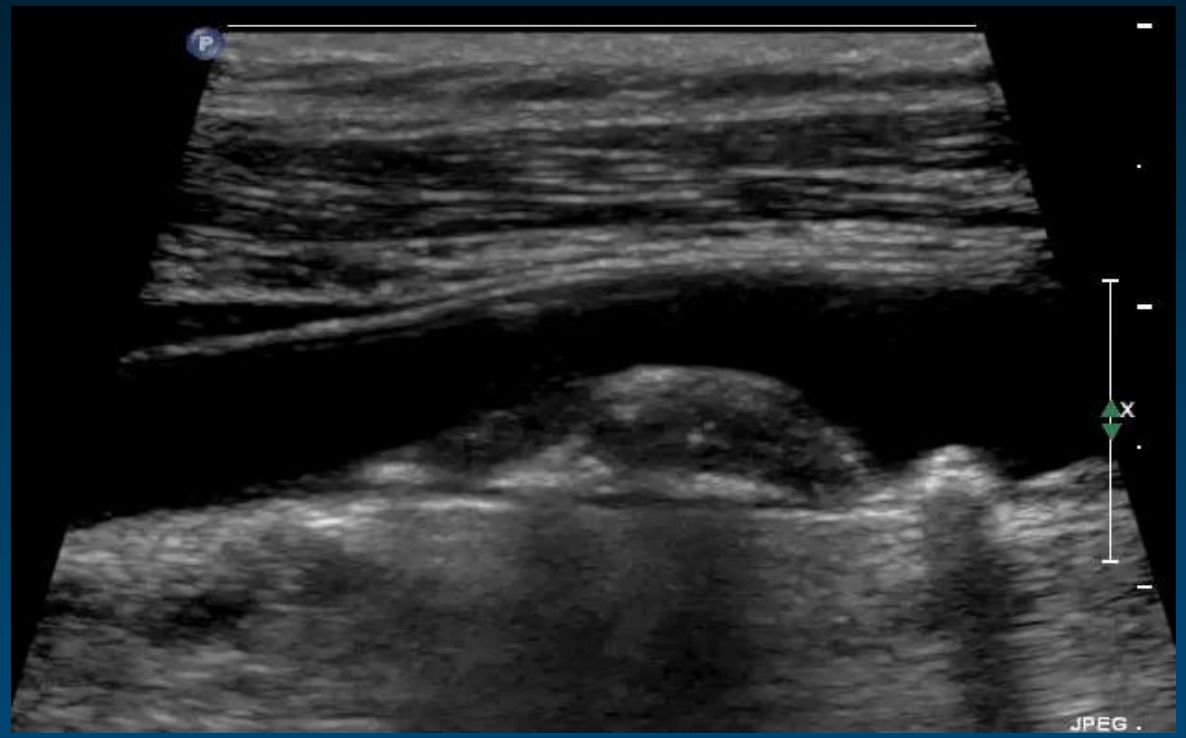
## *Qualitative Analysis*

- Surface
  - smooth vs. irregular
  - ulcerated, intra-plaque hemorrhage
  - mobile atheroma
- Structure;
  - homogenous vs. heterogenous
  - echolucent, juxtaluminal black area
  - calcified

# Duplex Ultrasonography

## *Homogenous vs. Heterogenous Plaque*



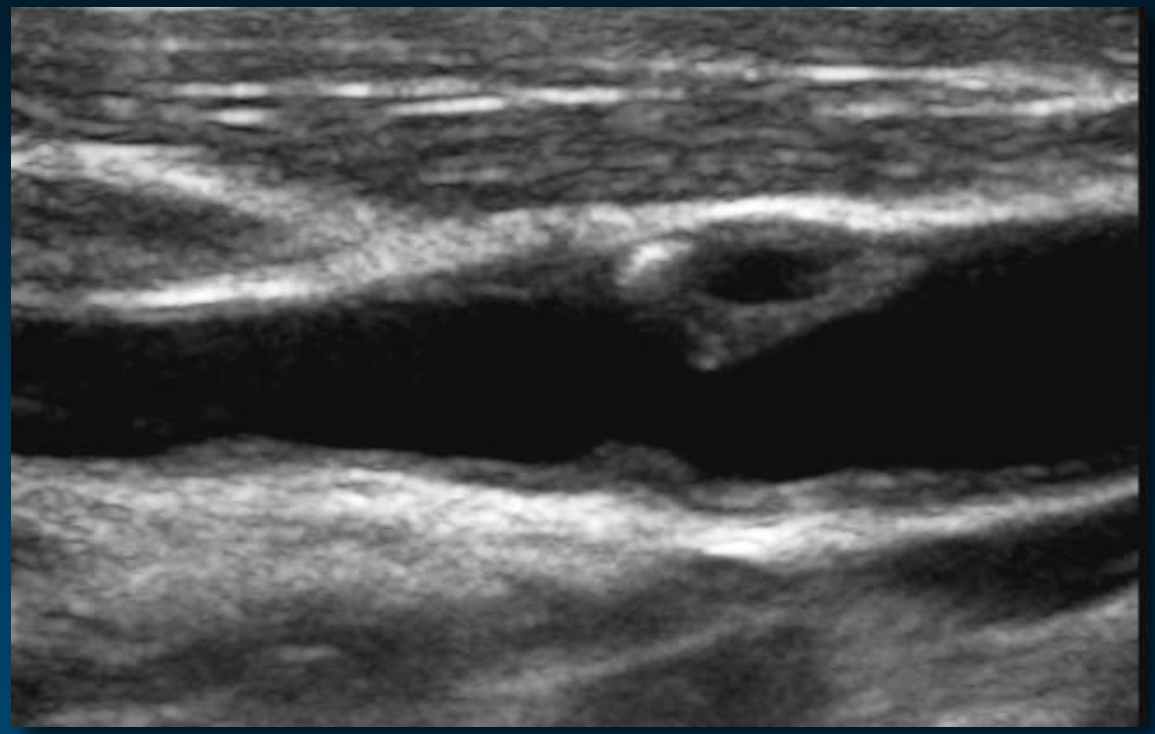



**Homogenous**

**Heterogenous**

# Duplex Ultrasonography

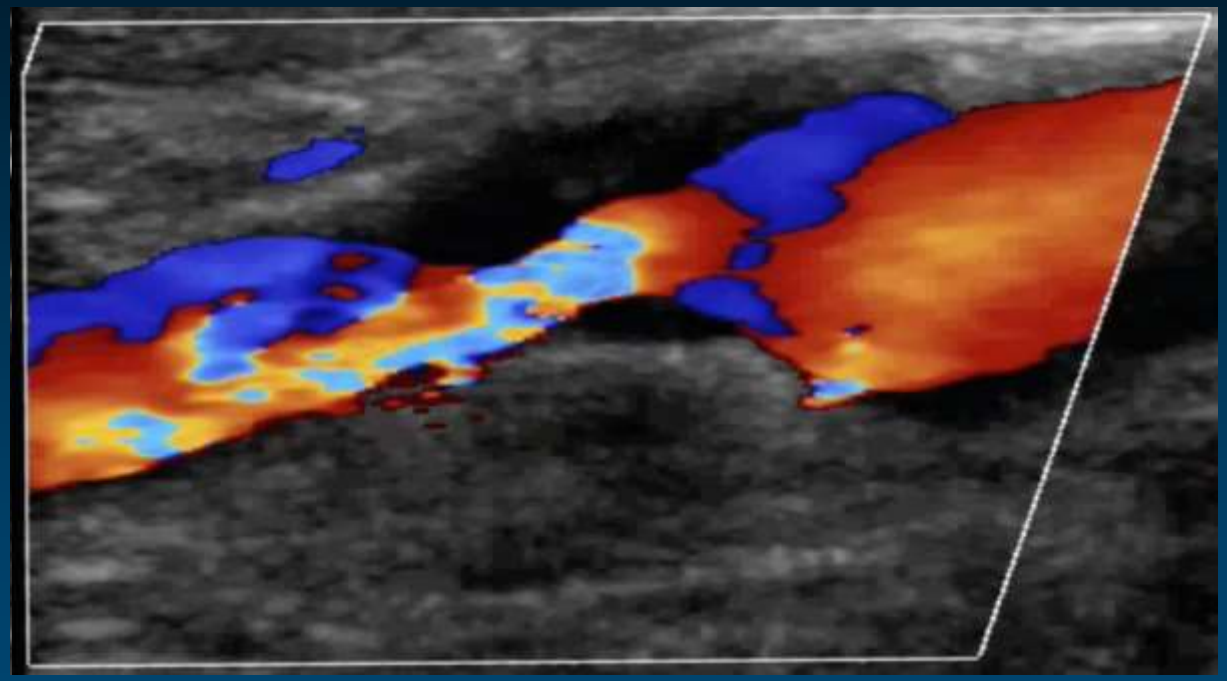
## *Heterogenous Plaque – Focal Anechoic Area*

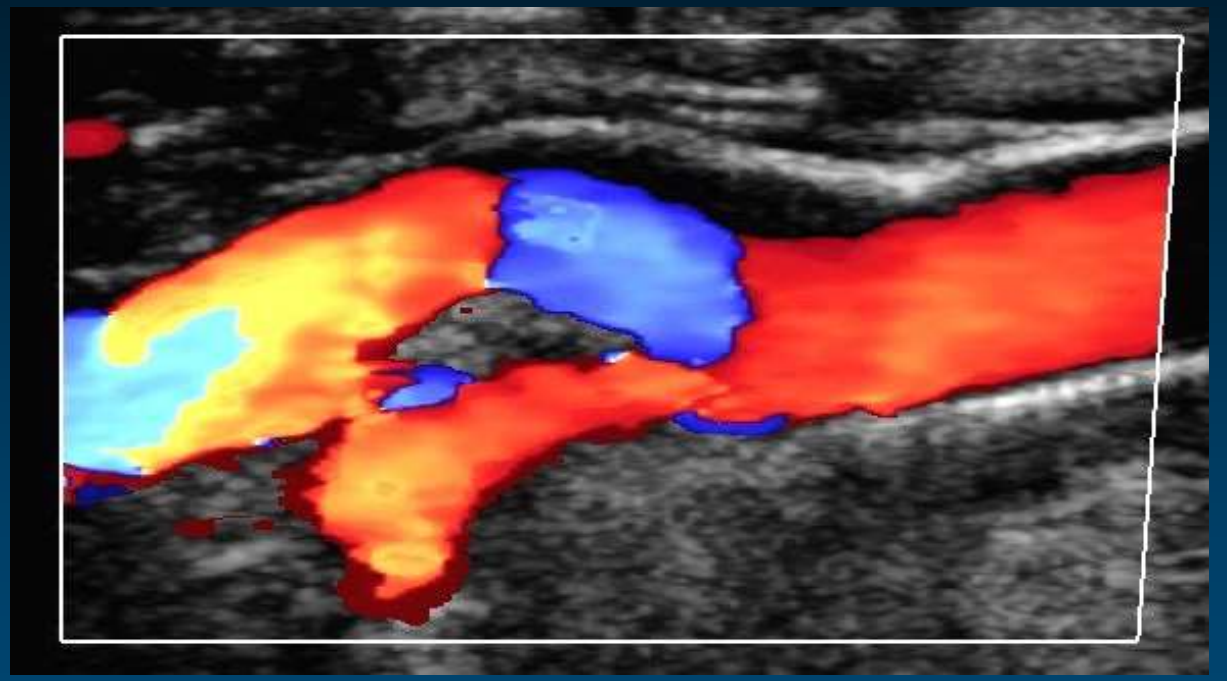


**Hallmark of intra-plaque hemorrhage**

# Duplex Ultrasonography

## *Echolucent Plaque (Juxtaluminal Black Area, JBA)*



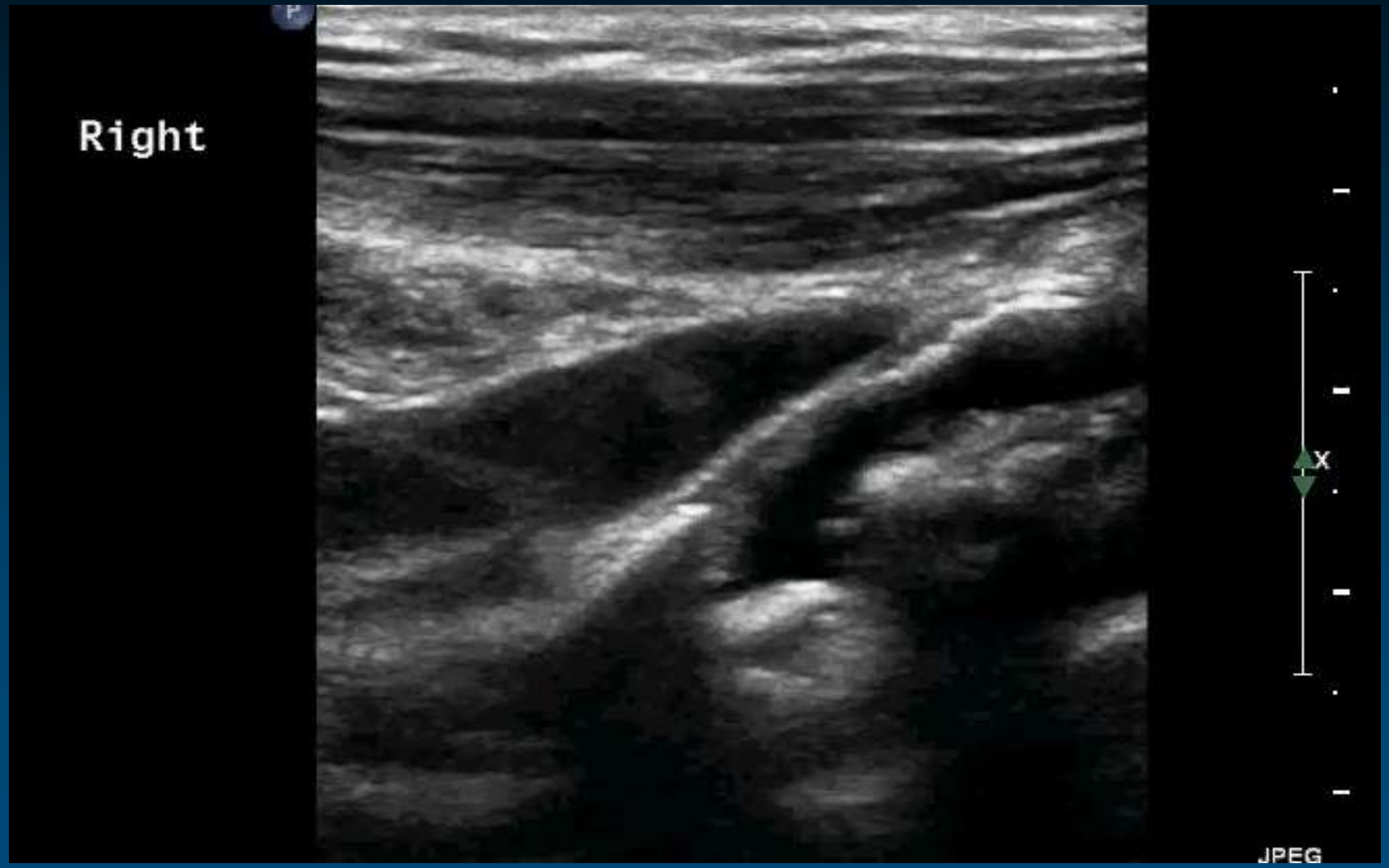


**Independent risk factor for ischemic event;**

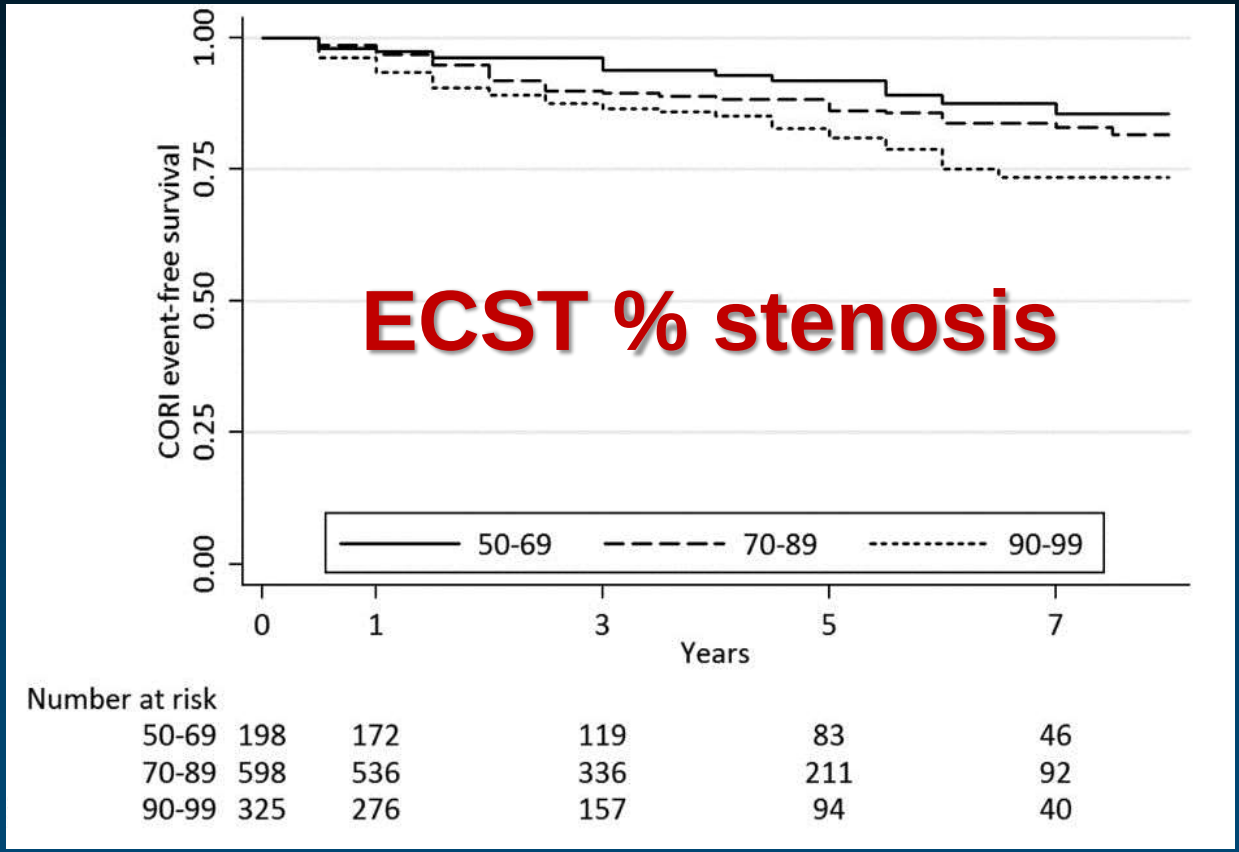
- ***whether or not stenosis is hemodynamically significant***
- ***more likely to result in emboli post CAS vs. post CEA***

# Duplex Ultrasonography

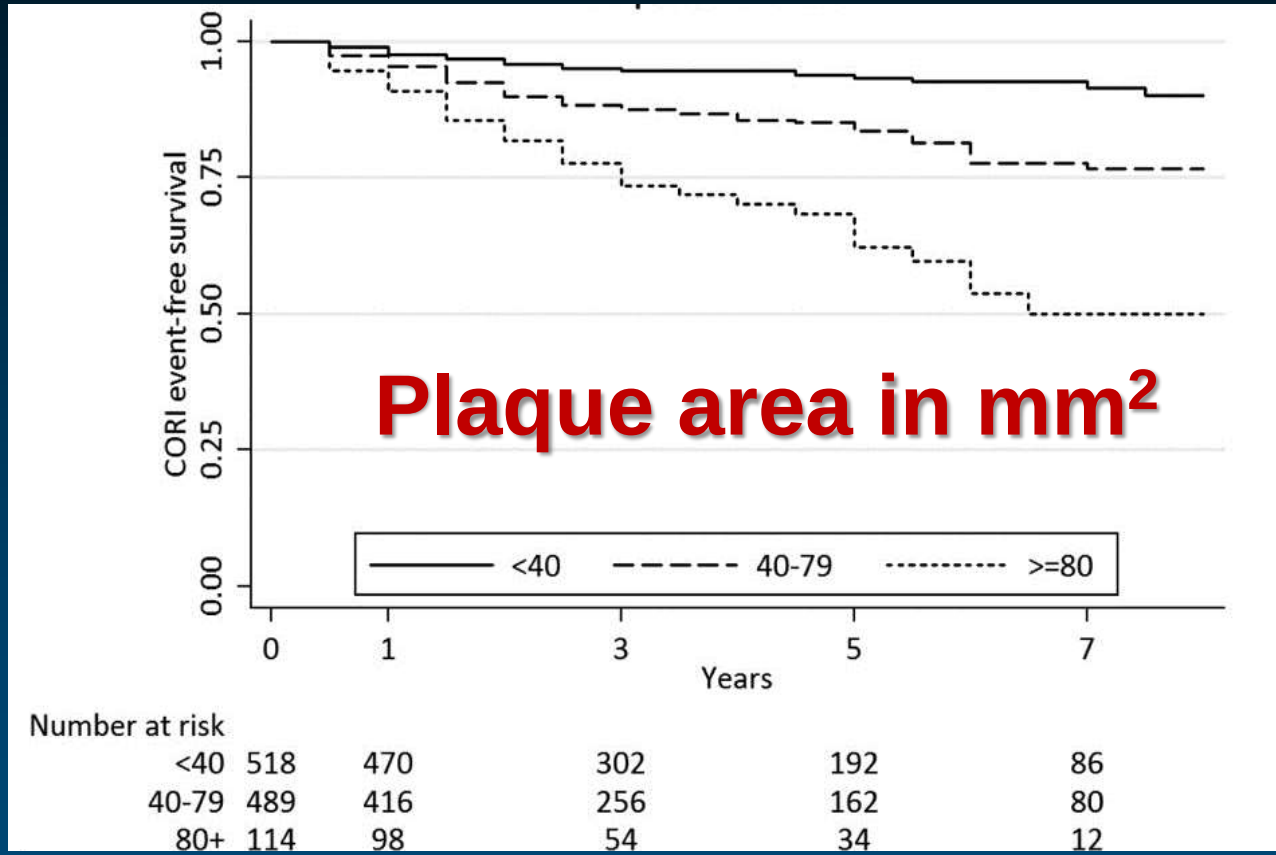
## *Calcified Plaque with Mobile Atheroma*



# USG Prediction & ASx Carotid Stenosis
# Predictors of Stroke




**ECST % stenosis**



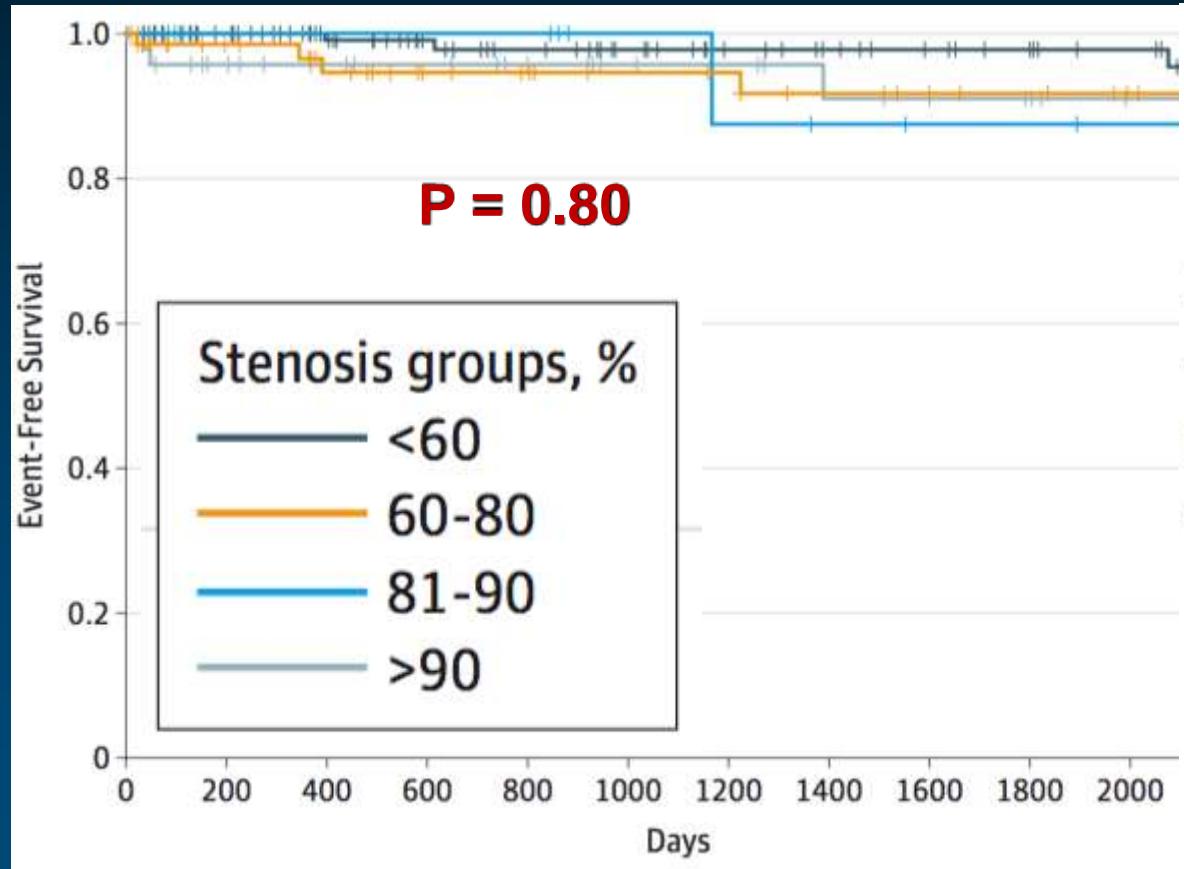

**Plaque area in $mm^2$**

*Nicolaides AN, J Vasc Surgery 2010;52(6): 1486-1496*

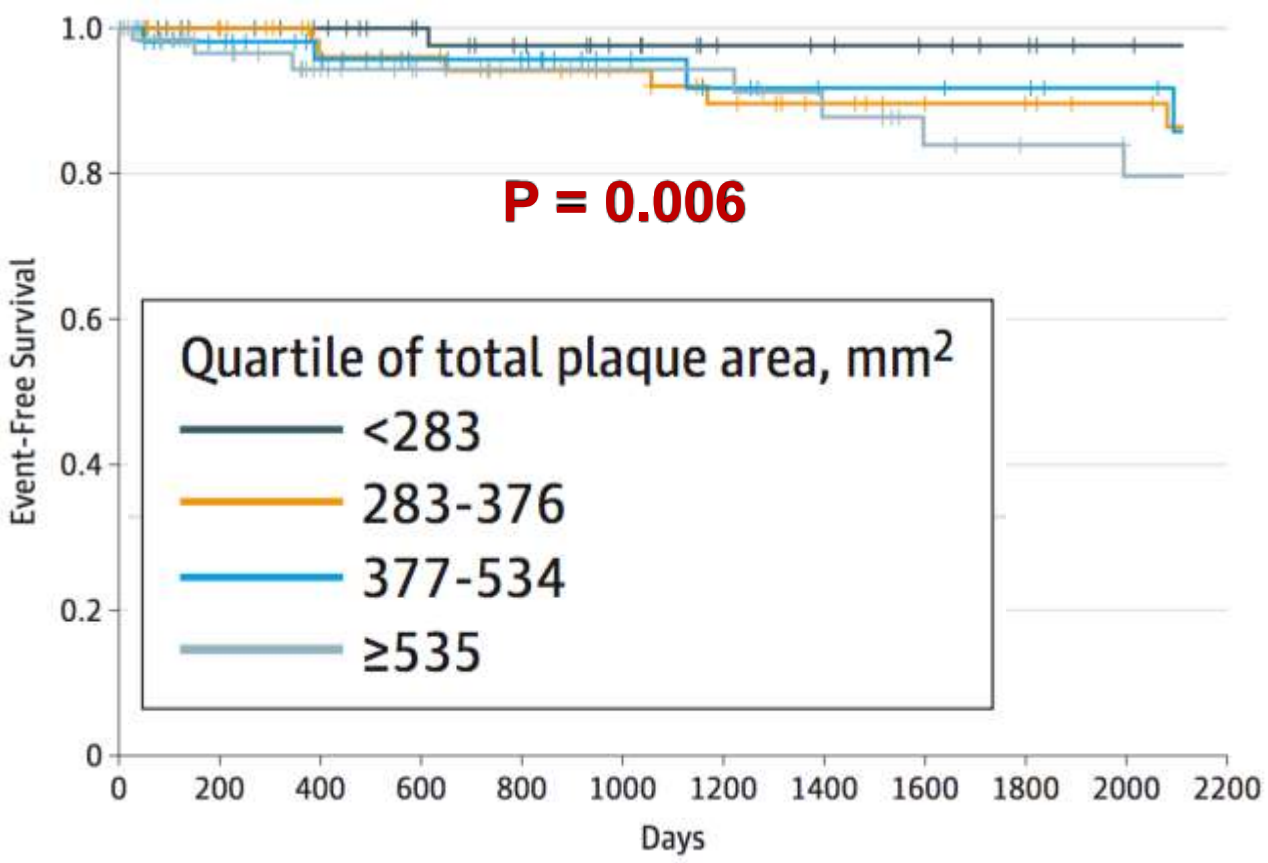
# Asymptomatic Carotid Stenosis

## *Predictors of Stroke*

### Percent Stenosis




### Plaque Burden

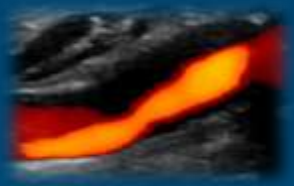



*Yang, et al. JAMA Neurol. 2015;72(11):1261-1267*

# Echolucent Plaque & ASx Carotid Stenosis

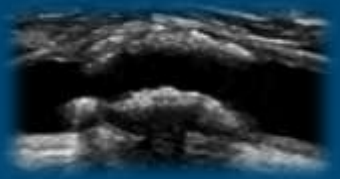
## *Annual Risk of Ipsilateral Stroke*

| Plaque Type | Annual Stroke Risk |
|---|---|
| 4 | 0.4% |
| 3 | 0.8% |
| **1 & 2** | **3.0%** |



*Type 1; Uniformly echolucent (black)*

*Type 2; Mainly echolucent*



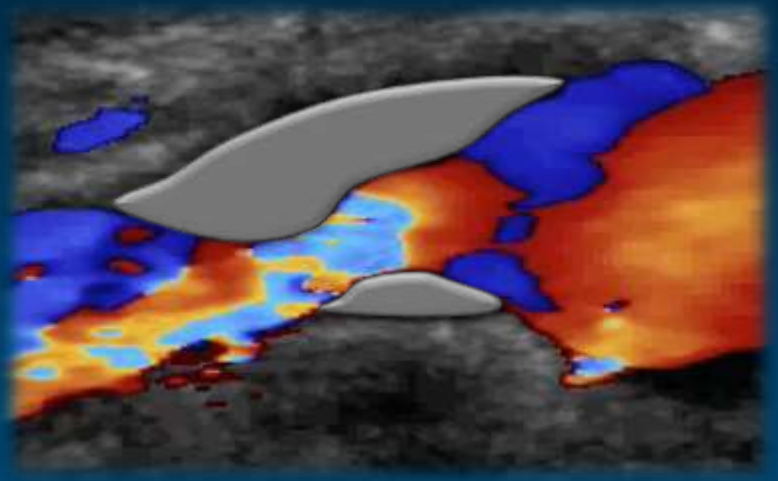
*Type 3; Mainly echogenic*

*Type 4 or 5; Uniformly echogenic*

*Nicolaides AN, J Vasc Surgery 2010;52(6): 1486-1496*

# JBA & ASx Carotid Stenosis

## *Annual Risk of Ipsilateral Stroke*

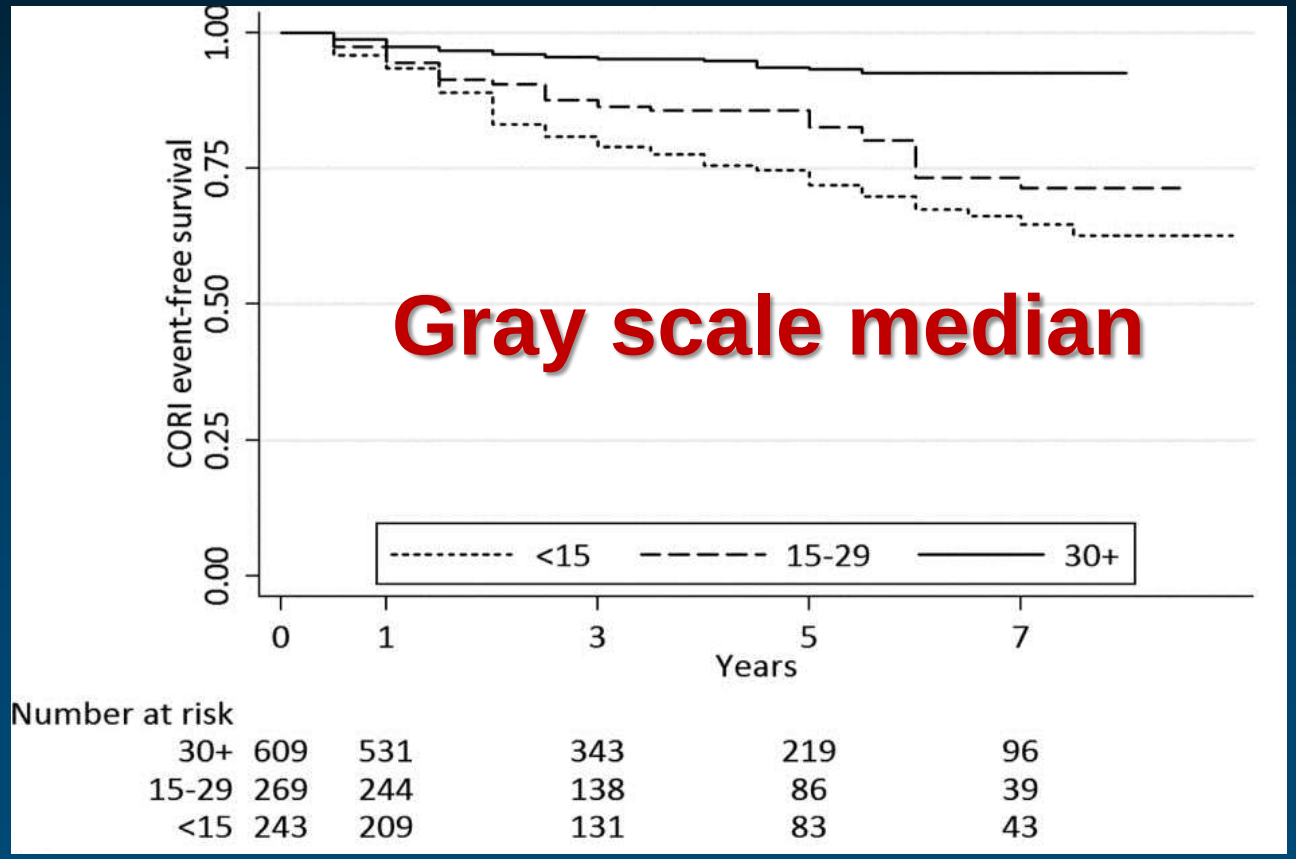


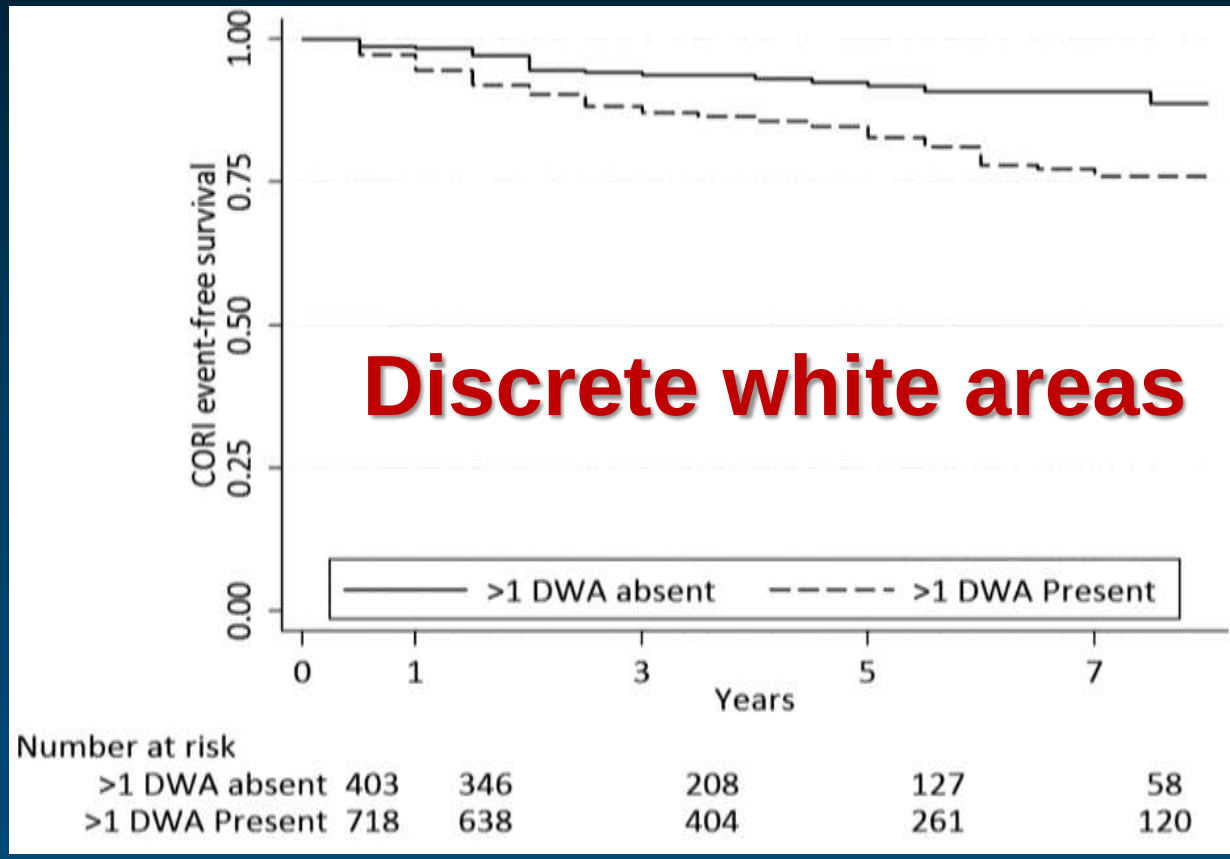
| JBA ($mm^2$) | Annual Stroke Risk |
|---|---|
| <4 | 0.4% |
| 4-8 | 1.4% |
| **8-10** | **3.2%** |
| **>10** | **5.0%** |

*Nicolaides AN, J Vasc Surgery 2010;52(6): 1486-1496*

# USG Prediction & ASx Carotid Stenosis

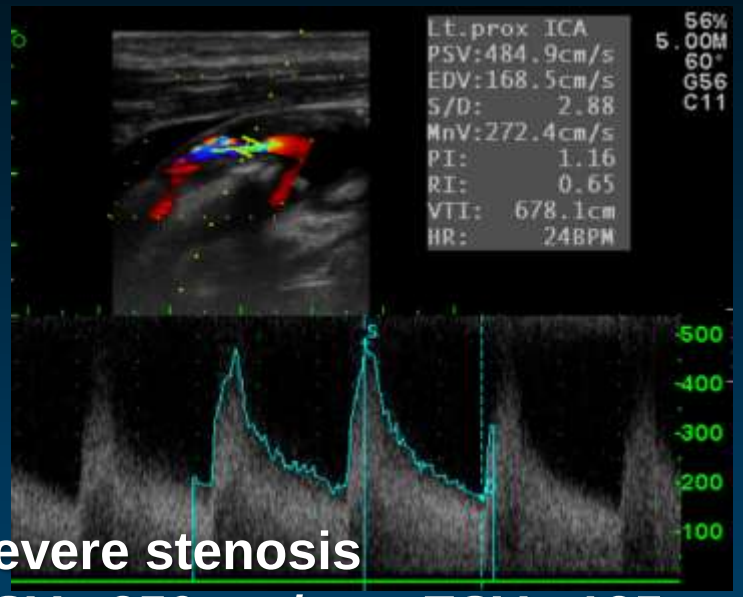
## *Ehcolucent plaque*



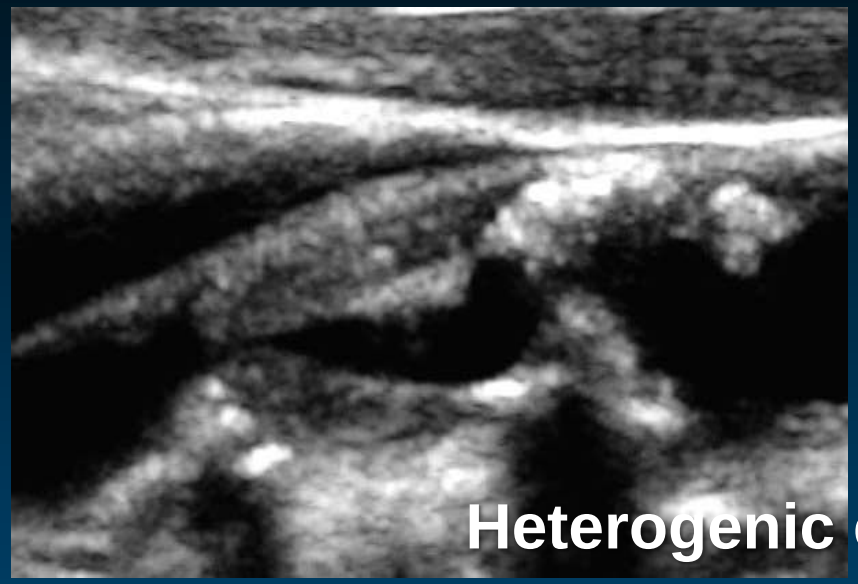

*Nicolaides AN, J Vasc Surgery 2010;52(6): 1486-1496*

# High Risk Predictors; Duplex USG

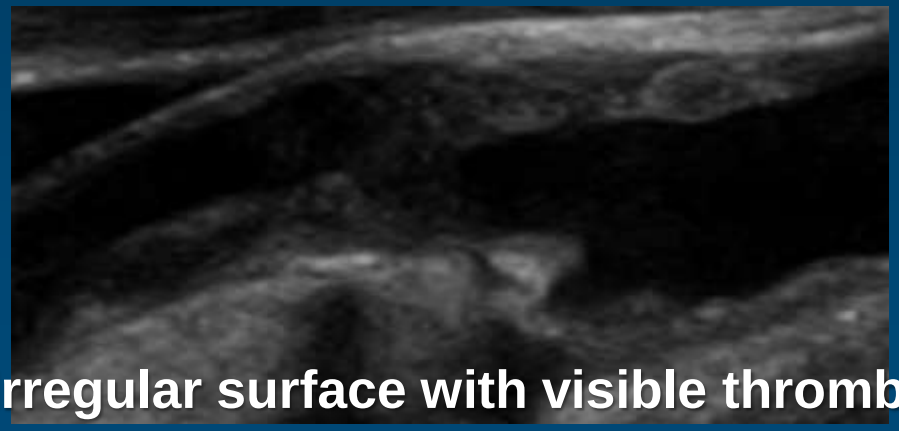



Severe stenosis

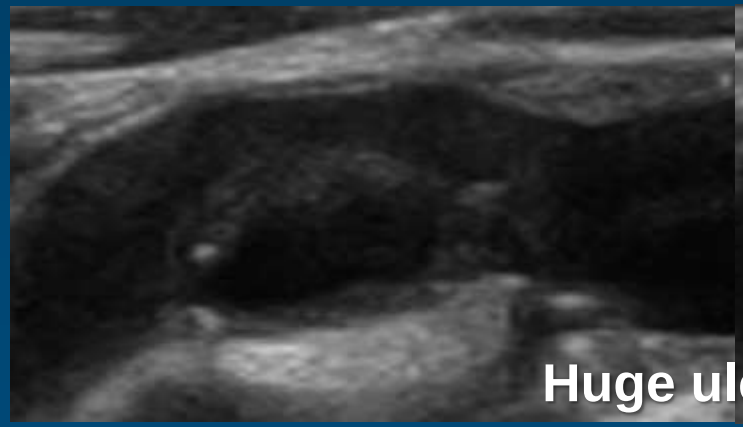
PSV >250 cm/sec, ESV >135 cm/sec

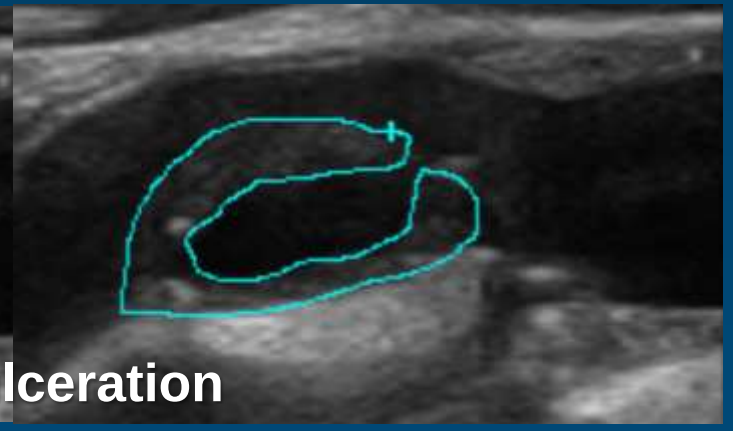


Heterogenic echogenicity



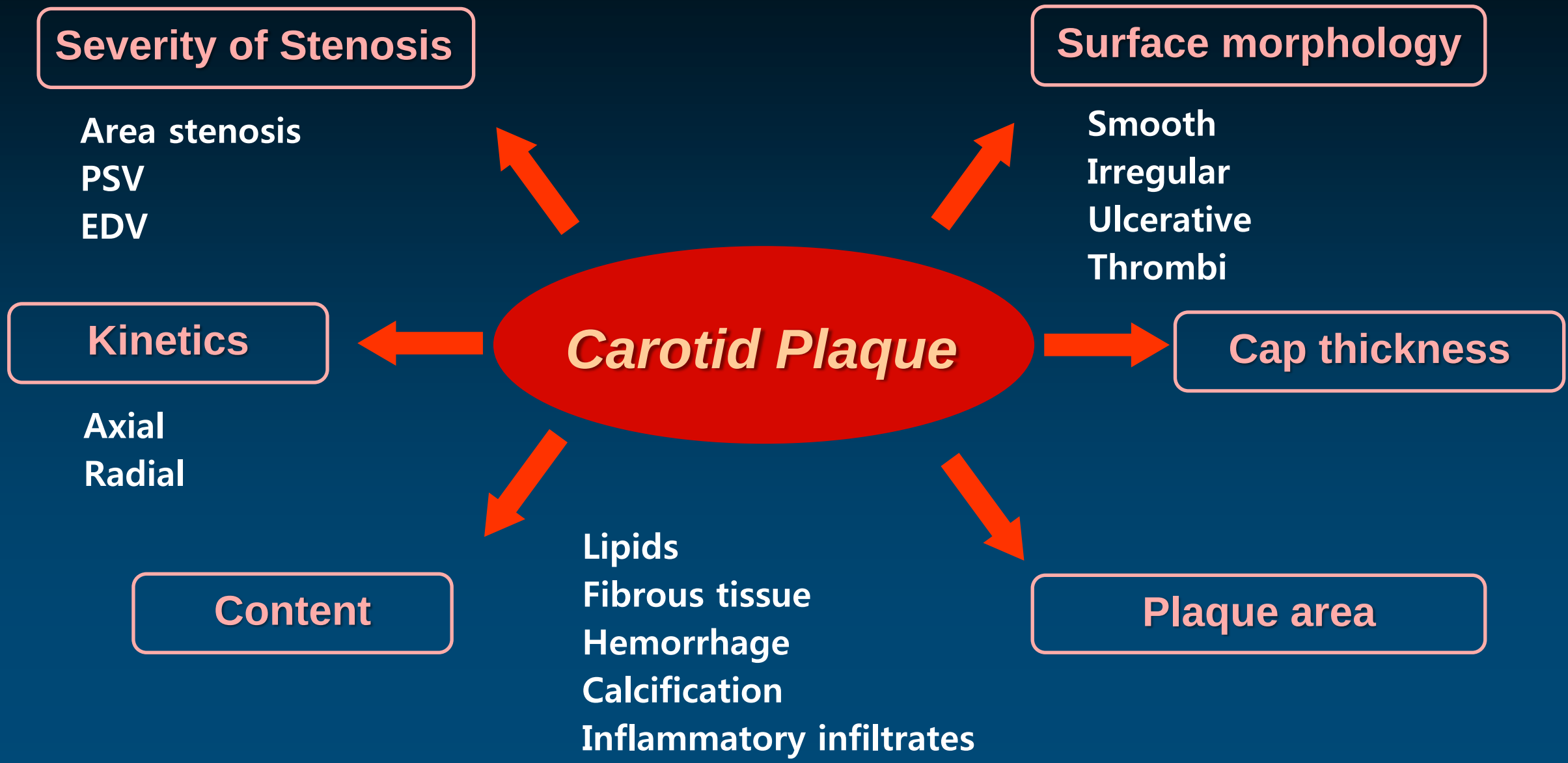
Irregular surface with visible thrombi





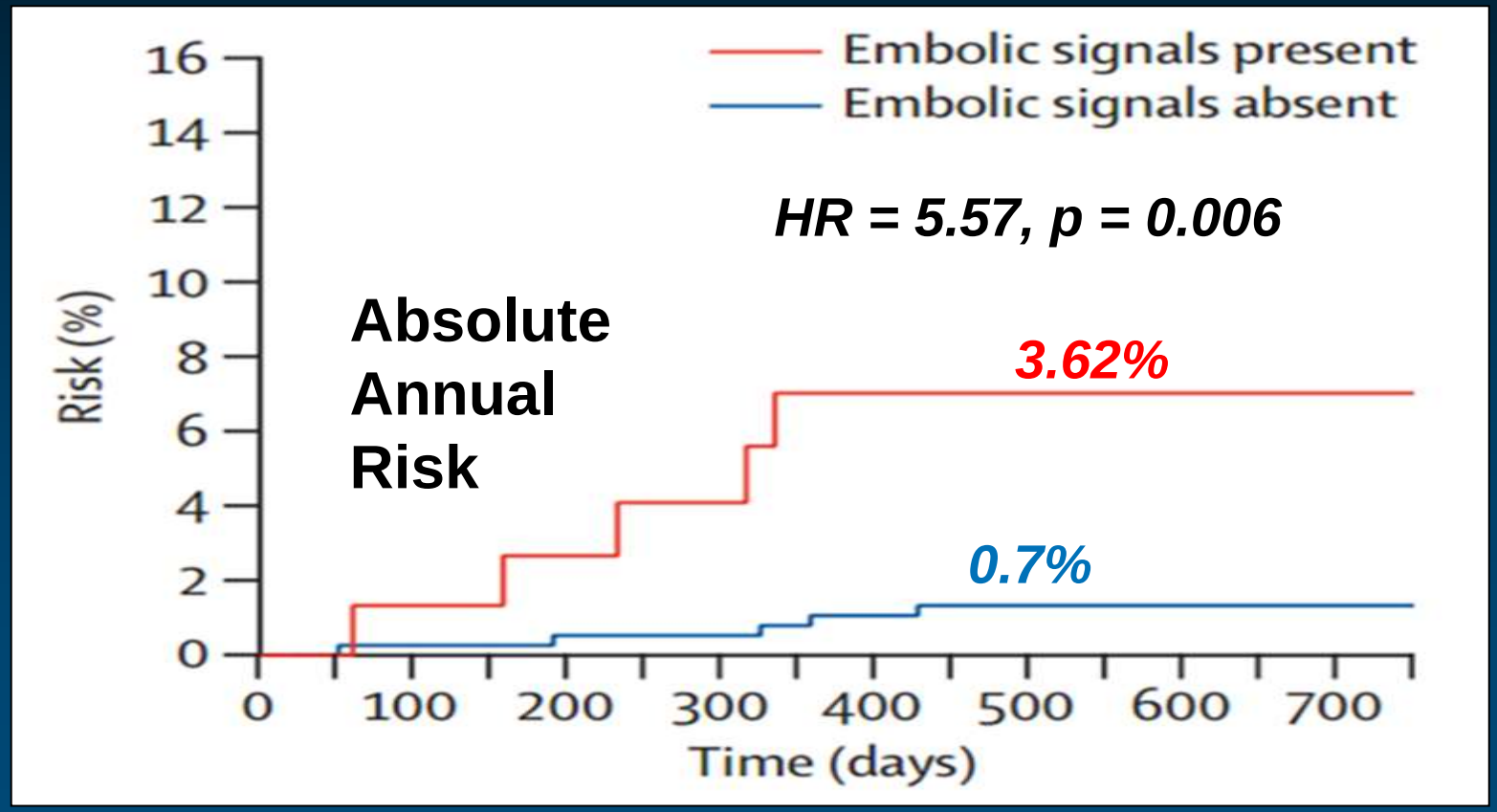
Huge ulceration

# High Risk Predictors; Duplex USG



# TCD Microembolic Signal & ASx Carotid Stenosis

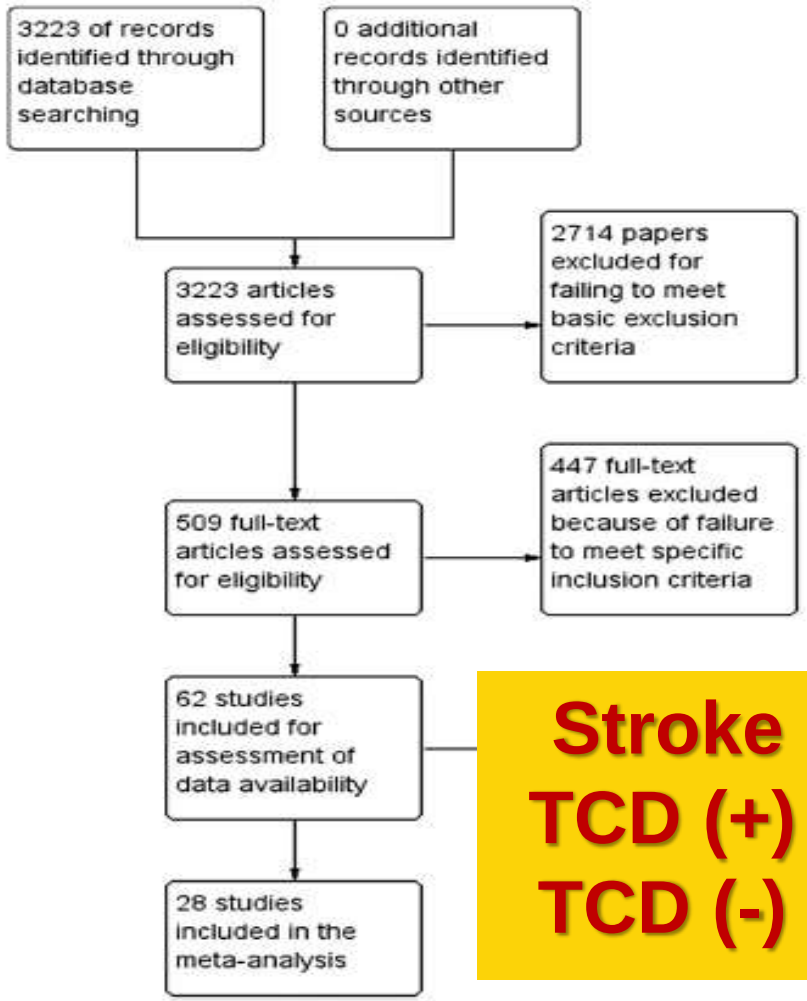
## *Ipsilateral Stroke/TIA*



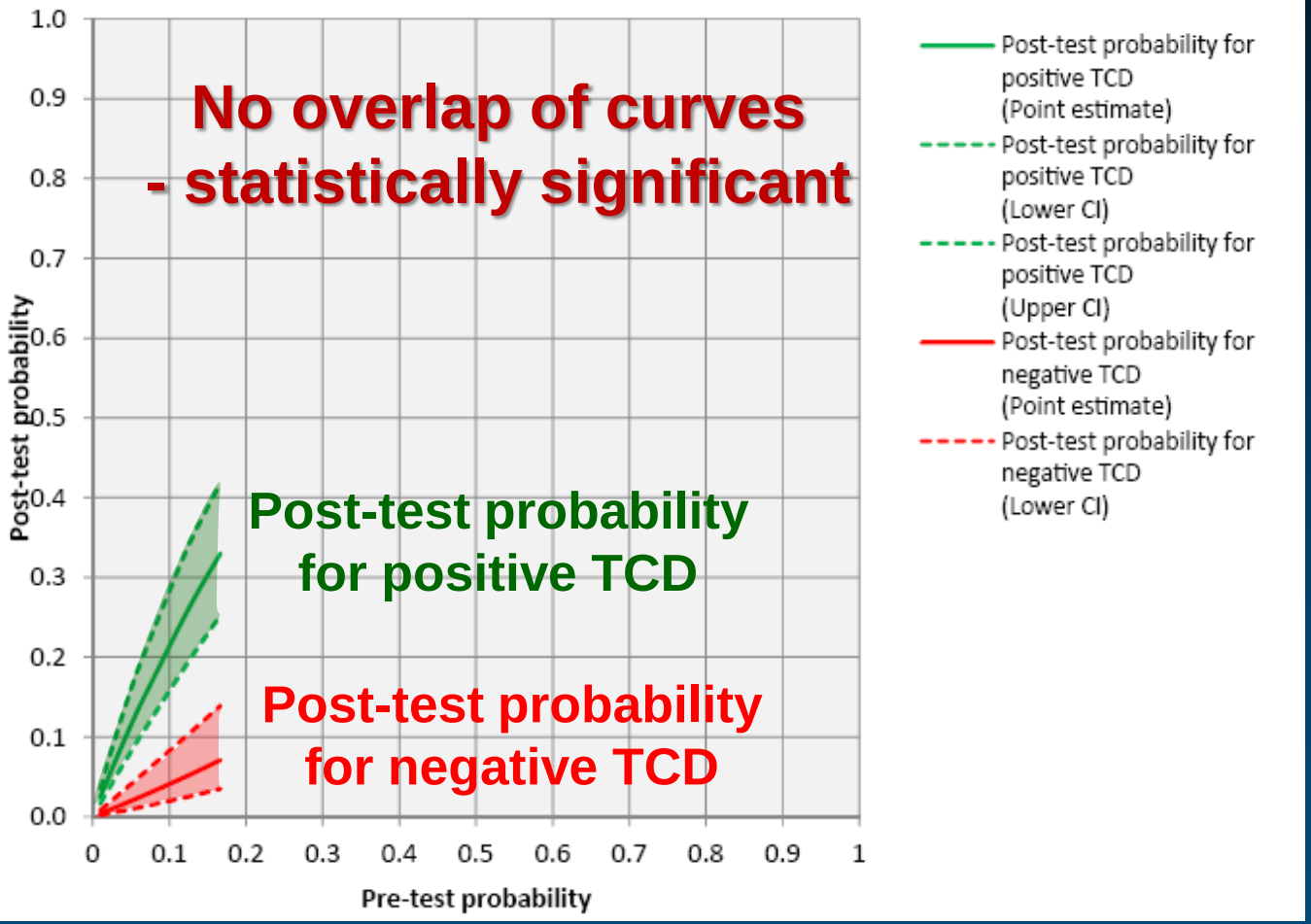

*ACES Registry, Prospective multicenter (n=467) , Markus HS et al, Lancet Neurol 2010; 9:663*

# TCD Microembolic Signal & ASx Carotid Stenosis

## *TCD MES Meta Analysis Data*




**Stroke Risk**
**TCD (+) 7.1%**
**TCD (-) 1.2%**




*Best LMJ et al, Euro J Vasc Endovasc Surg 2016;52:565-580*

# Silent Embolic Infarcts & ASx Carotid Stenosis

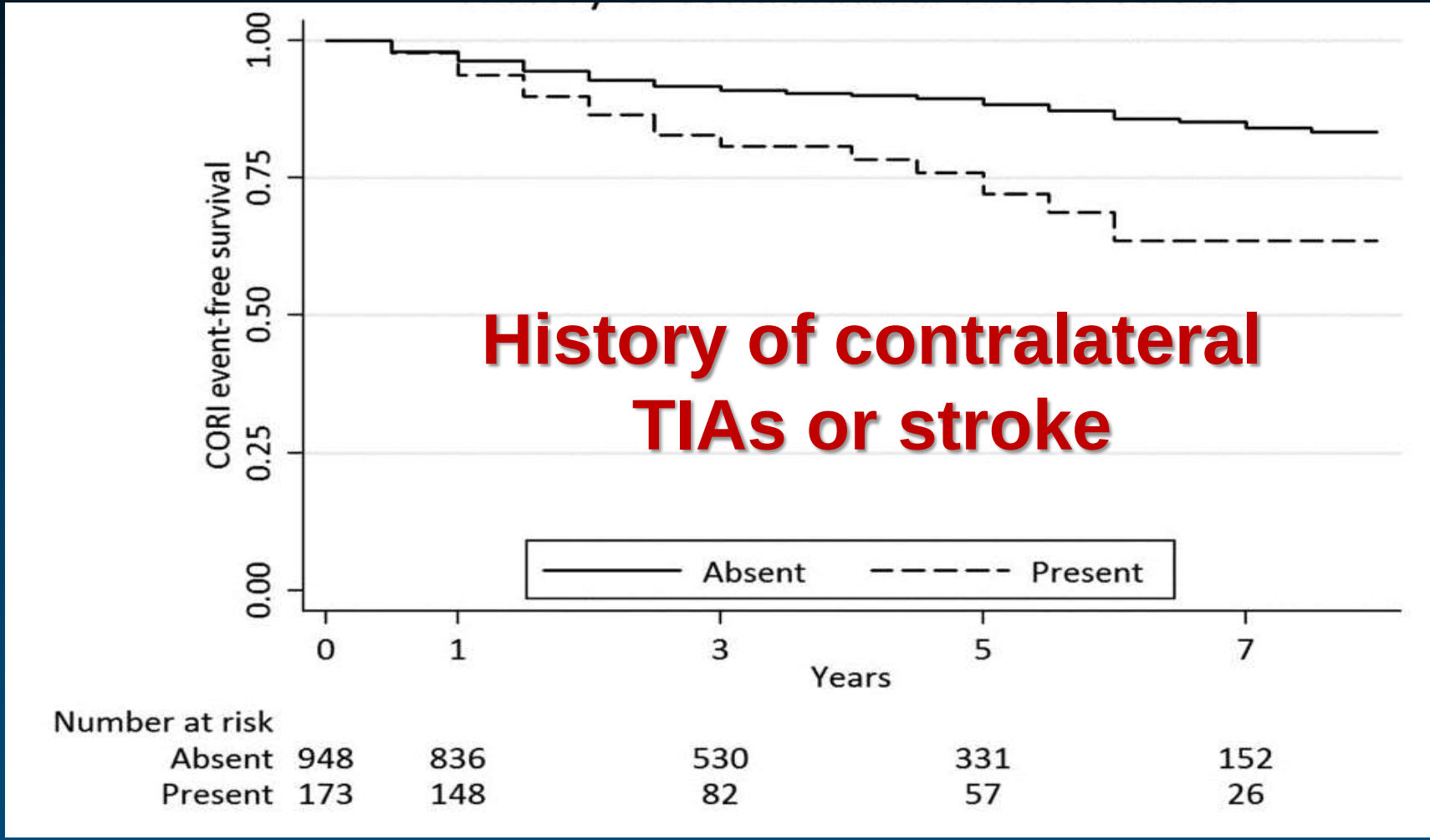
## *Annual Ipsilateral Stroke Rate*

| | Stroke Rate | | |
|---|---|---|---|
| Stenosis | No Infarct | Infarct* | p-value |
| <60% | 1.1% | 0.48% | NS |
| 60–99% | 1.0% | 3.6% | 0.002 |

**CT scans*

*Kakkos SK et al, J Vasc Surgery 2009;49:902*

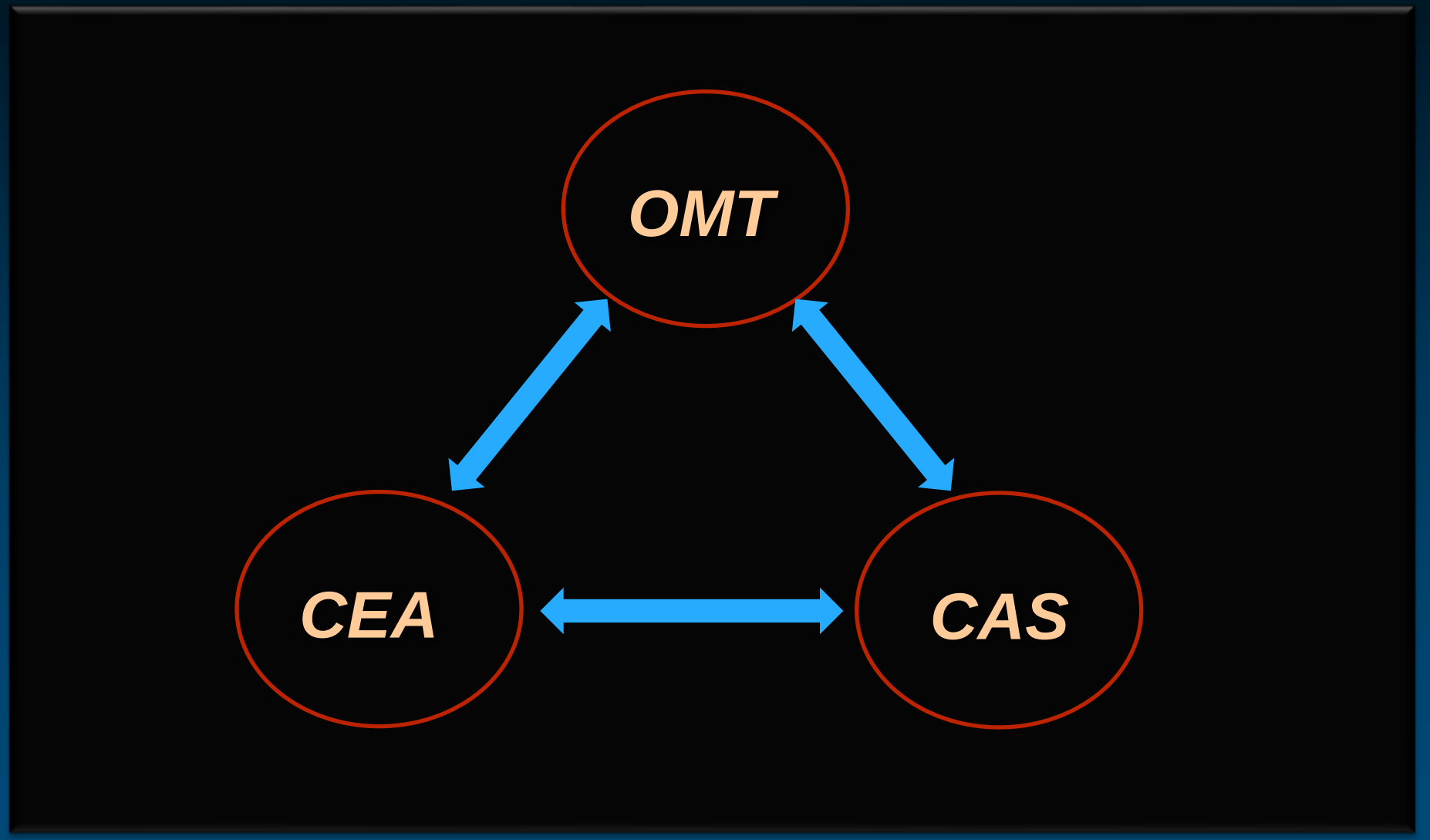
# Contralateral Stroke & ASx Carotid Stenosis




*Nicolaides AN, J Vasc Surgery 2010;52(6): 1486-1496*

# Asymptomatic Severe Carotid Stenosis

## *Three Treatment Options*



# Asymptomatic Severe Carotid Stenosis

## *When Do We Revascularize?*

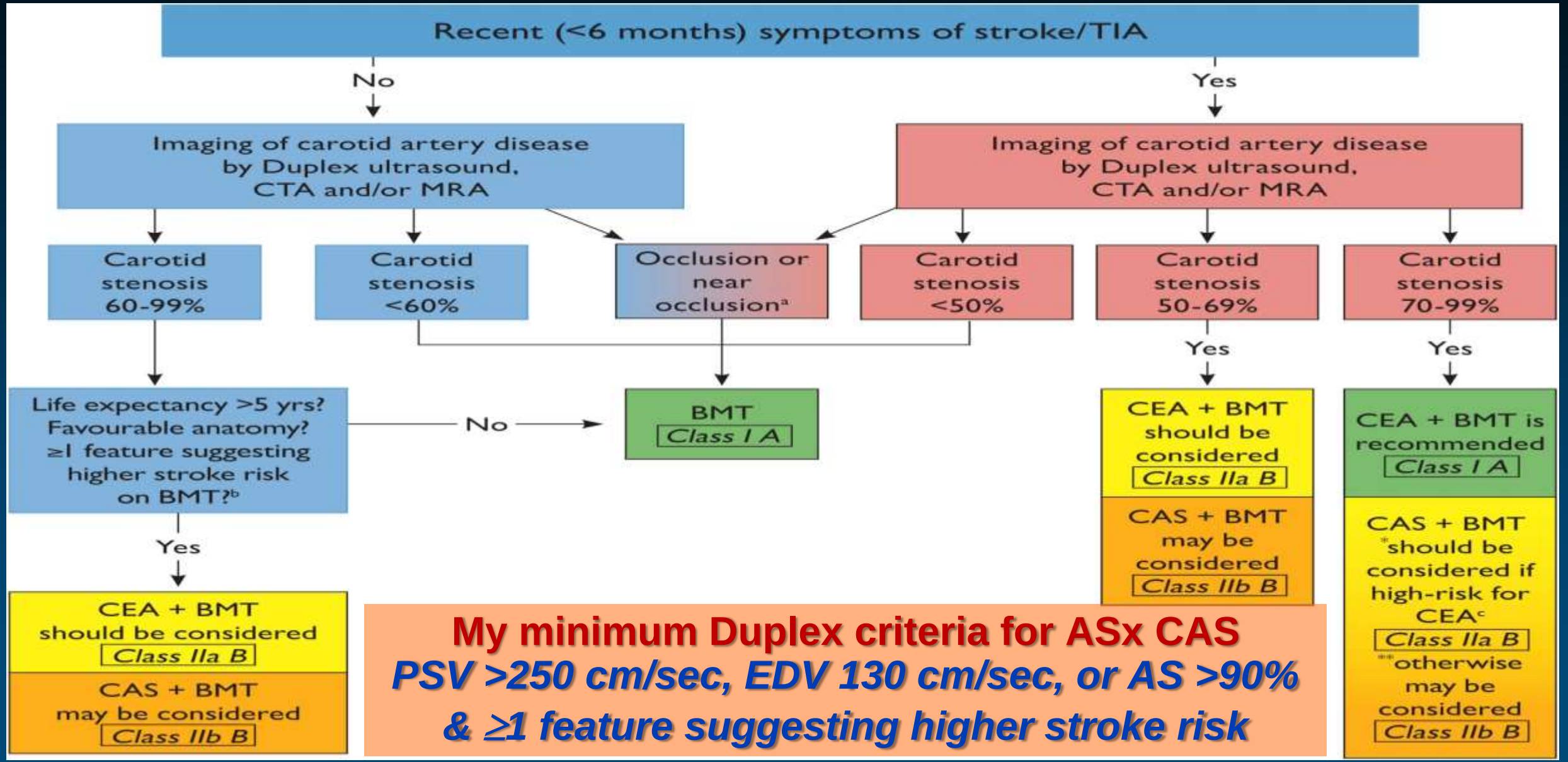
- **Life expectancy ≥5 years**
- **High risk imaging features**
  - ***Silent cerebral infarction, stenosis progression***
  - ***Plaque area on computerized plaque analysis >80 mm2***
  - ***JBA on computerized plaque analysis >8 mm2***
  - ***Intraplaque hemorrhage, Impaired CVR***
  - ***Plaque lucency on Duplex US, Spontaneous embolization on TCD***
  - ***Contralateral TIA/Stroke, Contralateral carotid occlusion***
- **Fully informed consent**

CEA + BMT
should be considered
*Class IIa B*

CAS + BMT
may be considered
*Class IIb B*

# Management Strategies for Asymptomatic Carotid Stenosis

## *2017 Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS)*




**My minimum Duplex criteria for ASx CAS**

***PSV >250 cm/sec, EDV 130 cm/sec, or AS >90%***

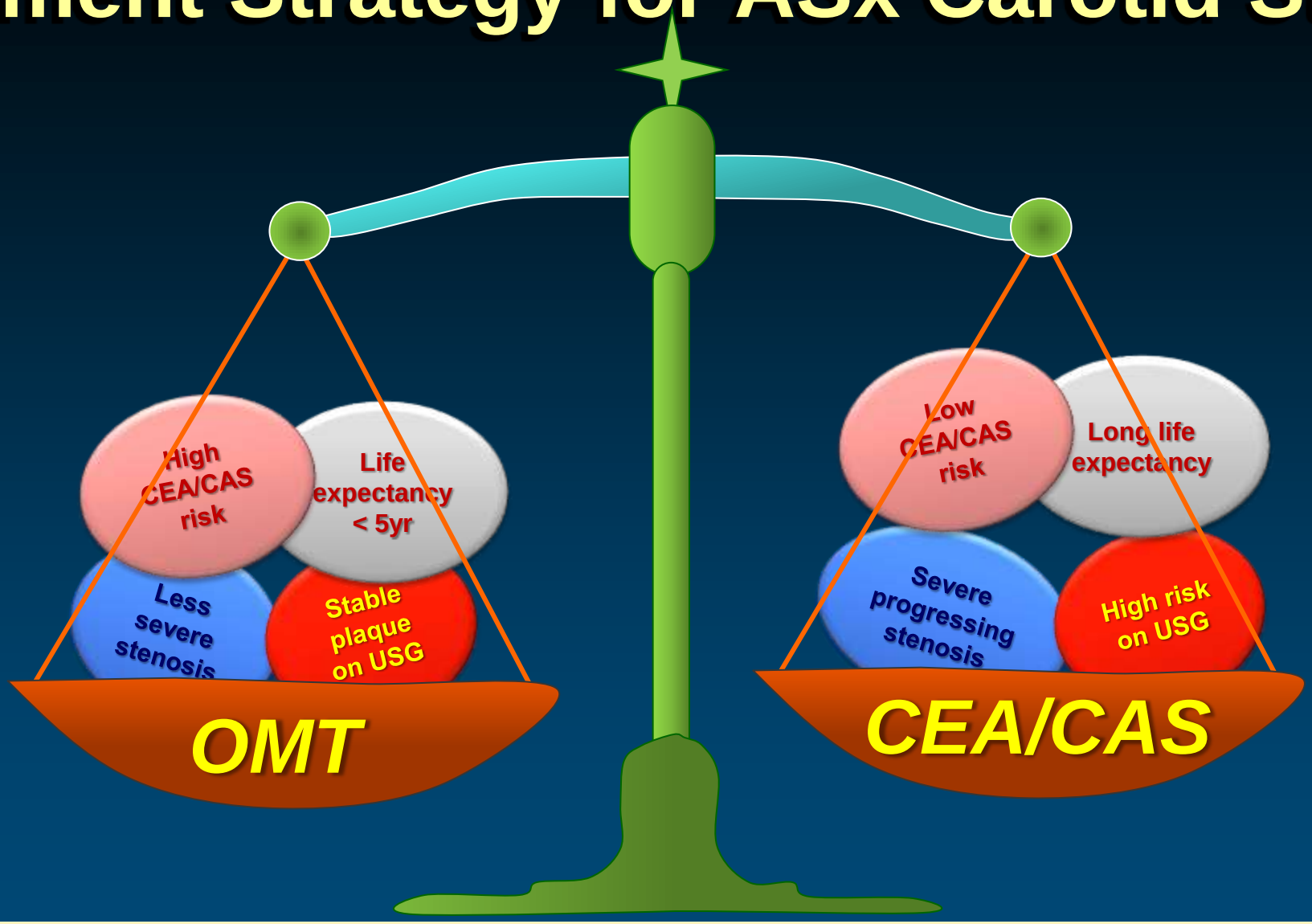
***& ≥1 feature suggesting higher stroke risk***

# Conclusion

## ASx Carotid Stenosis; Who Is The High Risk?

- Numerous methods promising, but none yet proven
- Controversy will continue regarding the best treatment of ASx carotid stenosis
- The general condition of the patient, concomitant diseases, the degree and characteristics of the lesion, and the risk of CEA / CAS should be considered as a whole.

# Treatment Strategy for ASx Carotid Stenosis




**Thanks for Your Attention**