

**Carotid plaque morphology is only  
relevant to consider in symptomatic  
carotid stenosis**

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# Disclosures

## STRONG BELIEVER IN PLAQUE MORPHOLOGY

Research support from Philips Ultrasound

I am a doctor in a country where we consider  
expenses of treatment because resources are  
NOT unlimited

# Wouldn't it be great if ...

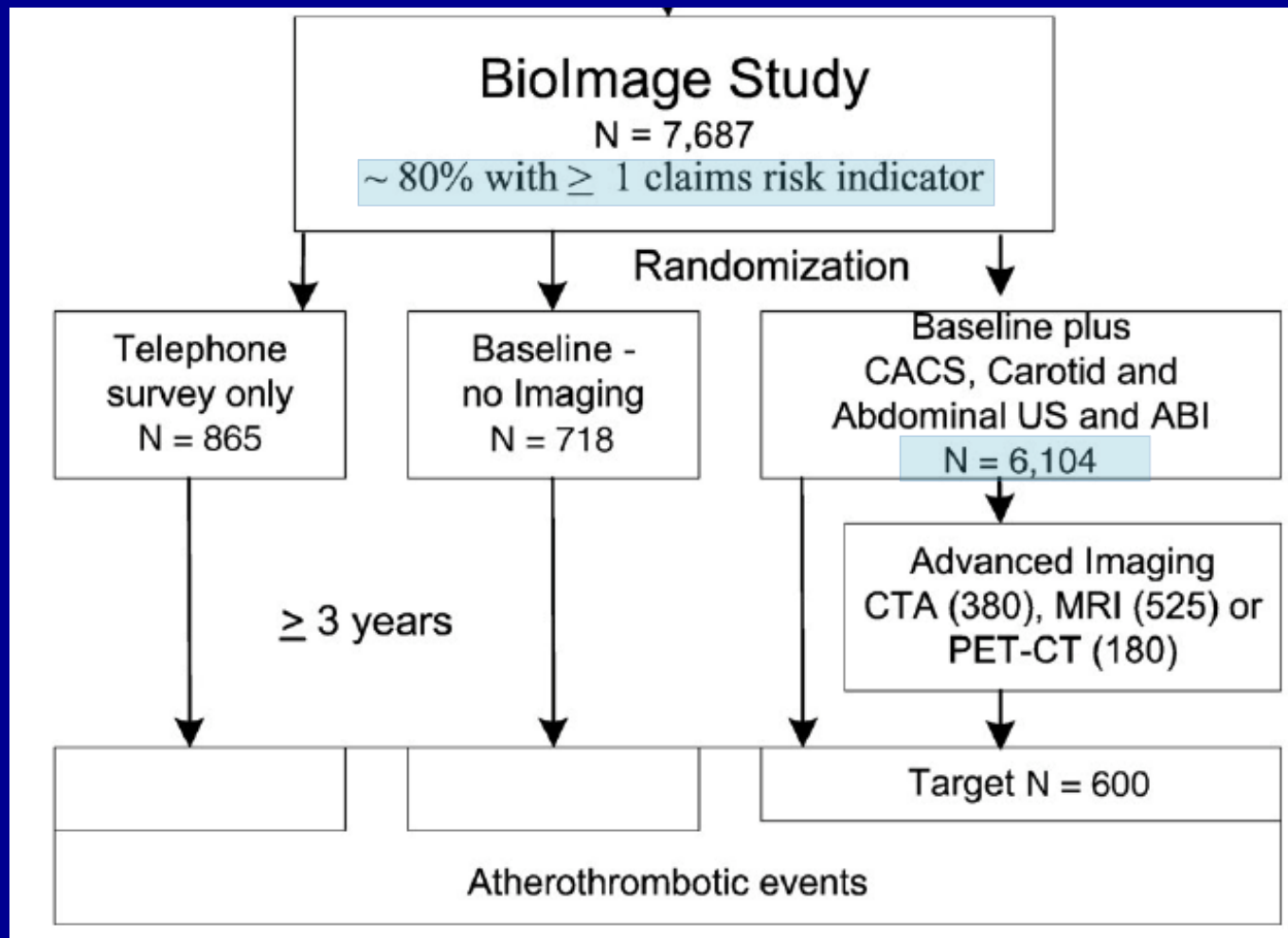
- We could predict who among asymptomatic people with carotid stenosis (CS) would have a stroke
- Clearly, not everybody with CS will have one

# Declining stroke risk in asymptomatic carotid stenosis – 75% reduction



Risk of Ipsilateral stroke < 1% p.a.

# Does imaging of atherosclerosis improve risk prediction?



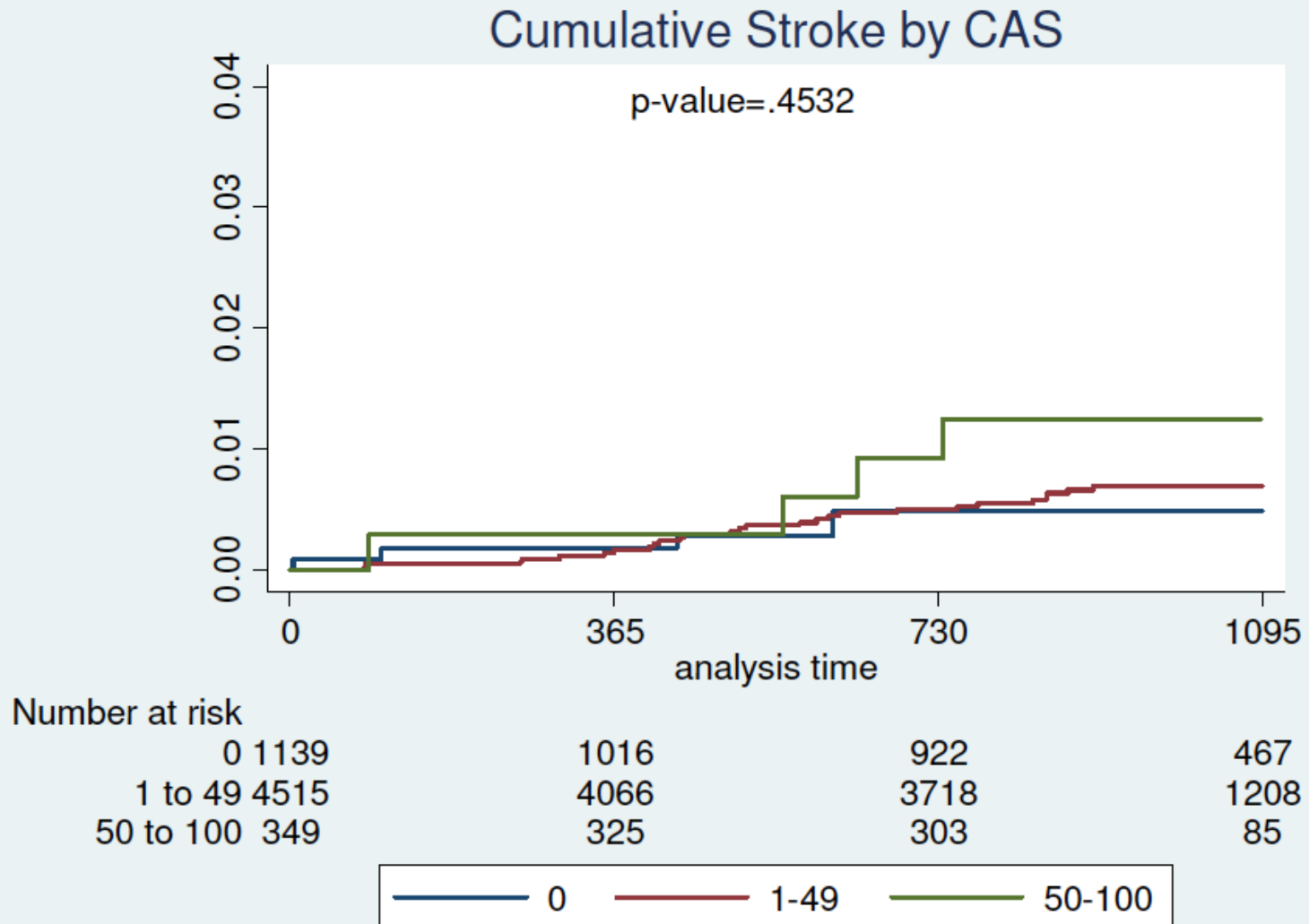
# Carotid stenosis (%)

overall		
0 (both side 0)	1139	18.97
<50	4515	75.21
>50 (at list one side >50)	349	5.81
Total	6003	

Diagnosis of carotid stenosis based on standard Doppler criteria

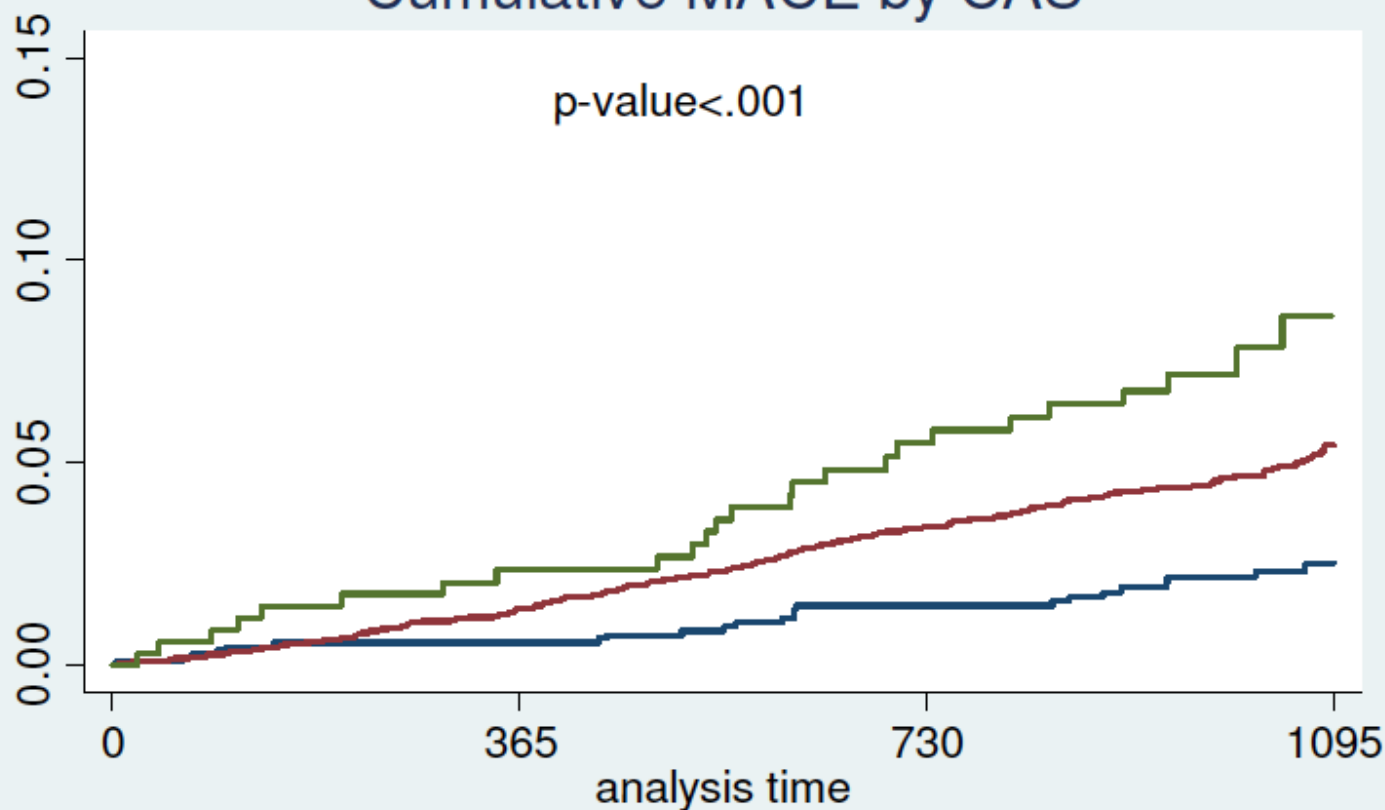
Unpublished data

# Risk of stroke is LOW



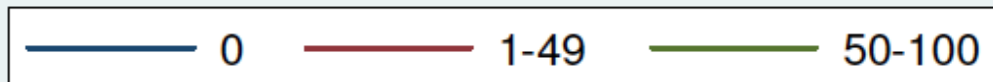
# Risk of cardiovascular events **HIGH**

## Cumulative MACE by CAS



Number at risk

0	1139	1013	920	463
1 to 49	4514	4035	3661	1177
50 to 100	349	319	296	84





# Treatment efficacy today ACS

- Overall ACS population has an annual stroke rate of 1%
- CEA: relative risk reduction: 50%
- 2% peri-procedural risk of stroke and death
- ARR in 5 years = 1.5%
- NNT = 66 CEAs to prevent 1 stroke in 5 years or 330 to prevent 1 stroke in 1 year

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# At what annual risk is CEA cost-effective?

– 1% - **NO**

– 3%

– 5% - or more

# Identification of high risk ACS

- Assuming a 3% annual ipsilateral stroke rate
- 2% complication rate (death and stroke)
- 50% RRR
- 6.5% ARR at 5 years (1.5% per year)
- **15,4** to prevent 1 stroke in 5 years
- **NNT 77 CEA's** to prevent 1 stroke in 1 year

# Identification of high risk ACS

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# Identification of high risk ACS

- Assuming a 5% annual ipsilateral stroke rate
- 2% complication rate (death and stroke)
- 50% RRR
- 11.5% ARR at 5 years (2.3% per year)
- NNT: **9** to prevent 1 stroke in 5 years
- or **43 CEA's** pt.s to prevent 1 stroke in 1 year
- Cost effective – **could be!**

Need to identification of ACS with **5% annual risk** of ipsilateral stroke!

- If average risk in all ACS pt.s is 1%
- Maybe only 10% of cases – or less
- Looking for few among many
- HOW could we identify this group?

# Imaging features with higher risk

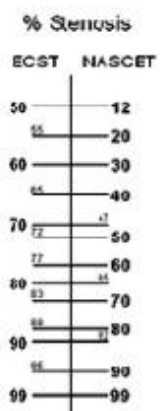
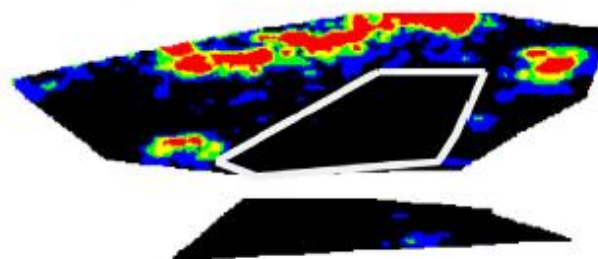
Feature		Annual rate of ipsilat stroke
Silent infarction	Kakkos et al 2009	3.6%
Stenosis progression	Kakkos 2014	2%
Predominantly echolucent plaque	Gupta 2014	4%
Low GSM plaque/part of plaque	Kakkos 2015	5%
Large plaque area	Nicolaides	4.6%
> 3 micro ulcers on plaque	Madani 2011	6%
MRI intraplaque hemorrhage	Singh 2009	OR 3.6
Emboli on TCD	Markus 2010	OR 6.6
Emboli + dark plaque	Topikain 2011	8.9%
Impaired cerebrovascular reserve	Gupta 2012	OR 3.9



**A**

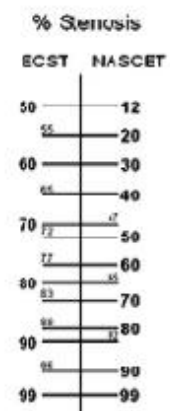
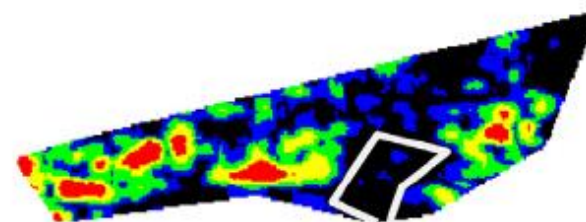
patient5anrr20

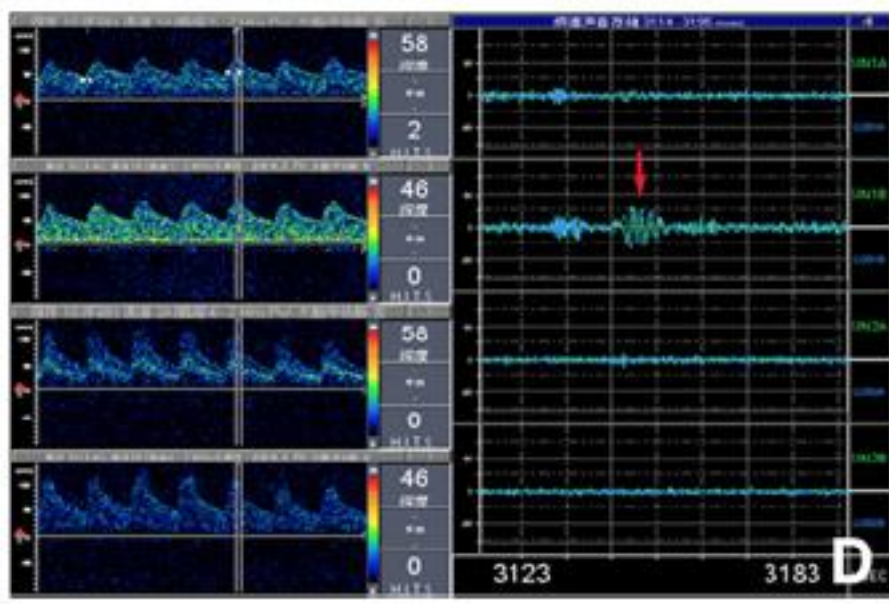
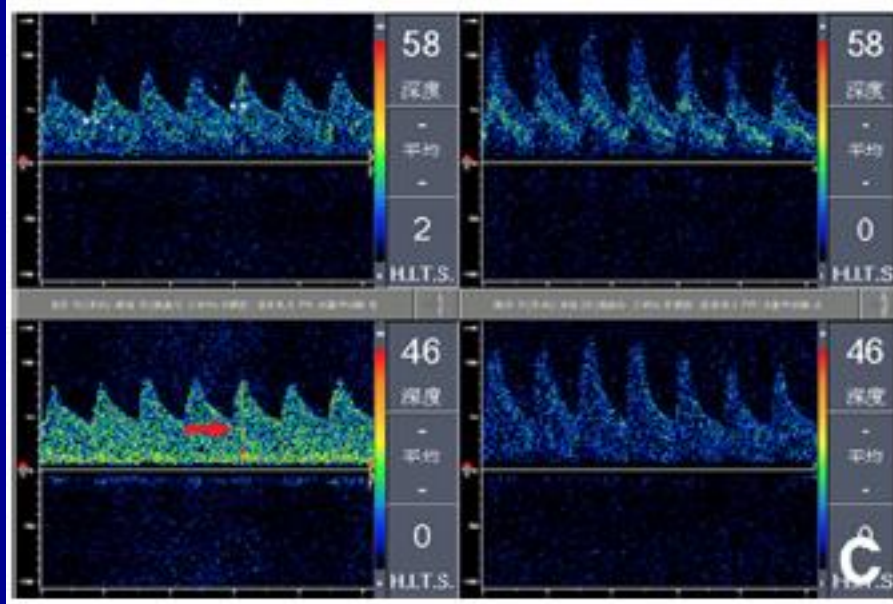
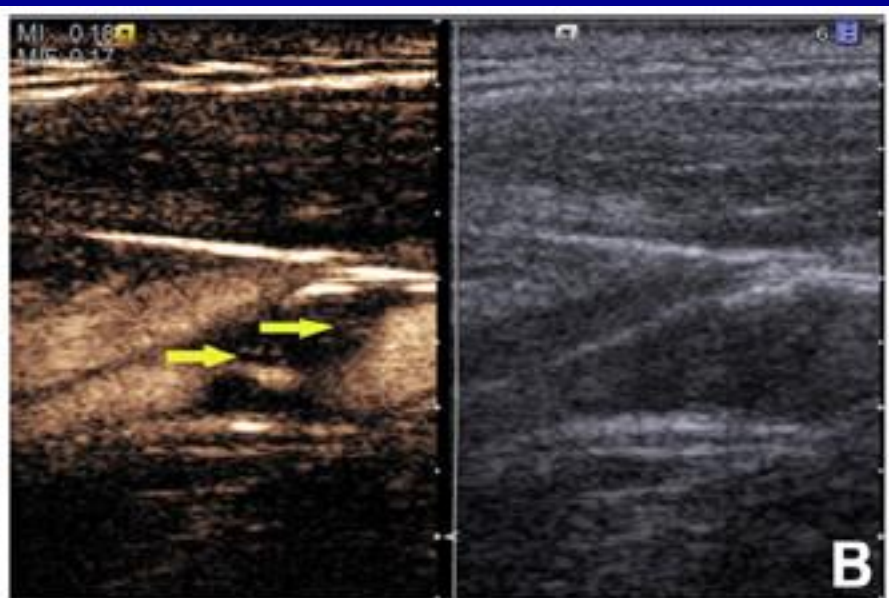
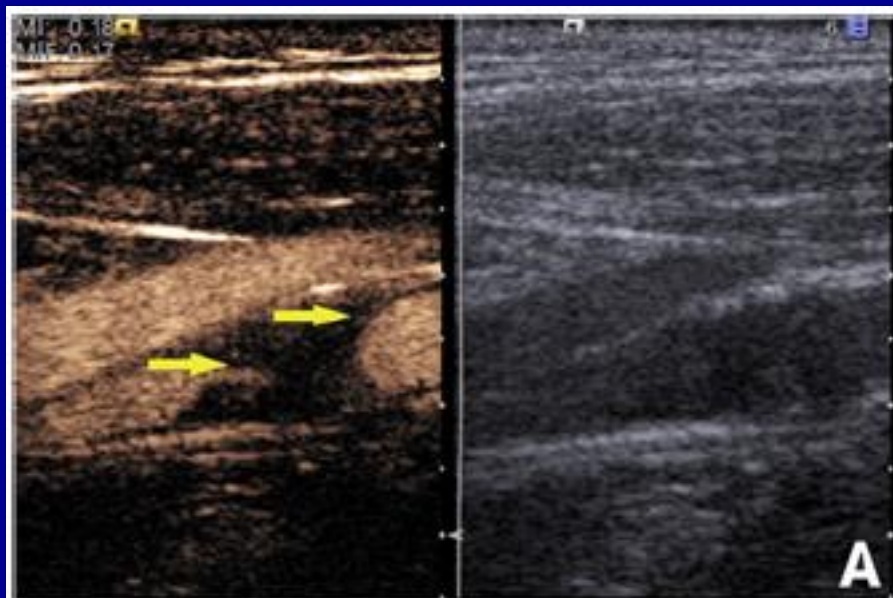
Params: Black/blue perc:85 GSM low:25/high:50

*Image region**Image colouring (10 contours)***B**

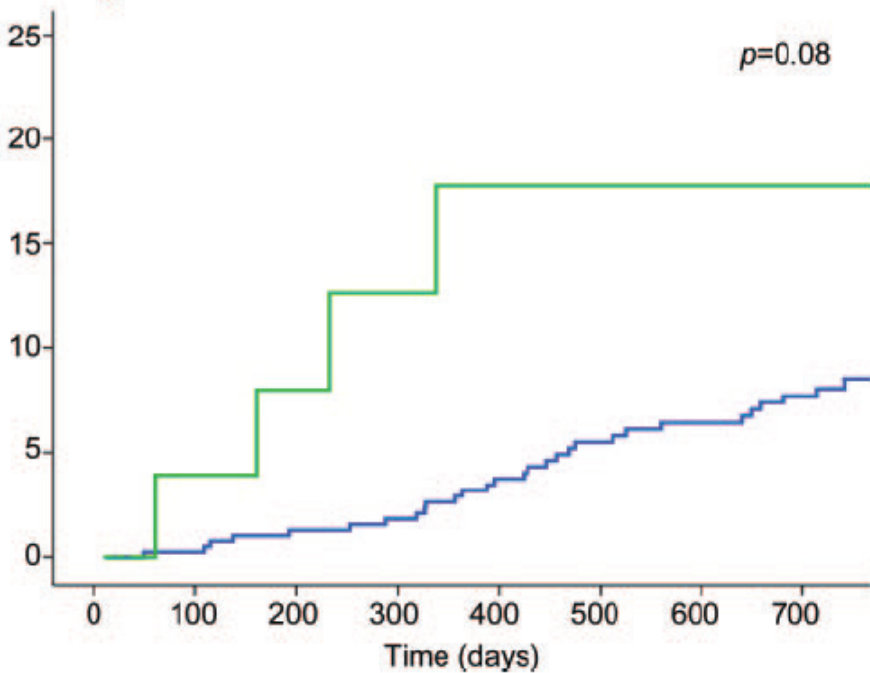
patient6anrr20

Params: Black/blue perc:85 GSM low:25/high:50

*Image region**Image colouring (10 contours)*

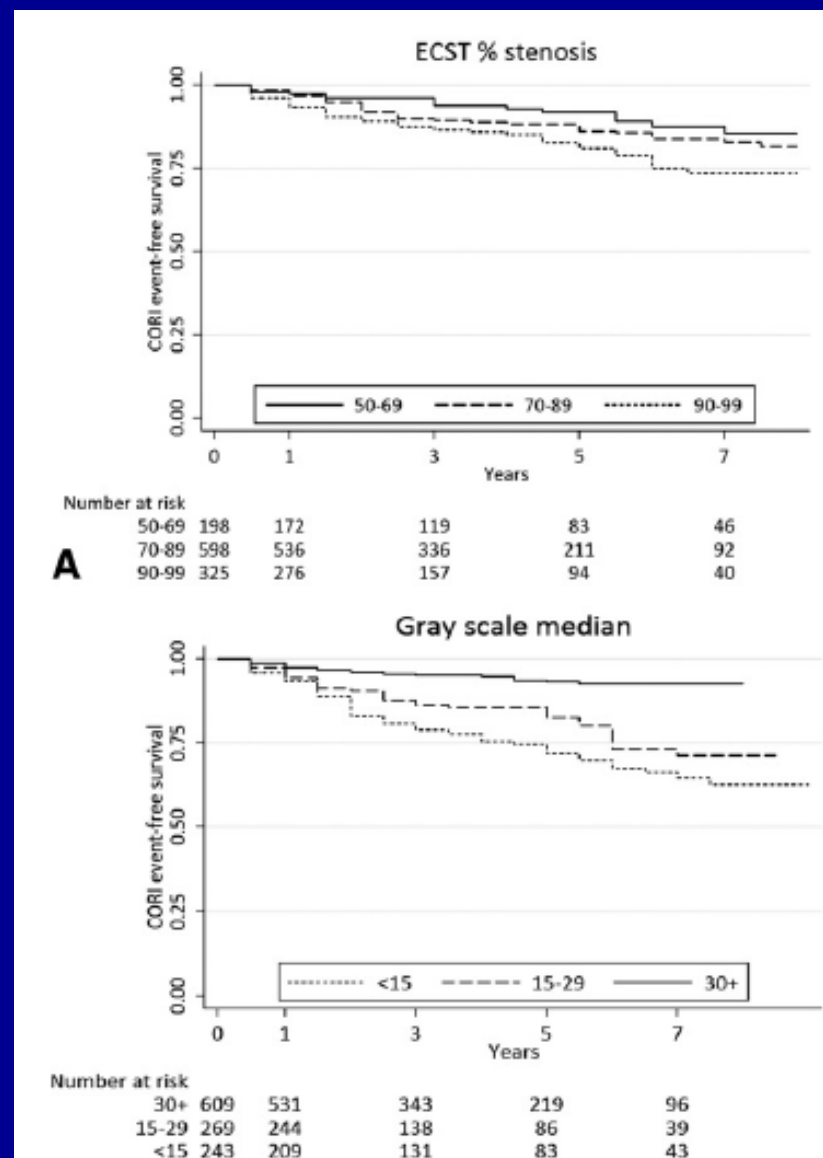


### D Any stroke or cardiovascular death



Topakian et al, Neurology 2011

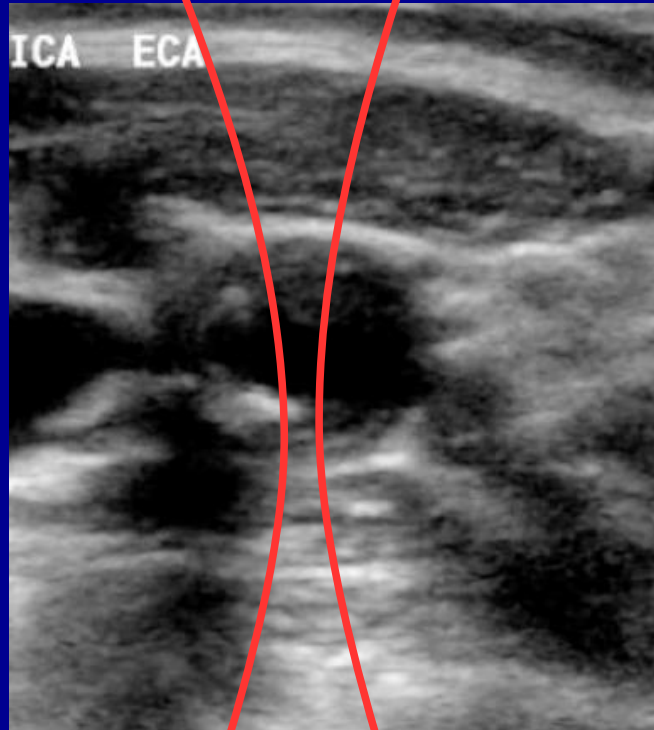
Nicolaides et al JVS 2010



# Identification of high risk

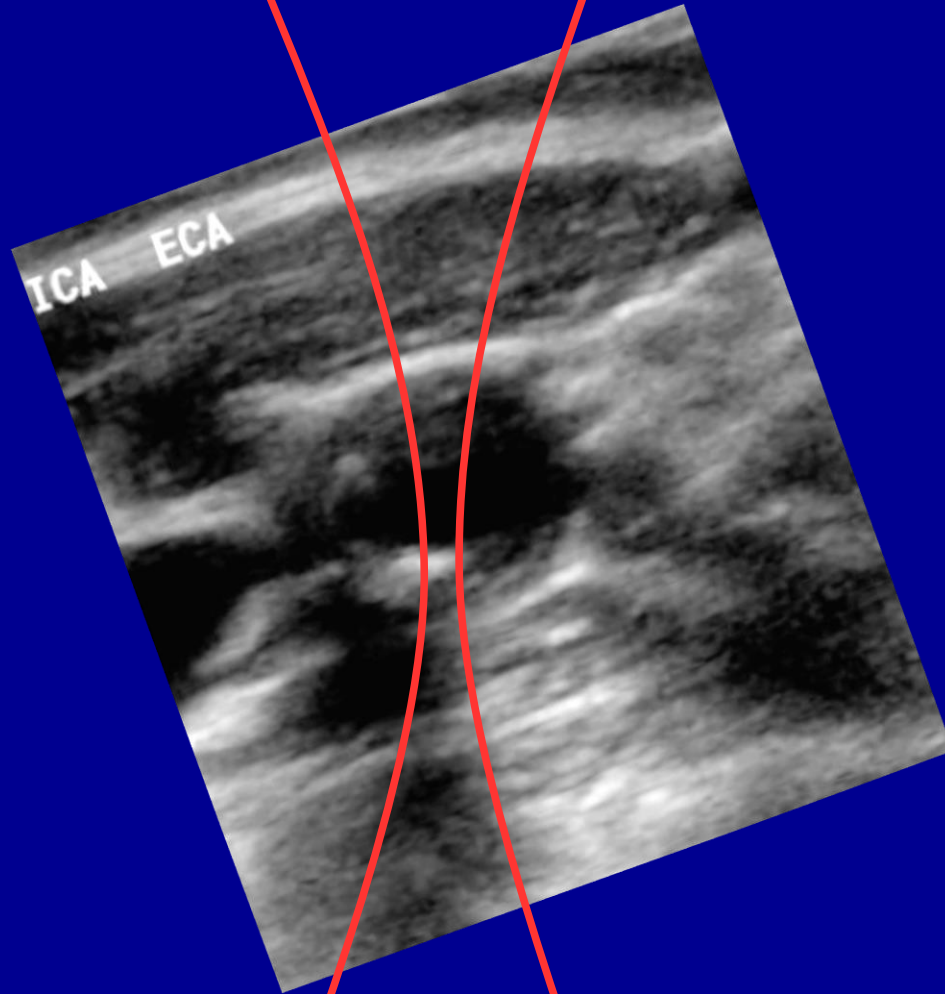
- Cases of higher risk seem to exist according to the literature
- However, most of the studies are unvalidated as findings were in historical case series or in small studies
- Most studies conducted with sub-optimal medical therapy as opposed to today's

Transducer



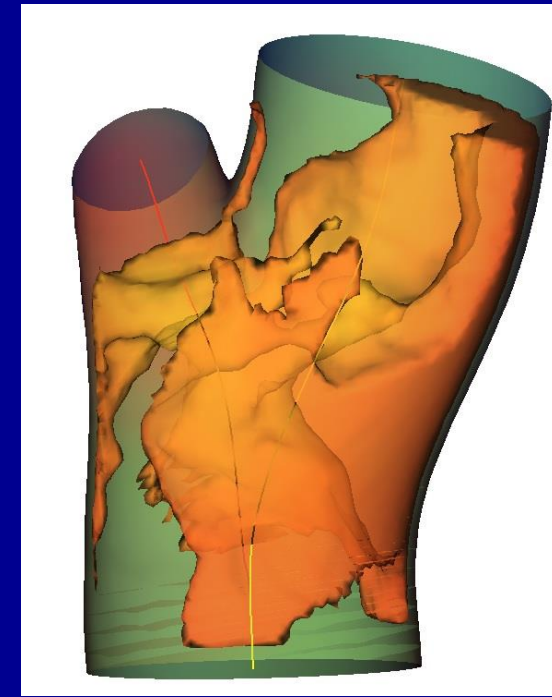
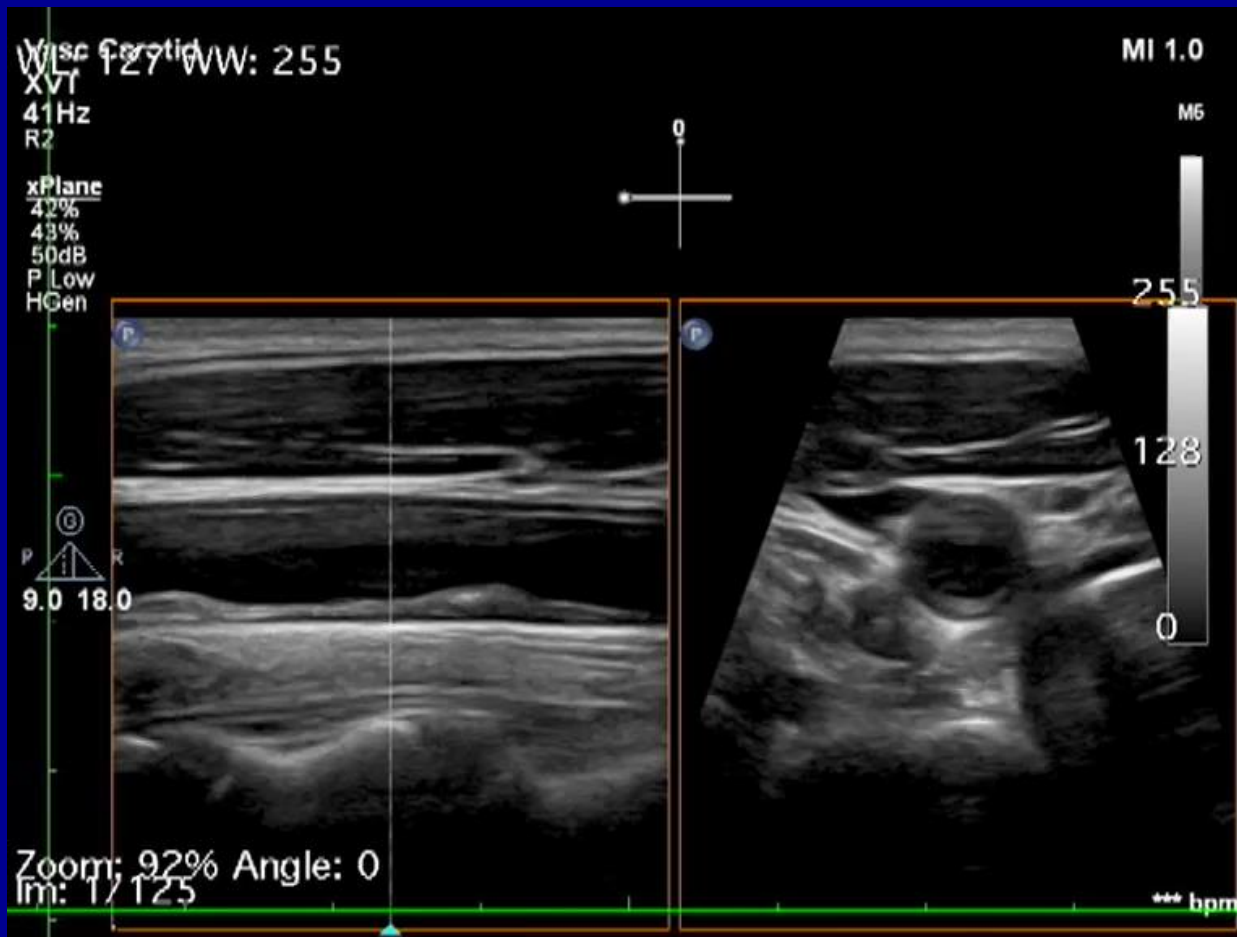


Transducer



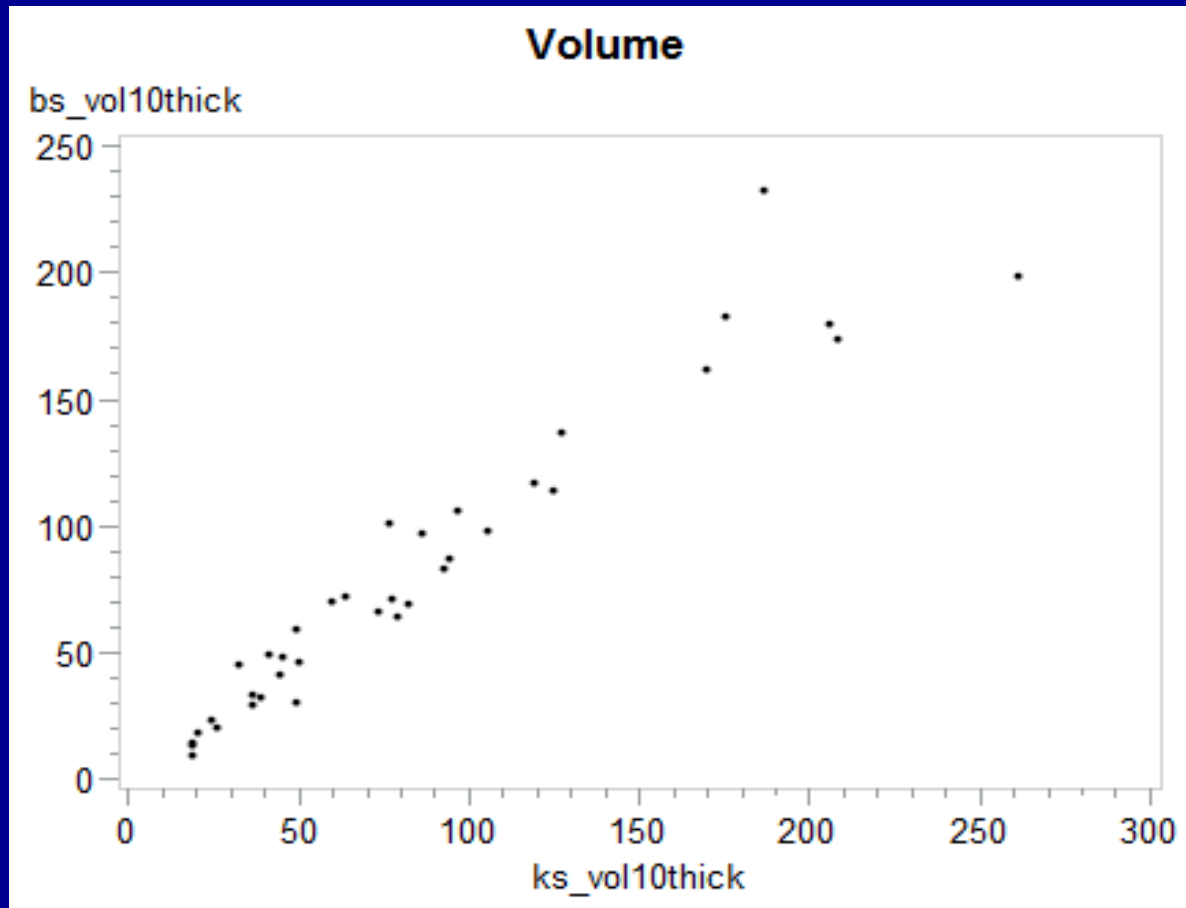
# Will 3D at solve the challenge

- Technology there, however awaiting refinement – high res. matrix transducers – in clinical testing now



# 3D XVT Repro

10mm Slice centered on Max Thickness 37 plaques



Sandholdt BS et al, subm.



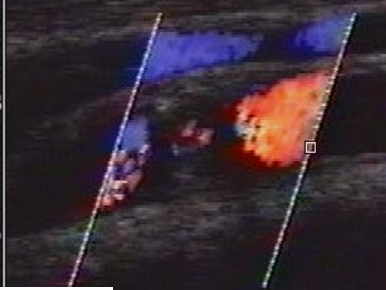
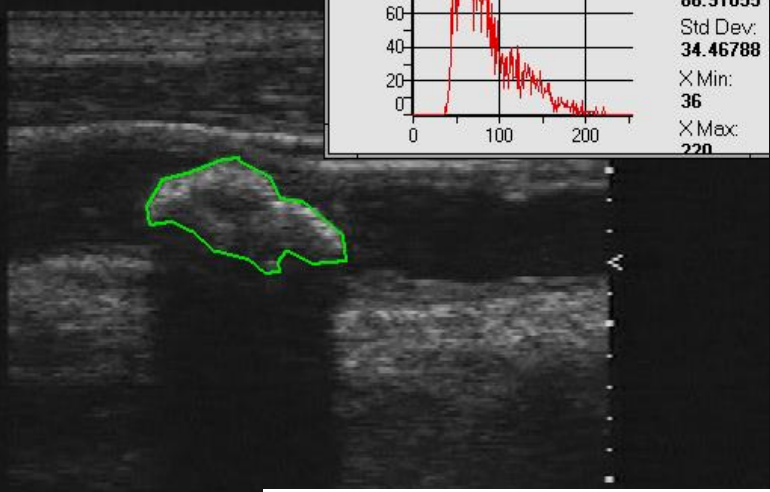
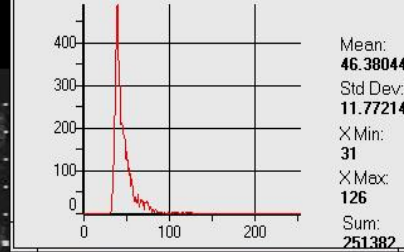
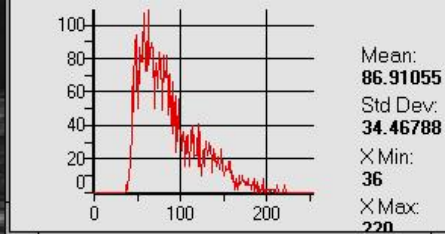
# Ultrasonic Echolucent Carotid Plaques Predict Future Strokes

Marie-Louise M. Grønholdt, MD, PhD; Børge G. Nordestgaard, MD, DMSc;  
Torben V. Schroeder, MD, DMSc; Sissel Vorstrup, MD, DMSc; Henrik Sillesen, MD, DMSc

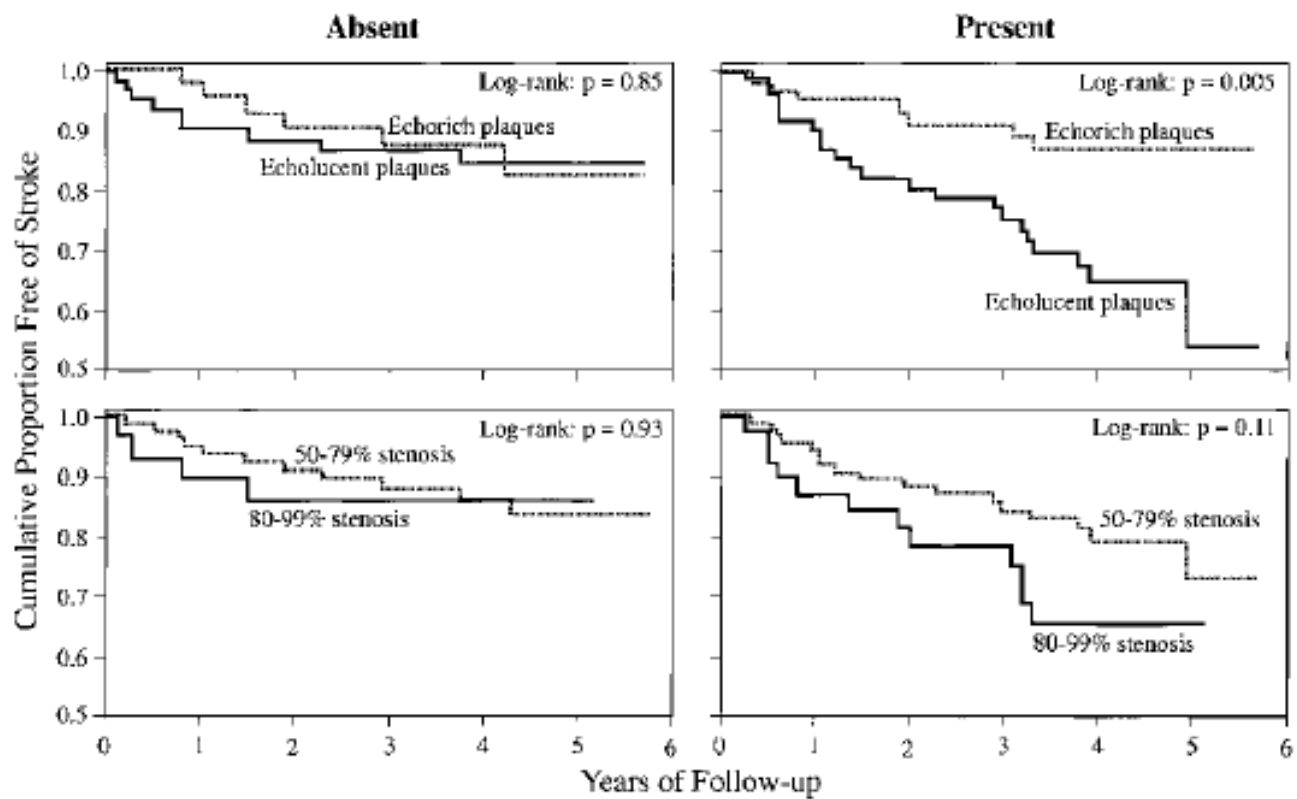
**Background**—We tested prospectively the hypothesis that stroke development can be predicted by echolucency of carotid atherosclerotic plaques in previously symptomatic and asymptomatic patients.

**Methods and Results**—We followed incidence of ipsilateral ischemic strokes for 4.4 years in 111 asymptomatic and 135 symptomatic patients with  $\geq 50\%$  relevant carotid artery stenosis. At inclusion, echogenicity of carotid plaques and degree of stenosis were evaluated with high-resolution B-mode ultrasound with computer-assisted image processing and Doppler ultrasound, respectively. We observed 44 ipsilateral ischemic strokes. In symptomatic patients, relative risk of ipsilateral ischemic stroke for echolucent versus echogenic plaques was 3.1 (95% CI, 1.3 to 7.3), whereas for 80% to 99% versus 50% to 79% stenosis, the relative risk was 1.4 (95% CI, 0.7 to 3.0). Relative to symptomatic patients with echogenic 50% to 79% stenotic plaques, those with echogenic 80% to 99% stenotic plaques, echolucent 50% to 79% stenotic plaques, and echolucent 80% to 99% stenotic plaques had relative risks of ipsilateral ischemic strokes of 3.1 (95% CI, 0.7 to 14), 4.2 (95% CI, 1.2 to 15), and 7.9 (95% CI, 2.1 to 30), equivalent to absolute risk increases of 11%, 18%, and 28%. This was not observed in previously asymptomatic patients.

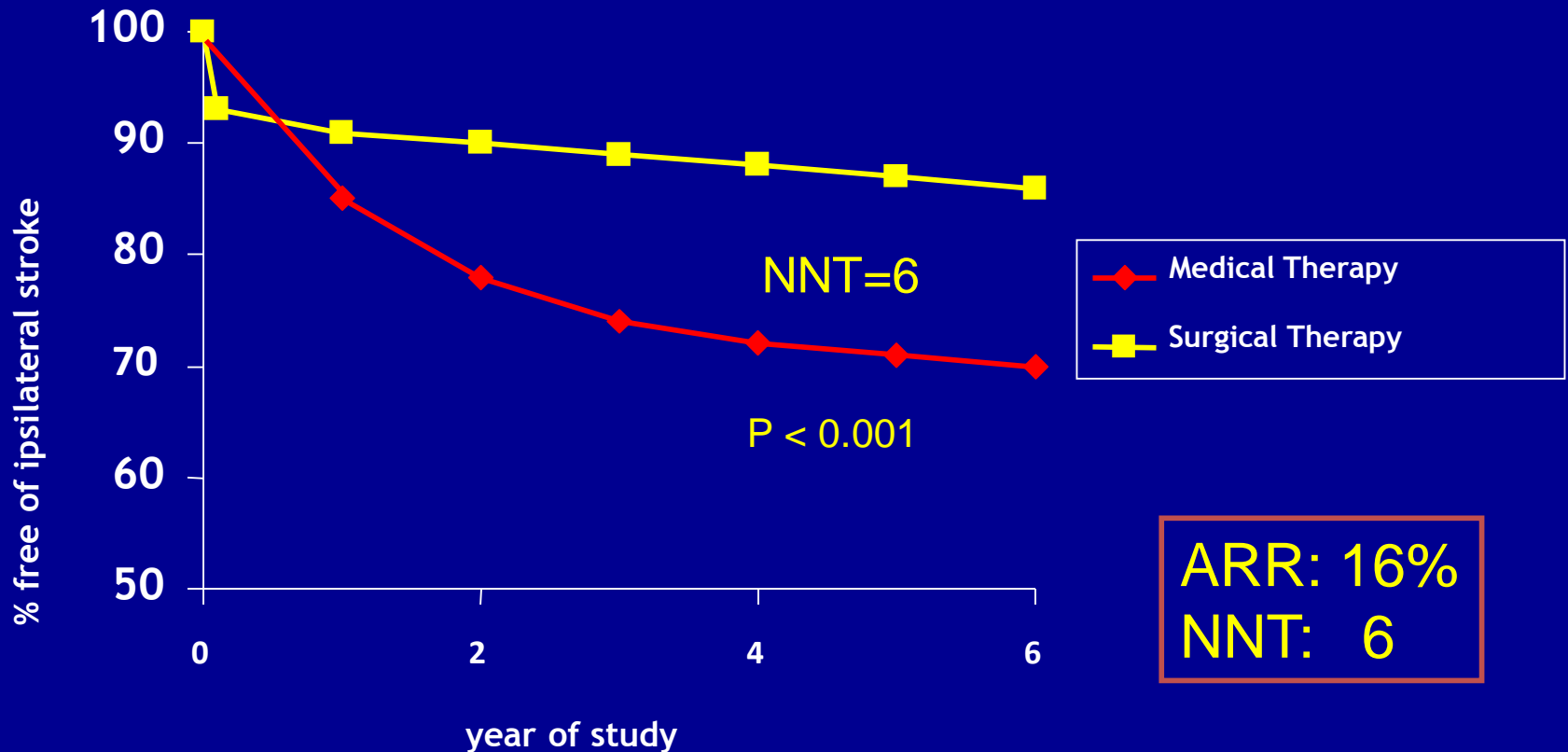
**Conclusions**—Echolucent plaques causing  $\geq 50\%$  diameter stenosis by Doppler ultrasound are associated with risk of future stroke in symptomatic but not asymptomatic individuals. This suggests that measurement of echolucency, together with degree of stenosis, may improve selection of patients for carotid endarterectomy. (*Circulation*. 2001;104:68-73.)



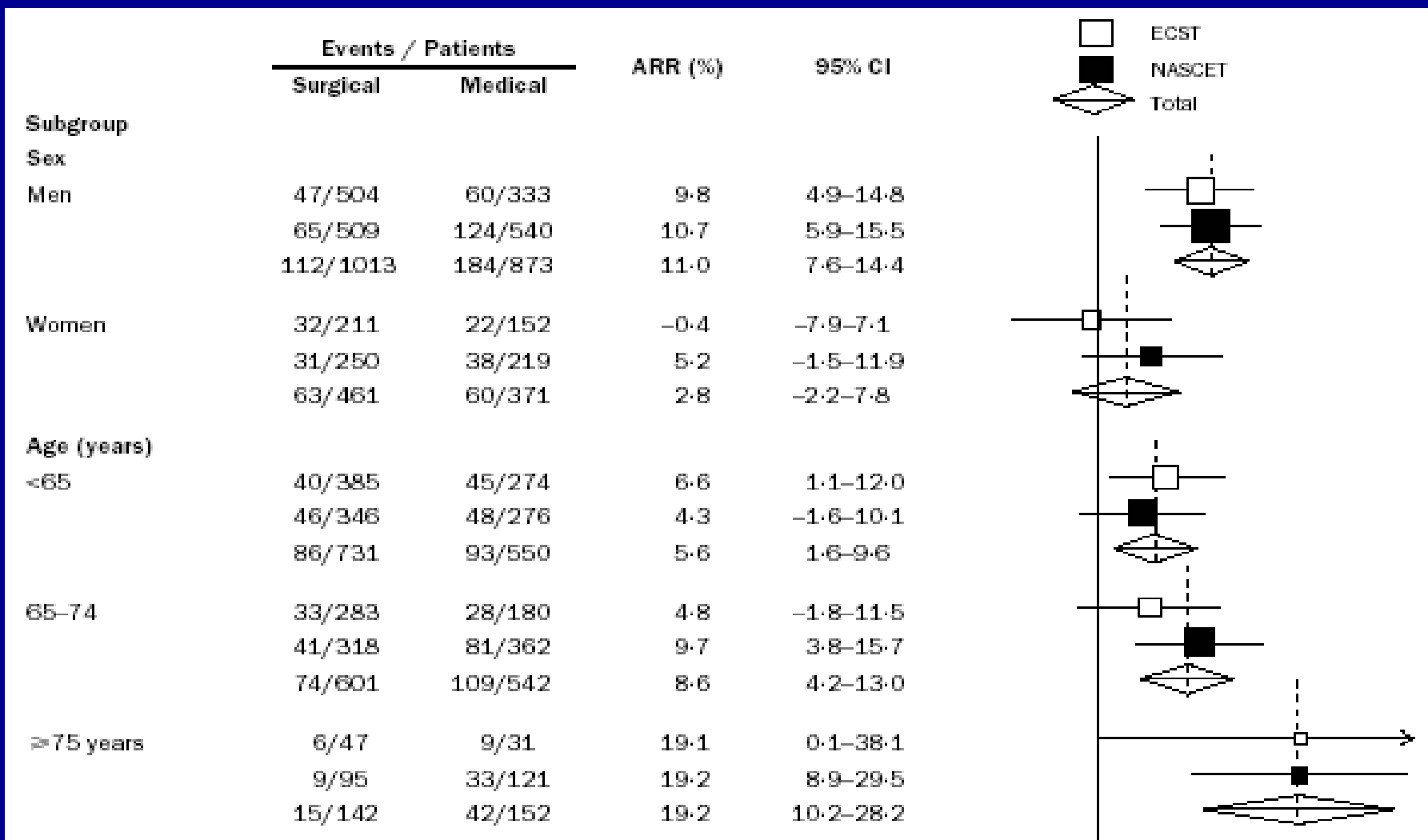
### Previous Focal Neurological Symptoms



# Risk of ipsilateral stroke in symptomatic patients with 70-99% stenosis



# Gender & Age



# Timing of surgery

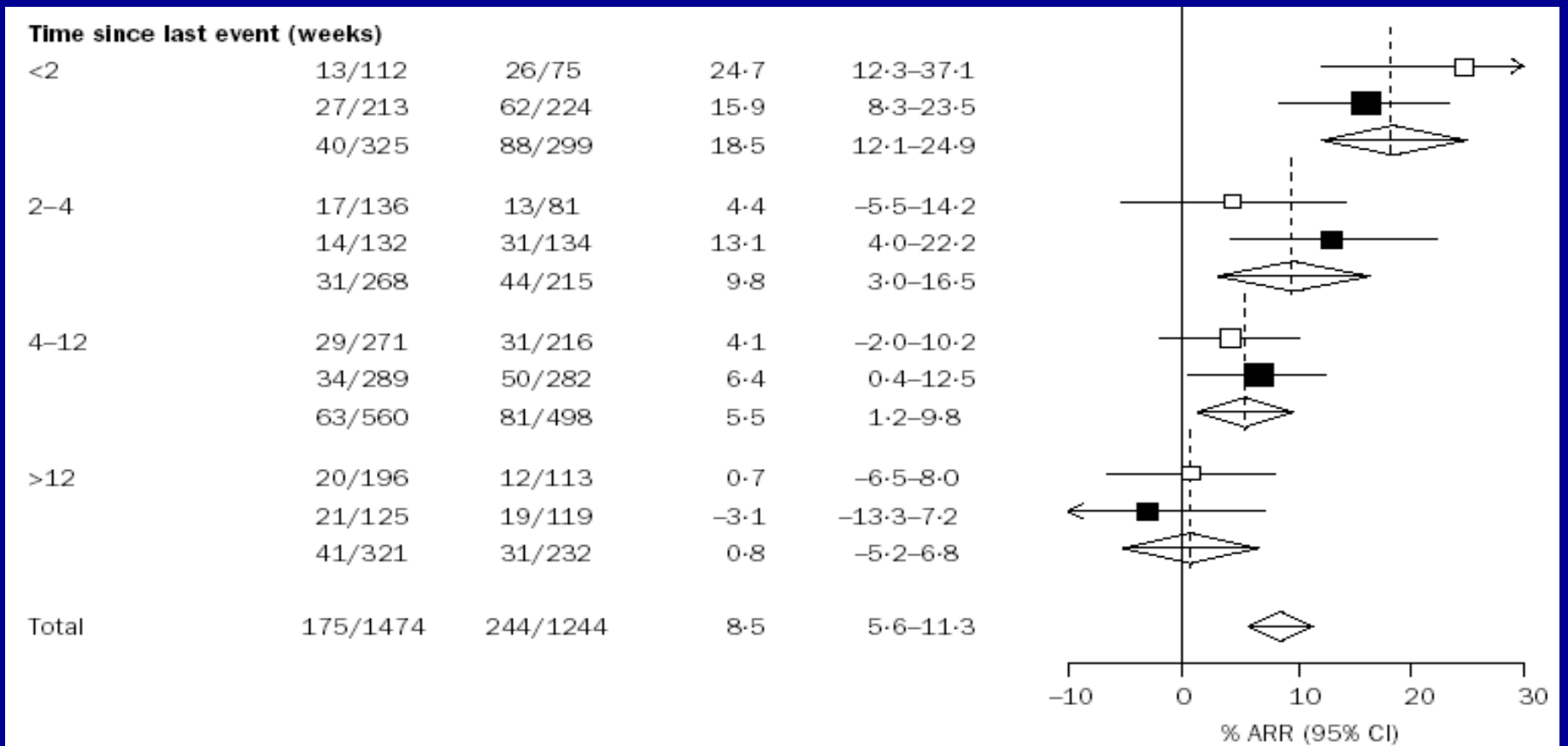
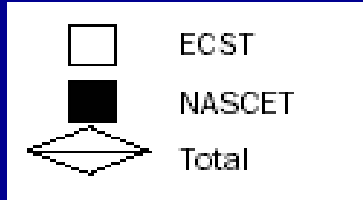
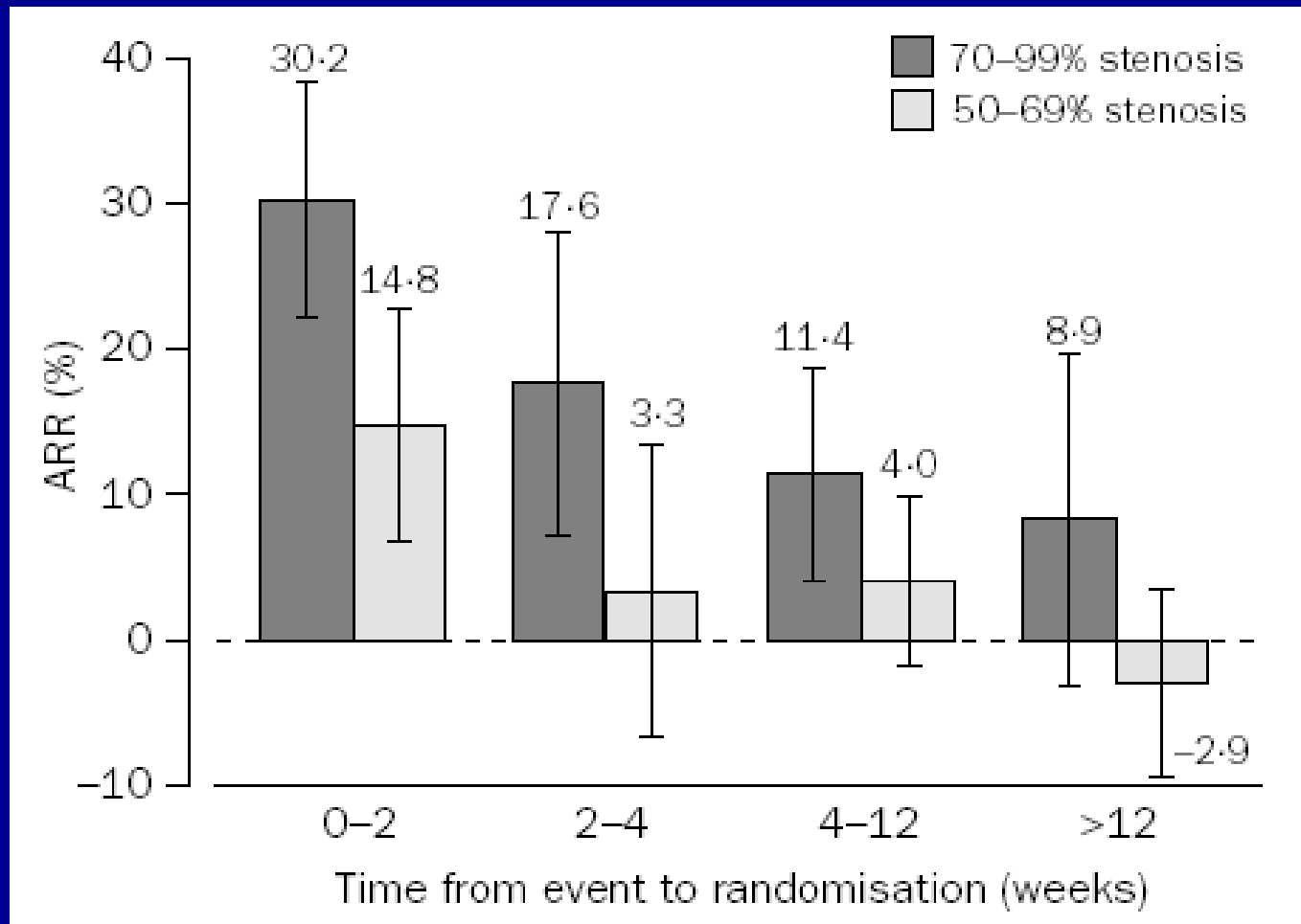


Figure 4: Absolute reduction with surgery in the 5-year cumulative risk of ipsilateral carotid ischaemic stroke and any stroke or death within 30 days after trial surgery according to three variables in patients with  $\geq 50\%$  carotid stenosis in ECST and NASCET

# Effect of “fast” endarterectomy



*P M Rothwell et al., Lancet 2004; 363: 915-24*

# Morphology in symptomatic CS

- Plaque morphology may help select those at high risk among those symptomatic who on average are not at so high risk:
  - moderate stenosis
  - "distant" symptoms
  - younger patients
  - females
- I.e. 50% stenosis in an younger symptomatic person, plaque echolucent!

# Thank you for your attention





# Thank you for your attention

New Home



We do OK despite  
Living in a Socialistic country  
With Communistic healthcare