TCT2009 | TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

In search for predictors of carotid plaque destabilization: Update from the ongoing CRACK–VH* study.

*Carotid arteRy plaque morphology And atherosClerosis biomarkers: Krakow – Virtual Histology study

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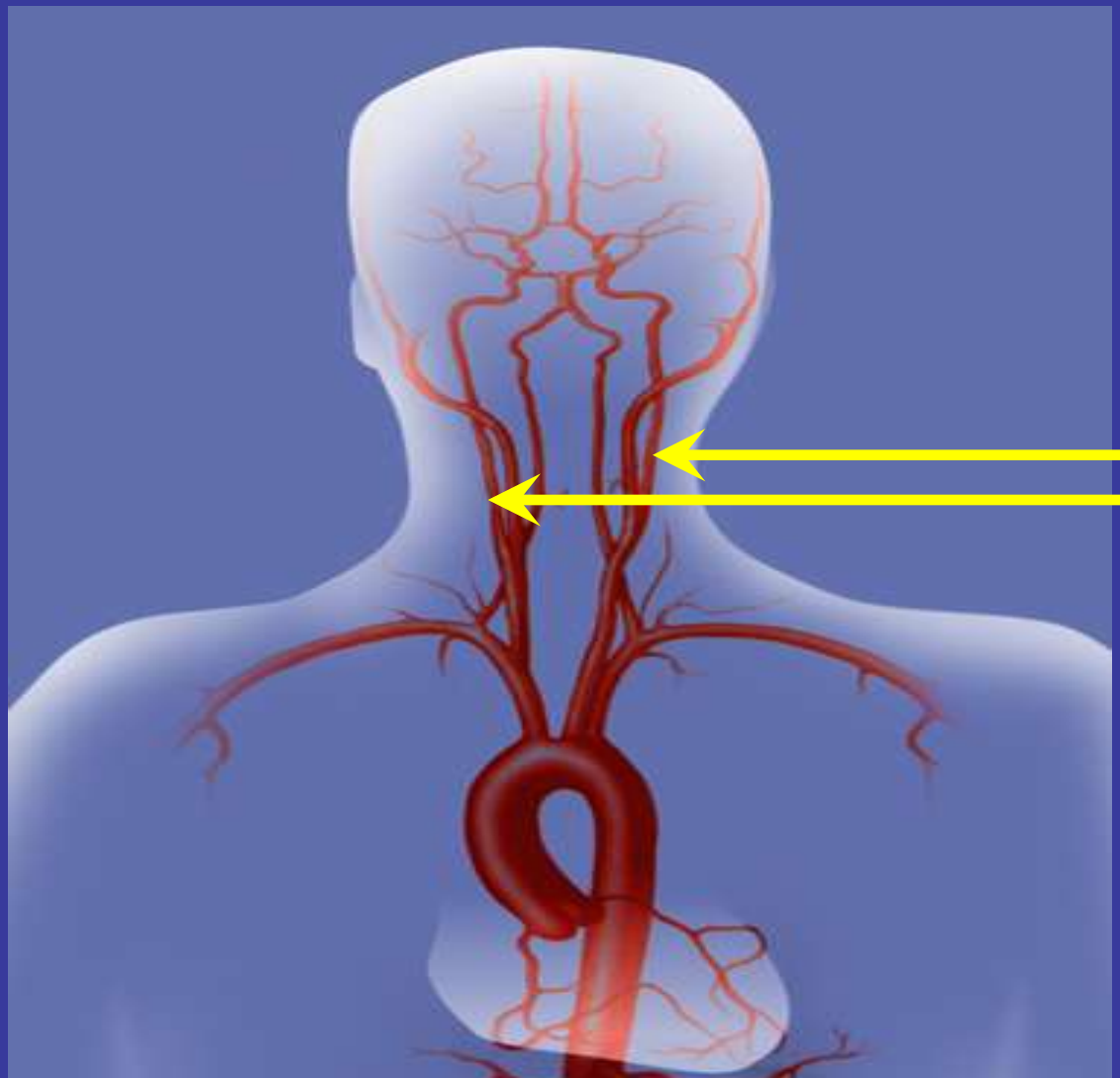
Disclosure Statement of Financial Interest

I, **Piotr Musialek** DO NOT have any financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

Carotid artery stenosis and stroke



~20% strokes

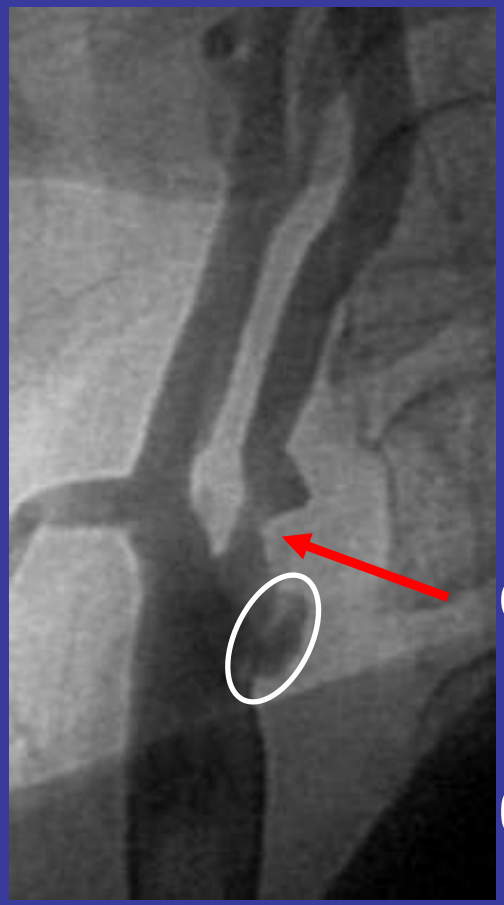
Poland: ~ 12 000 / y

USA: ~ 140 000 / y

The Problem

MZ, 74y, *asymptomatic*
LICA stenosis 85%

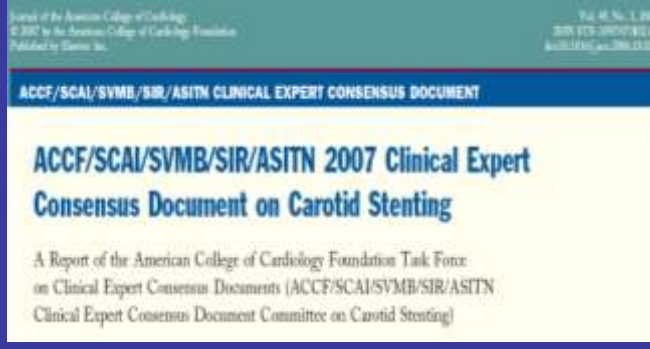
SŻ, 68y, *asymptomatic*
LICA stenosis ~40% + ulcer



QCA 43%

Doppler 0.9/0.35 m/s

Whether –and which of the two– plaques should be treated by mechanical stabilization (CAS) or removal (CEA) ?

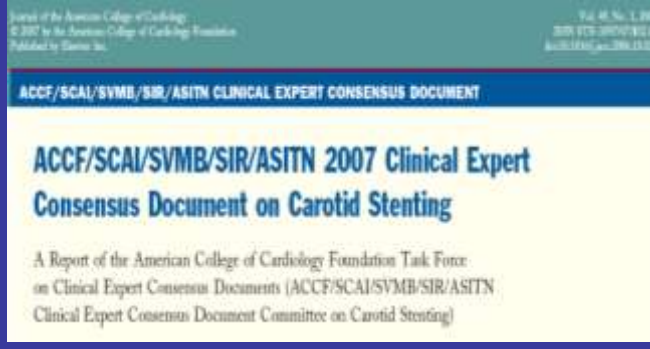


Carotid artery stenosis: Indications to CEA or CAS

- stenosis ≤ 50% ⟶ no indications to CEA / CAS

  (*even if* 'high risk' plaque)
  (*even if symptoms*: TIA/stroke !)

- asymptomatic stenosis < 80% ⟶ no indications to CEA / CAS)
- symptomatic stenosis > 50% ⟶ CEA (or CAS)
- asymptomatic stenosis > 80% ⟶ one may perform CEA (or CAS)



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- symptomatic stenosis > 50% ⟶ CEA (or CAS)

- asymptomatic stenosis > 80% ⟶ one may perform CEA (or CAS)

MZ, 74y, *asymptomatic*
LICA stenosis 85%

indication
to CEA / CAS

SŻ, 65y, *asymptomatic*
LICA stenosis ~40%

no indication
to CEA / CAS

(in both – ‘full’ pharmacotherapy incl. ‘high-dose’ statin, ASA, ACEI)

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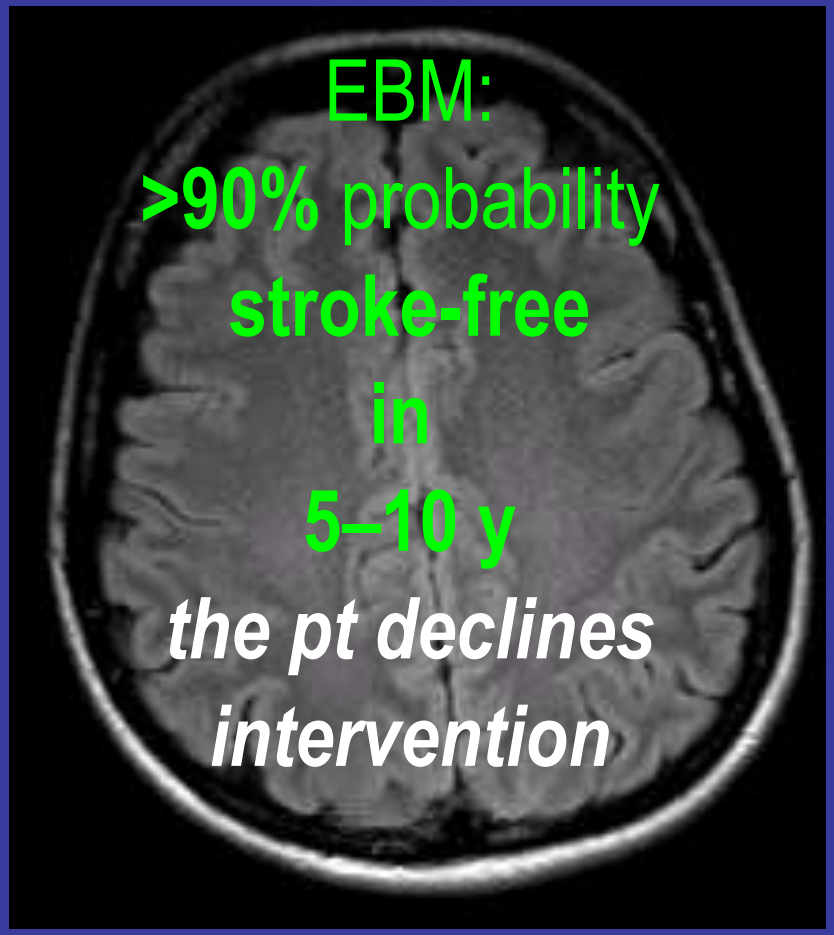

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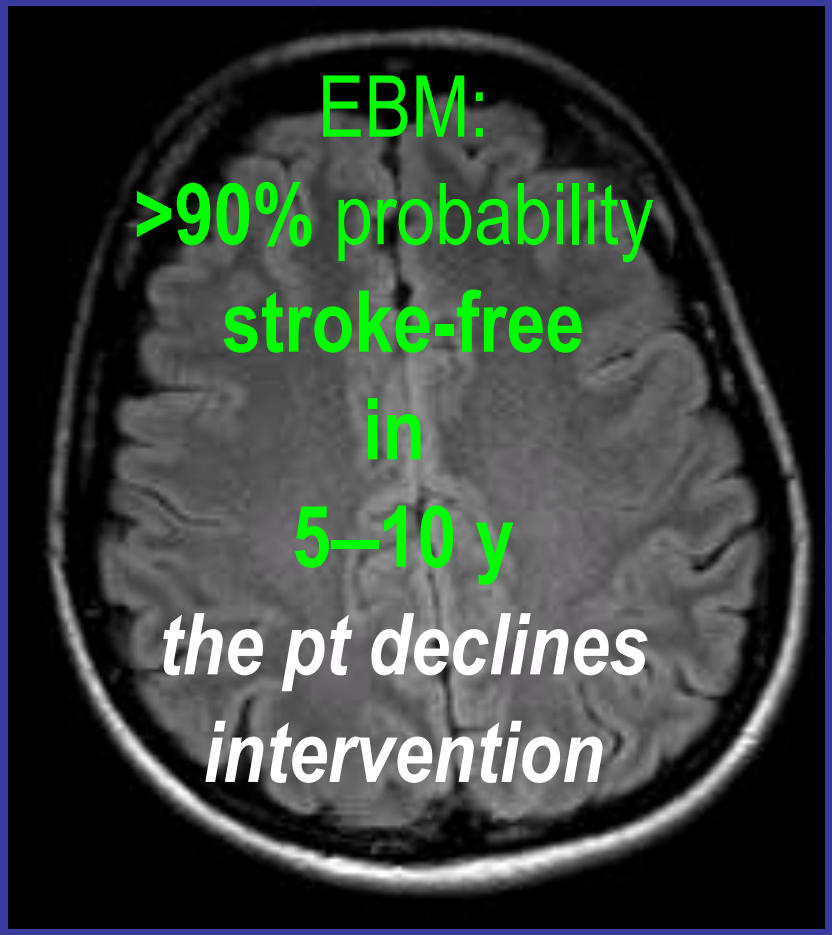

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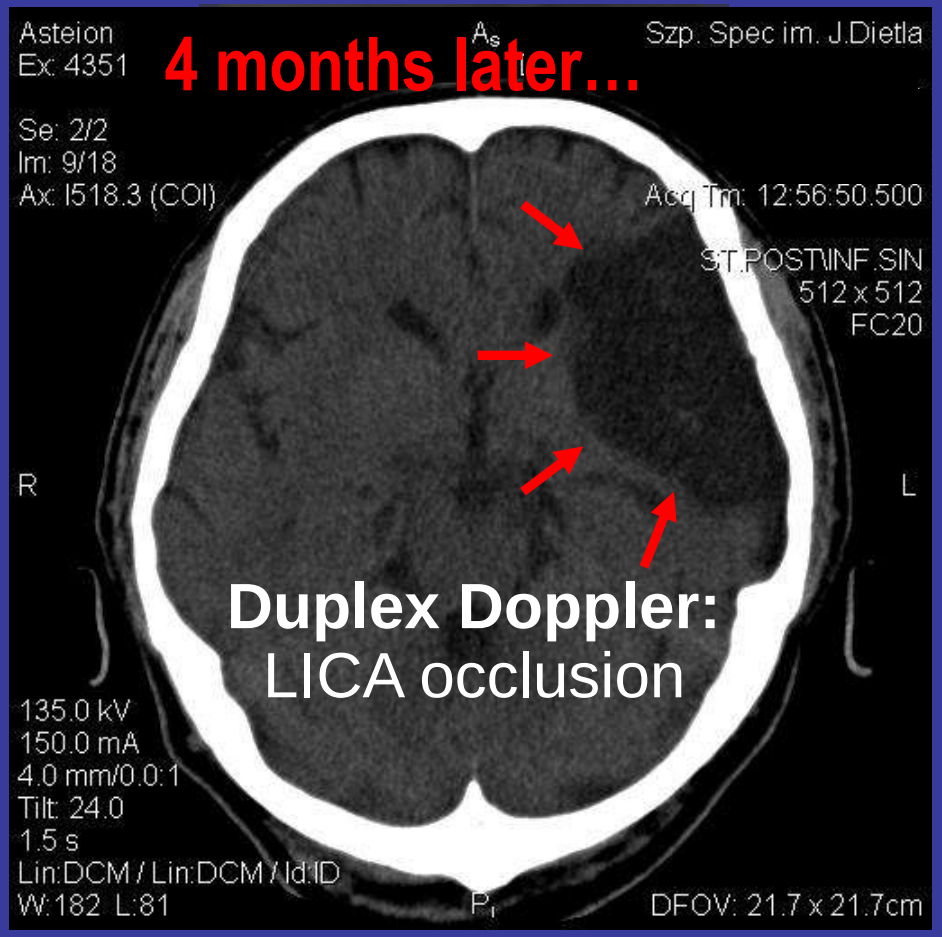
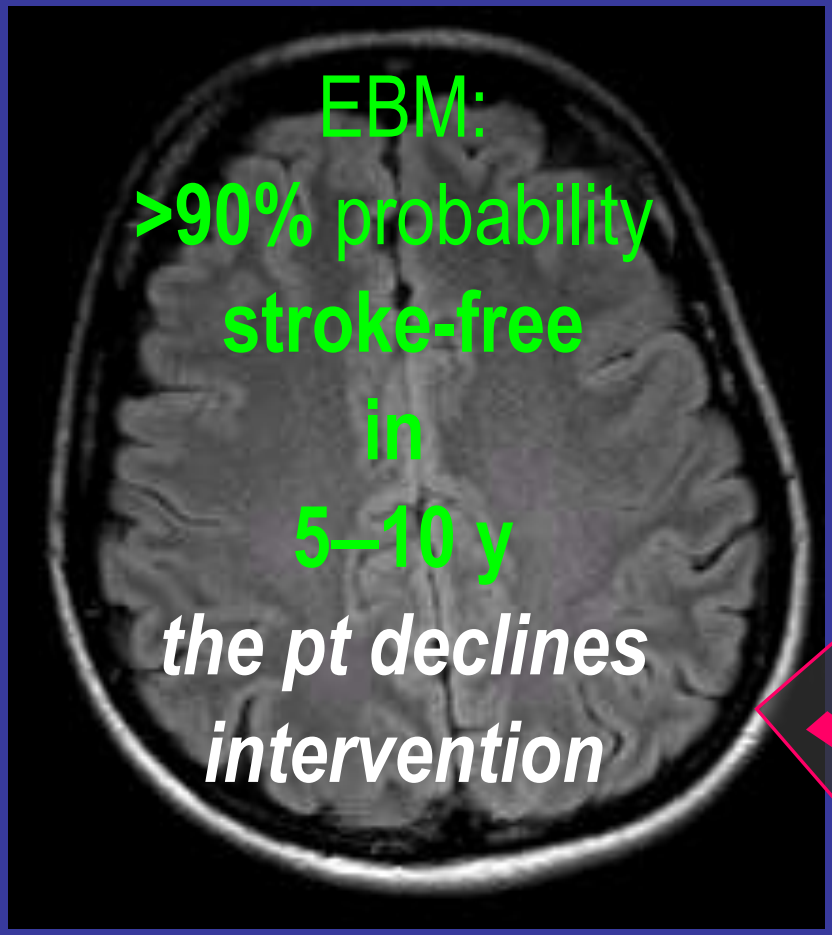


no indication
to CEA / CAS

NIH-SS	**5**
Rankin	**3**
motoric aphasia	**4/5**
right hemiparesis	**3/5**

M.Ł., 74y, *asymptomatic*
LICA stenosis 85%



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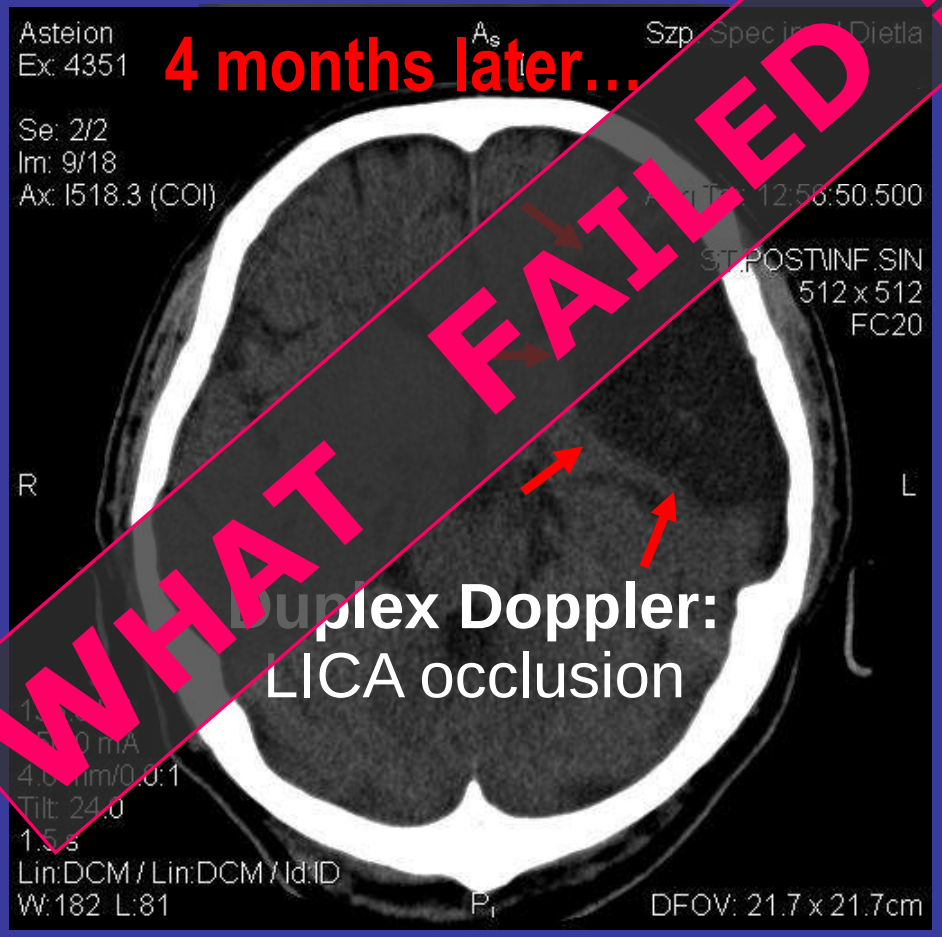


WHAT FAILED ?

Duplex Doppler:
LICA occlusion

no indication
to CEA / CAS

NIH-SS 5
Rankin 3

motoric aphasia 4/5
right hemiparesis 3/5

CRACK-VH

... still in 2009 !

TREATMENT OF CAROTID STENOSIS = TEREATMENT OF STATISTICS

symptomatic > (50)-60%	NNT = 6	complications < 6%
asymptomatic ≥ 80%	NNT = 12 (20-30)	complications < 3%

AHA 2006

... still in 2009 !

TREATMENT OF CAROTID STENOSIS = TEREATMENT OF STATISTICS

symptomatic > (50)-60%	NNT = 6	complications < 6%
asymptomatic ≥ 80%	NNT = 12 (20-30)	complications < 3%

but 80% major strokes occur w/o **ANY** prodromal signs (TIA)

‘The tighter the lesion the higher the risk’ …

‘The tighter the lesion the higher the risk’ …*not necessarily* !

TABLE 2. Relationship Between Severity of Stenosis and Stroke Rate

	Patient Stroke Rate					
Stenosis Severity*	NASCET (2-Year)[11]		ECST (3-Year)[12]		ACAS (3-Year)[13]	
60%–69%	428†	13%	137	11%	131	6%
70%–79%	43	21%	170	9%	94	5%
80%–89%	33	27%	159	21%		NS
90%–99%	24	35%	60	32%		NS
80%–99%	57	31%	219	24%	88	3%

Values given are the ipsilateral stroke rates at the time points stated. NS indicates not stated.
*Definition of stenosis varied.
†For patients with 50%–69% stenosis.[17]

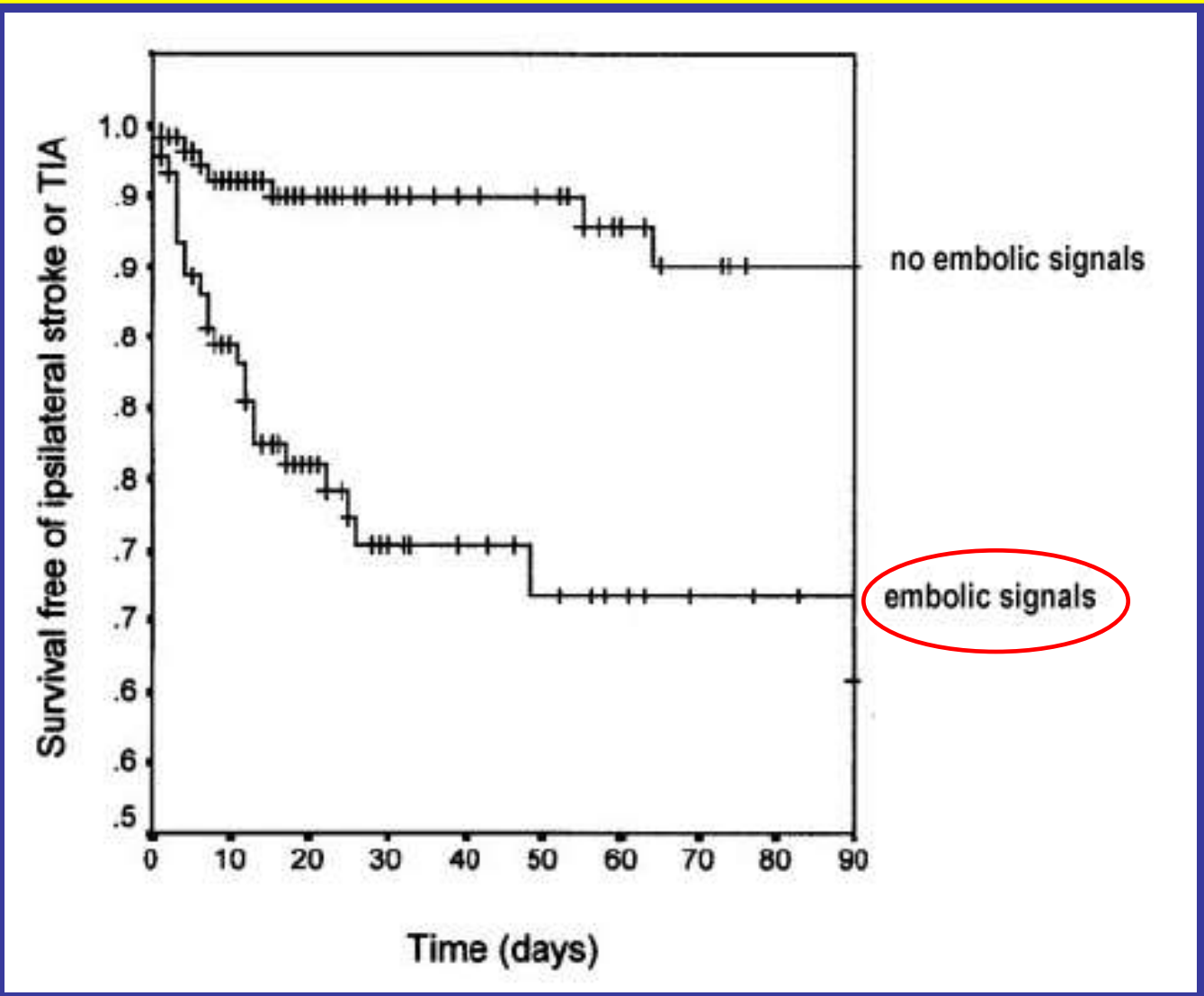
Golledge J, *Stroke* 2000

TABLE 2. Relationship Between Degree of Stenosis and Risk of Stroke With Medical Therapy (Pooled From ACAS and ACST)

Stenosis	60%–69%	70%–79%	≥80%
No. with stroke/total No.	60/774 (7.8%)	40/541 (7.4%)	28/550 (5.1%)

Derdeyn CP, *Stroke* 2007

Asymptomatic embolization from the carotid plaque vs. Stroke risk



H. S. Markus *Stroke* 2005

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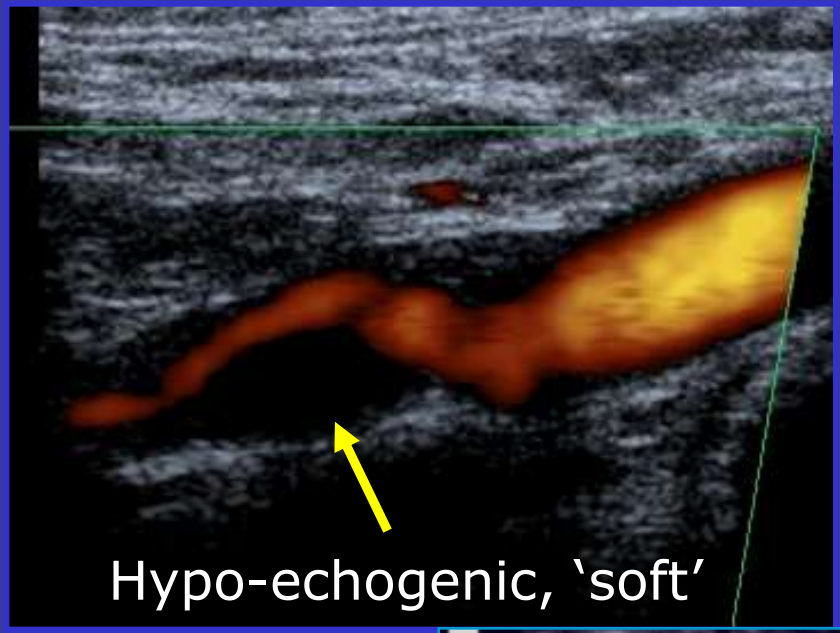
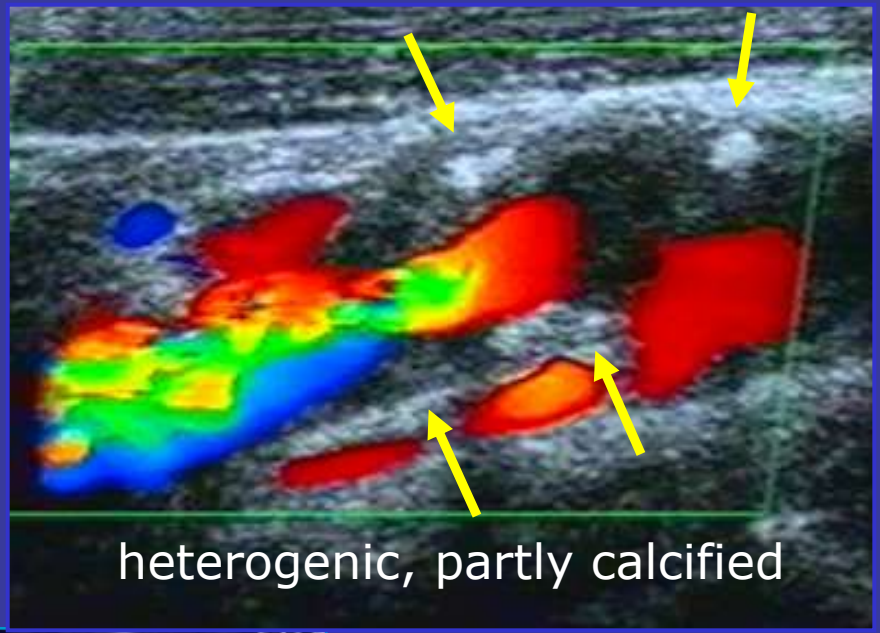
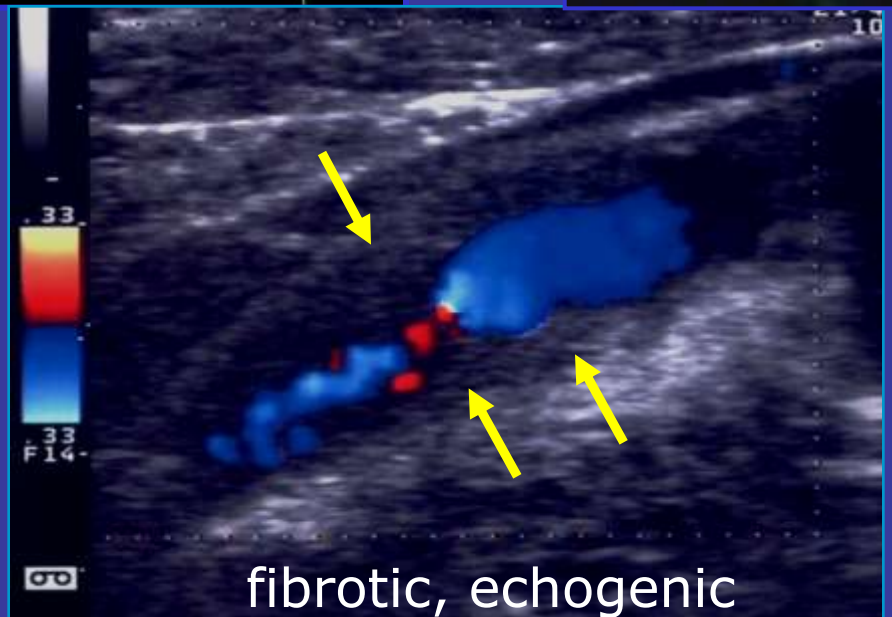
CRACK-VH

Can Duplex Doppler help?







A. Kabłak-Ziembicka, Kraków

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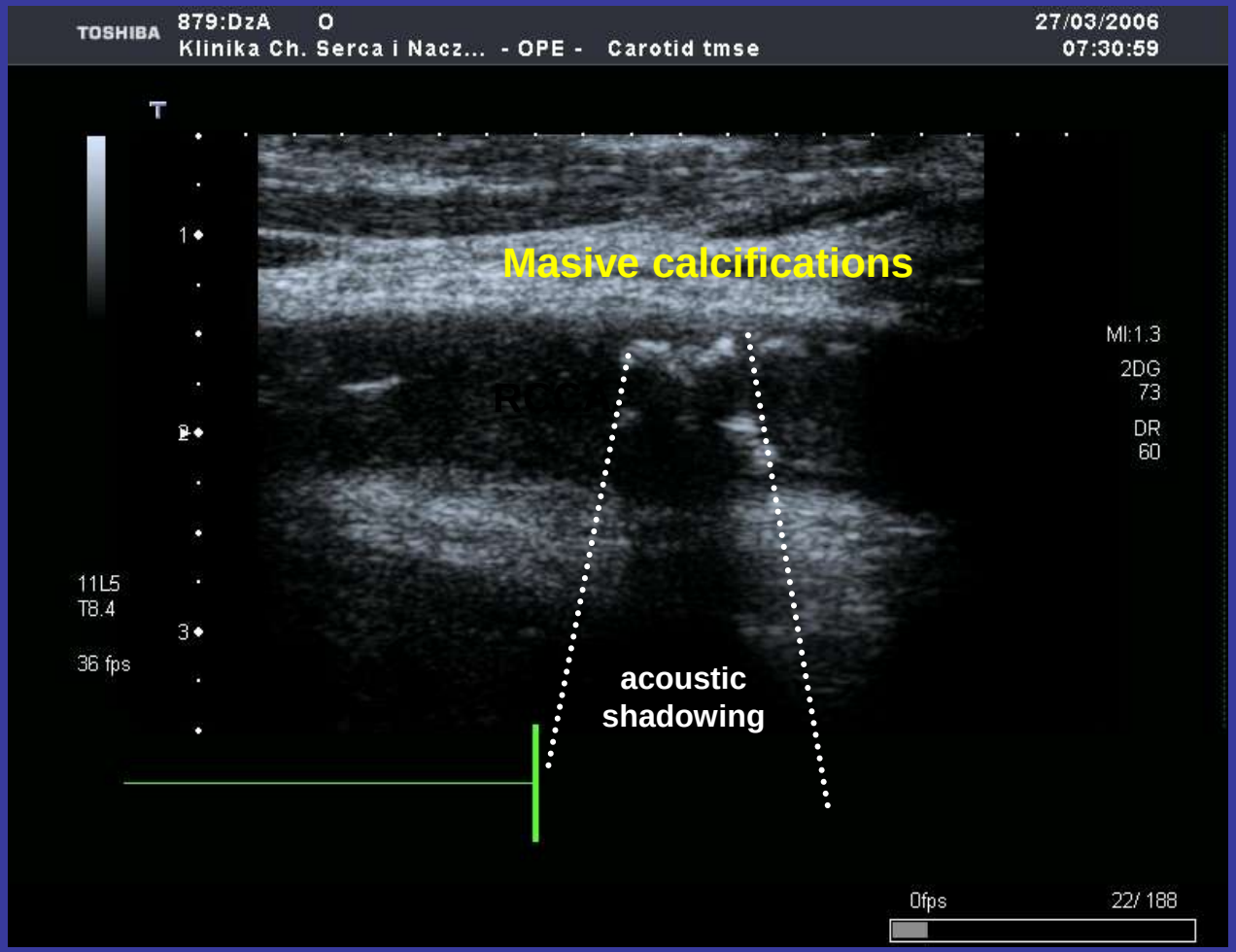
CRACK-VH

Duplex Doppler has limitations



A. Kabłak-Ziembicka,
Kraków

TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

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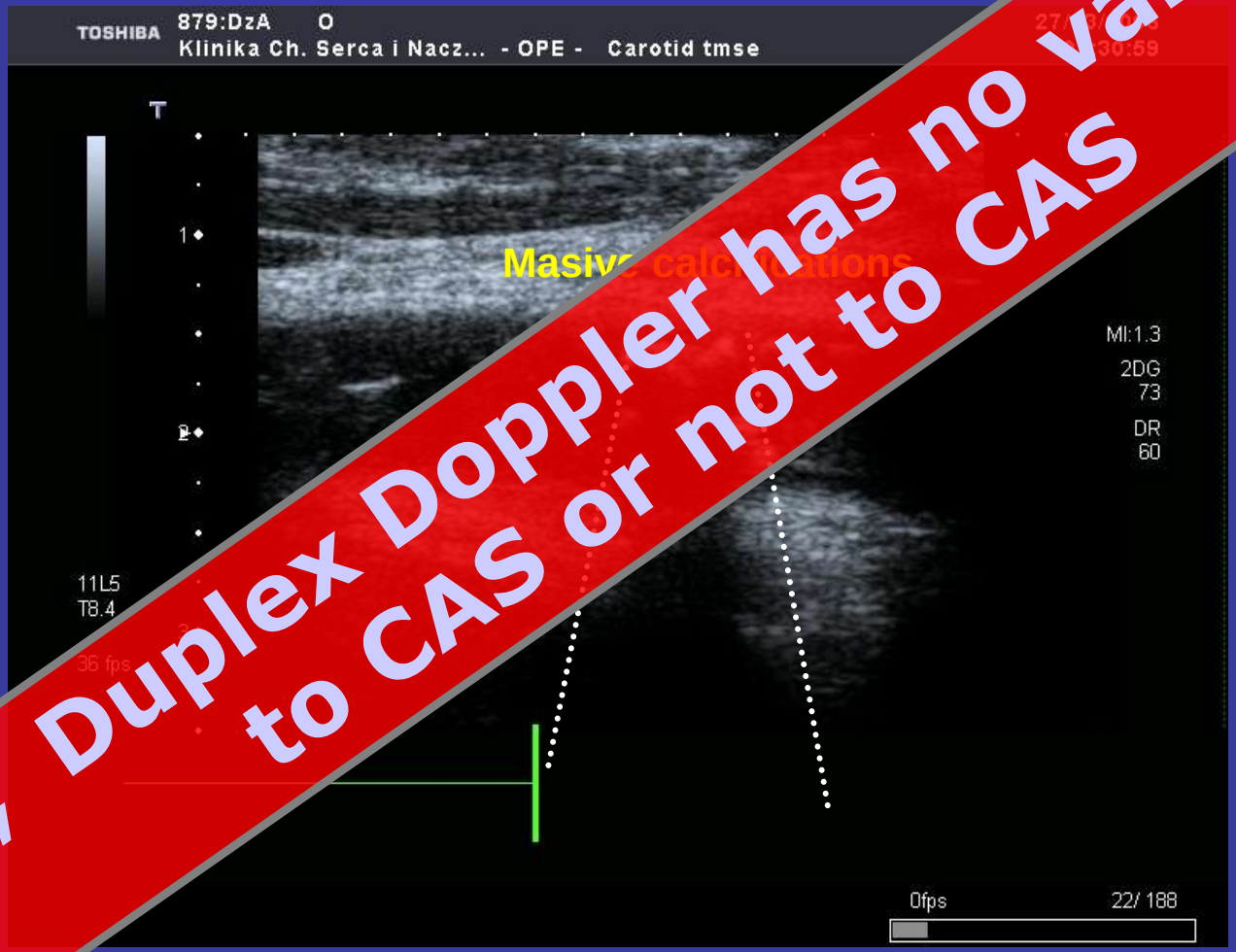


today, Duplex Doppler has no validation to CAS or not to CAS

A. Kabłak-Ziembicka,
Kraków

but Duplex Doppler can help in the selection of EPD and stent type !

J ENDOVASC THER
2008;15:249–262

◆ CLINICAL INVESTIGATION ◆

Carotid Artery Stenting With Patient- and Lesion-Tailored Selection of the Neuroprotection System and Stent Type: Early and 5-Year Results From a Prospective Academic Registry of 535 Consecutive Procedures (TARGET-CAS)

Piotr Pieniazek, MD, PhD[1]; Piotr Musialek, MD, PhD[1]; Anna Kablak-Ziembicka, MD, PhD[1]; Lukasz Tekieli, MD[1]; Rafal Motyl, MD, PhD[2]; Tadeusz Przewlocki, Zbigniew Moczulski, MD[3]; Mieczyslaw Pasowicz, MD, PhD[3]; Andrzej Sokolowski, MD, PhD[4]; Agata Lesniak-Sobelga, MD, PhD Krzysztof Zmudka, MD, PhD[5]; and Wieslawa Tracz, MD, PhD[1]

Departments of [1]Cardiac and Vascular Diseases and [5]Hemodynar Angiocardiography, Jagiellonian University Institute of Cardiolog Centers of [2]Clinical Neurology and [3]Diagnostics and Rehabilitatio Pulmonary Diseases, John Paul II Hospital, Krakow, Poland. [4]Dep Krakow University of Economics, Krakow, Poland.

Purpose: To develop and prospectively evaluate the safety and efficacy of an algorithm for tailoring neuroprotection devices (NPD) and stent types to the patient/lesion in carotid artery stenting (CAS).

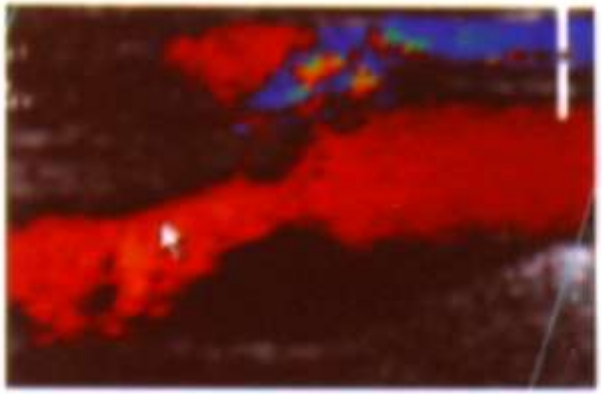
Methods: From November 2002 to October 2007, 499 patients (360 men; mean age 65.2±8.4 years, range 36–88) were prospectively enrolled in a safety and efficacy study of tailored CAS using proximal (flow blockade or reversal) or distal (filters or occlusion) NPDs and closed- or open-cell self-expanding stents. Of the 535 lesions treated in the study, 175 (32.7%) were "high risk" by morphology. Half (50.1%) the patients were symptomatic.

Results: A quarter (137, 25.6%) of the procedures were performed under proximal protection and the remainder (398, 74.4%) with distal NPDs; the direct stenting rate was 66.9%. High-risk lesions were treated predominantly with a proximal NPD and closed-cell stent (77.1% and 82.9%, respectively) and less frequently by direct stenting (37.1%, $p<0.0001$ versus non-high-risk lesions). The in-hospital death/stroke rate was 2.0% (95% CI 0.85% to 3.23%), and the death/major stroke rate was 0.7% (95% CI 0.02% to 1.48%). There were no myocardial infarctions, but there was 1 (0.2%) further death within 30 days. With the tailored approach, symptom status and high-risk lesion morphology were not risk factors for an adverse outcome after CAS; only age >75 years ($p<0.001$) was a predictor of short-term death. Long-term survival (95.4% at 1 and 88.3% at 5 years) was similar for symptomatic versus asymptomatic patients, direct stenting versus predilation, and closed- vs. open-cell stent design; only coronary artery disease adversely impacted survival ($p=0.04$). The rates of freedom from death/ipsilateral stroke were 94.9% at 1 year and 85.9% at 5 years.

Conclusion: Tailored CAS is associated with a low complication rate and high long-term efficacy. CAS operators should have a practical knowledge of different NPDs, including at least one proximal type.

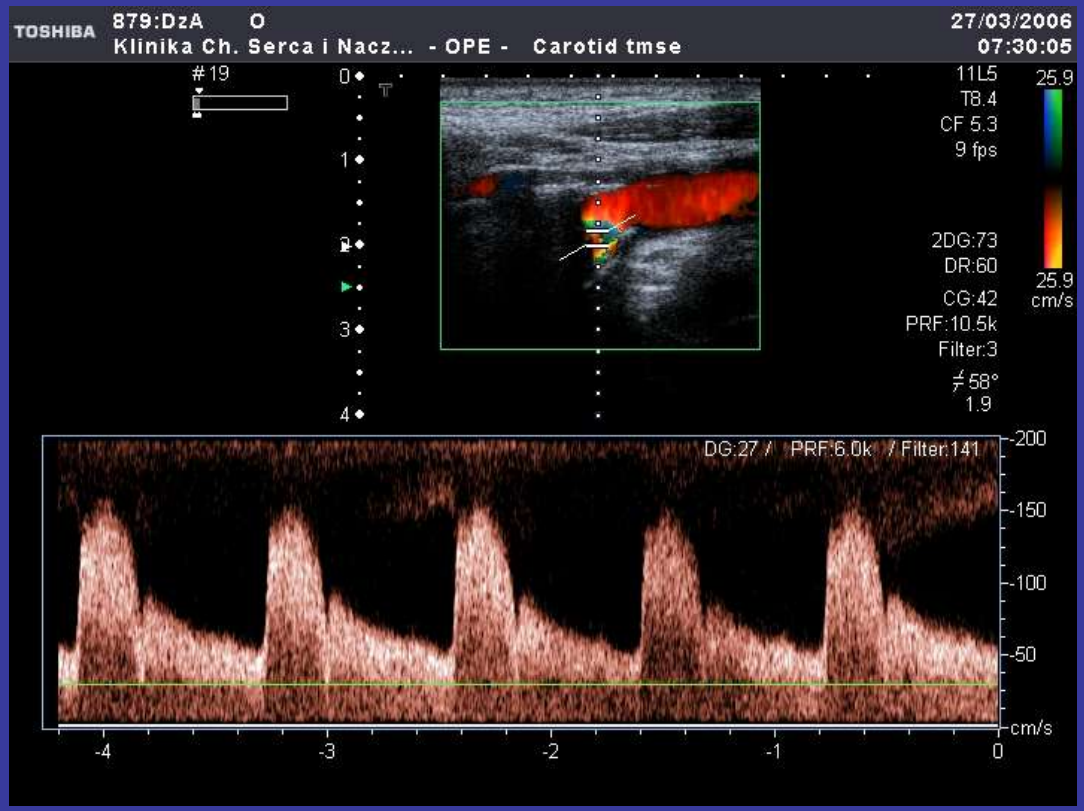
J Endovasc Ther 2008;15:249–262

Carotid plaque on DD and symptom risk

	Homogenic	*Heterogenic*
Hypo- *-echogenic*	Type I (6%) : OR 3.8 	Type II (28%) : OR 4.5 
Hyper- *-echogenic*	Type IV(21%) : OR 1.0 	Type III (45%): OR 3.3 

Nicolaides et al., TCT 2007

Classic ('*gray-scale*') IVUS in border-line carotid lesions



V max **1.6 / 0.54** m/s
indicates
non-significant **RICA stenosis** (***ca.*** **50%**)

[in this patient – recent L hemisph stroke, LICA occluded]

P. Musiałek
P. Pieniazek

EURO PCR06

reduced contrast opacification ('brightening') indicates that plaque burden might be higher...

COMPUTER DEFINED OBSTRUCTION ANALYSIS

RICA

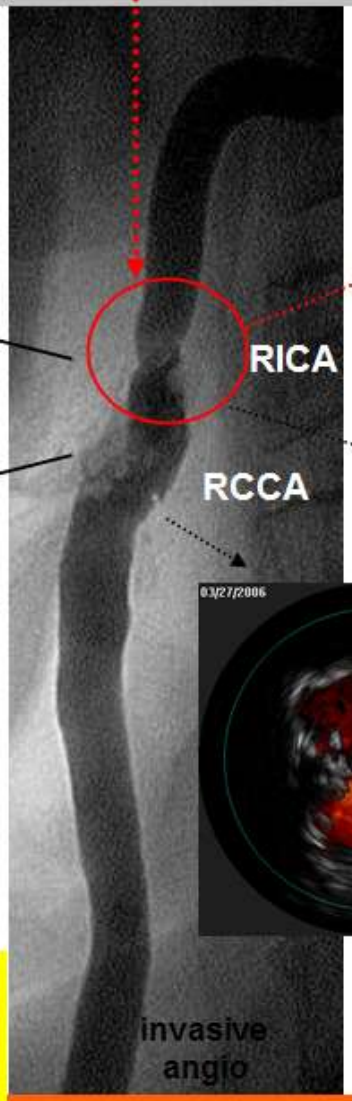
MLD	**3.73**	mm
% diameter stenosis	**30**	%
Reference diameter	**5.31**	mm
Length stenotic segment	**10.20**	mm
Position of proximal border	1.78	mm
MLA densitometry	7.88	mm2
MLA circular	10.93	mm2
% area stenosis densitometry	**64**	%
% area stenosis circular	**51**	%
Reference area	22.18	mm2

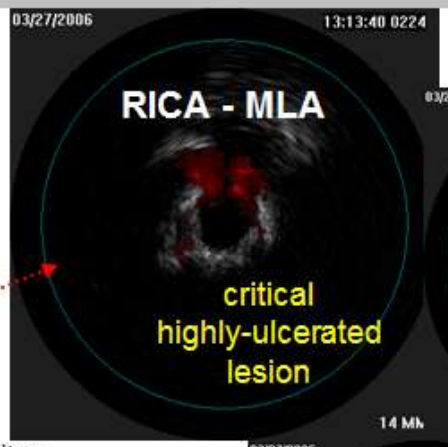
COMPUTER DEFINED OBSTRUCTION ANALYSIS

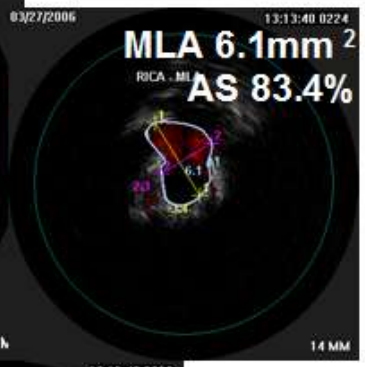
RCCA

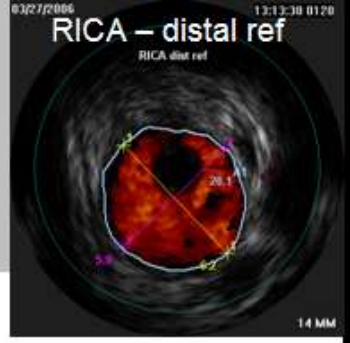
MLD	**4.04**	mm
% diameter stenosis	**32**	%
Reference diameter	**5.98**	mm
Length stenotic segment	**11.32**	mm
Position of proximal border	1.60	mm
MLA densitometry	23.89	mm2
MLA circular	12.83	mm2
% area stenosis densitometry	**15**	%
% area stenosis circular	**54**	%
Reference area	28.10	mm2

QCA

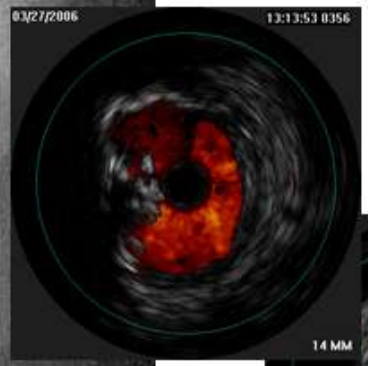


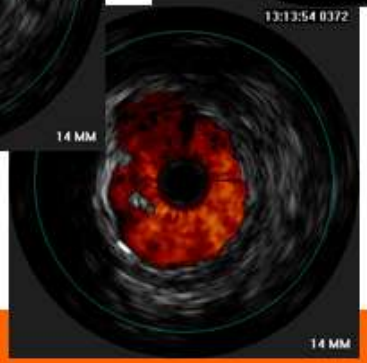


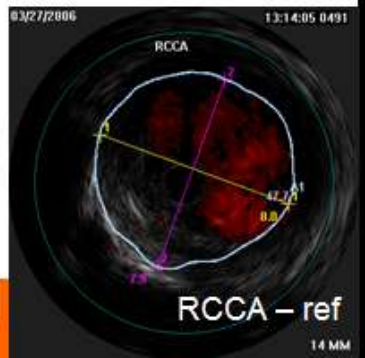




IVUS
(Avanar F/X, Volcano)





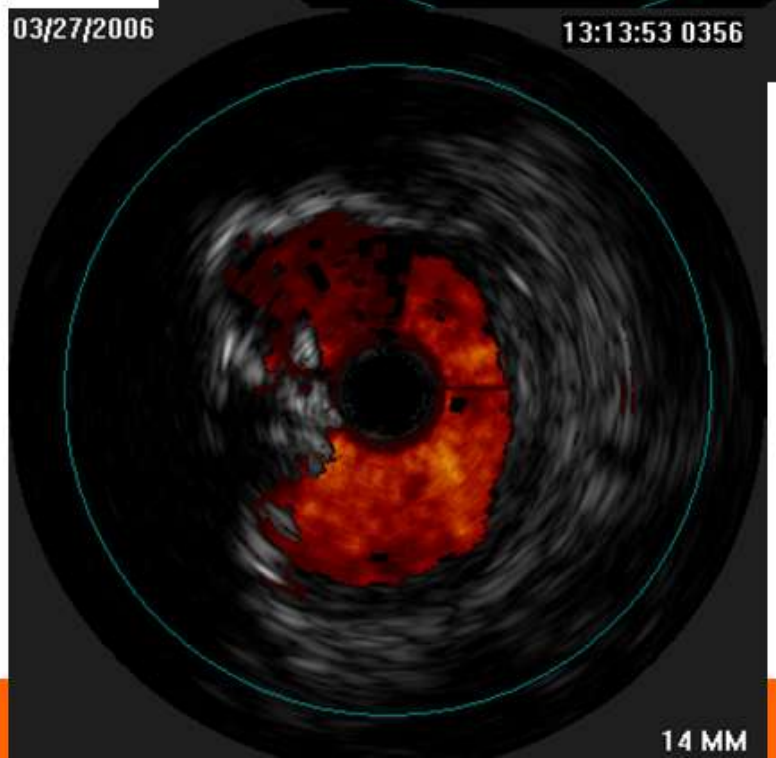


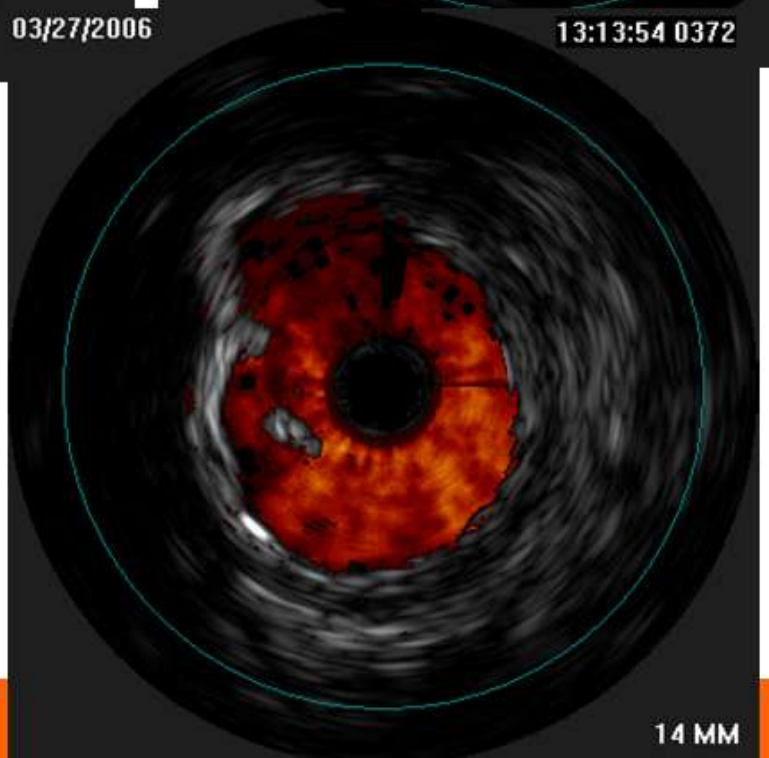
Emboshield-protected CAS performed

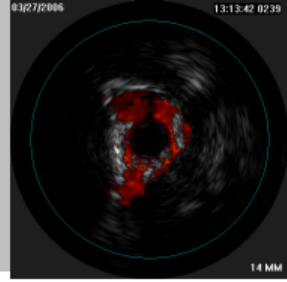
- cutting balloon predilatation
- Carotid Wallstent 7.0 x 30mm

P. Musiałek
P. Pieniazek

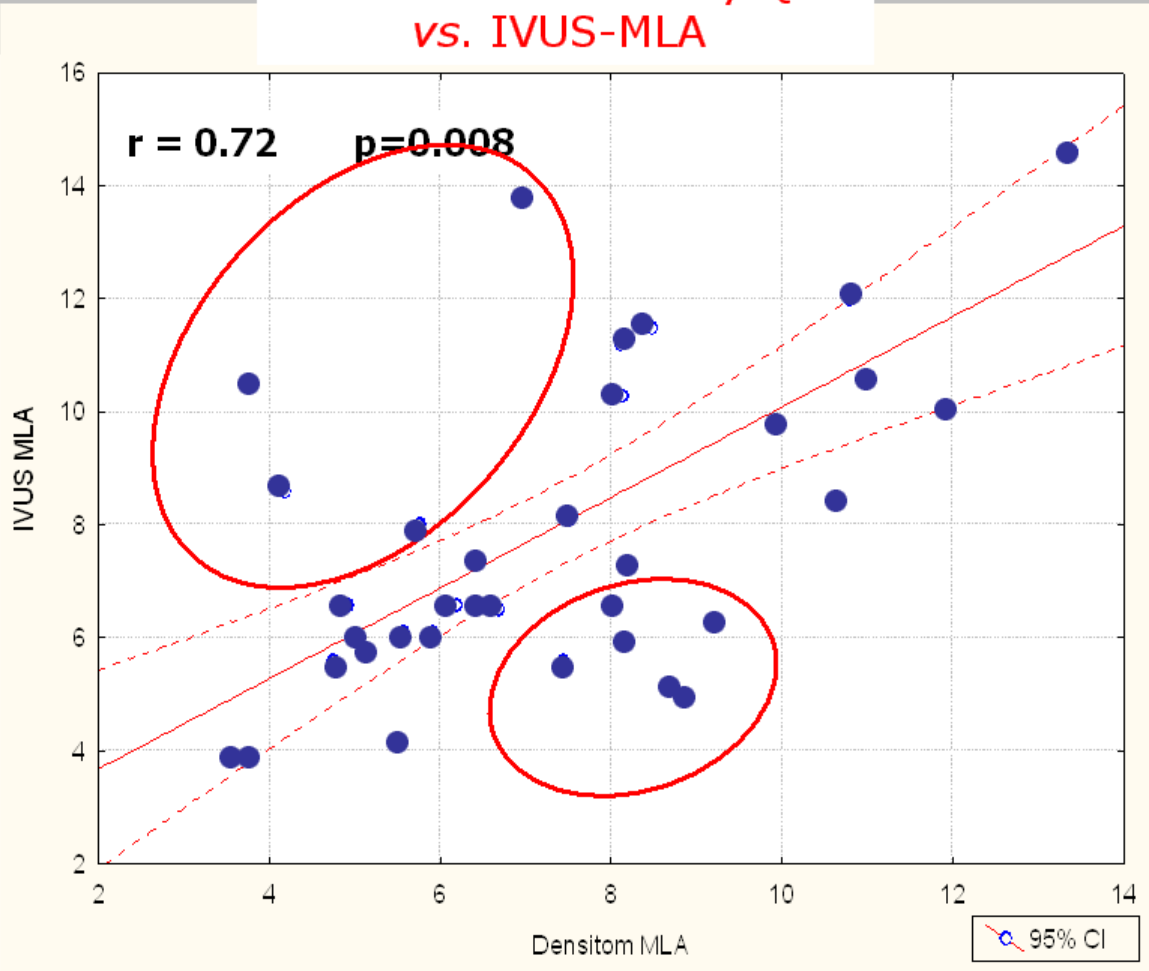
EURO PCR06





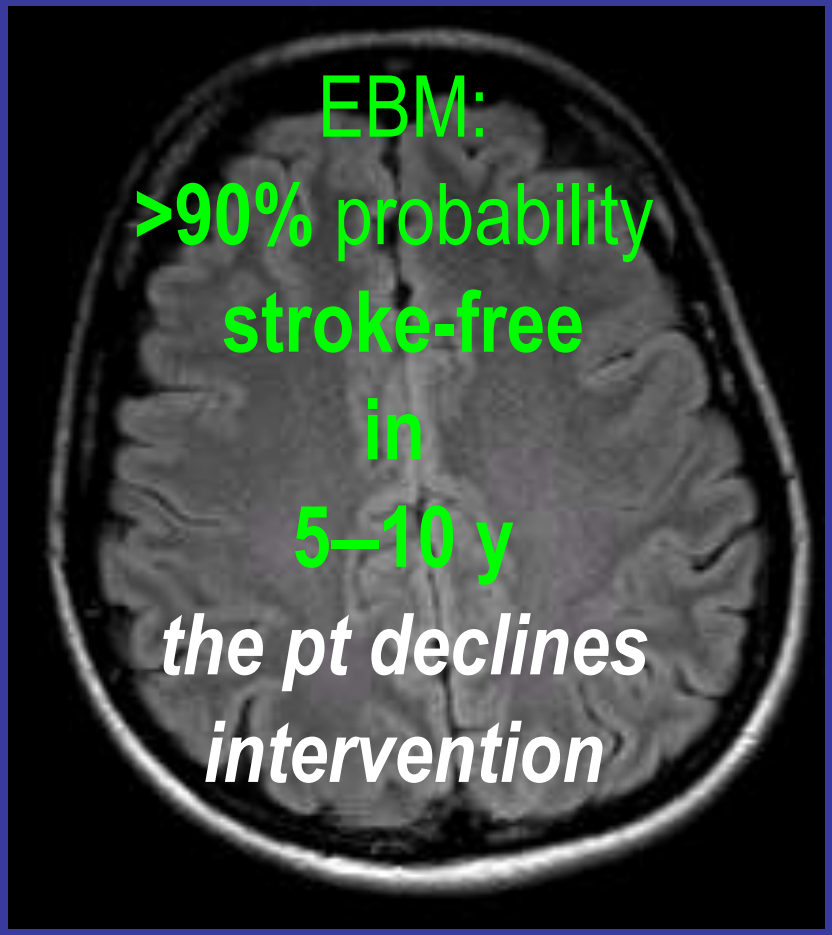


Densitometric MLA by QCA *vs.* IVUS-MLA



–> but densitometric MLA still not accurate enough to replace IVUS in decision-making

MZ, 74y, *asymptomatic*
LICA stenosis 85%



indication
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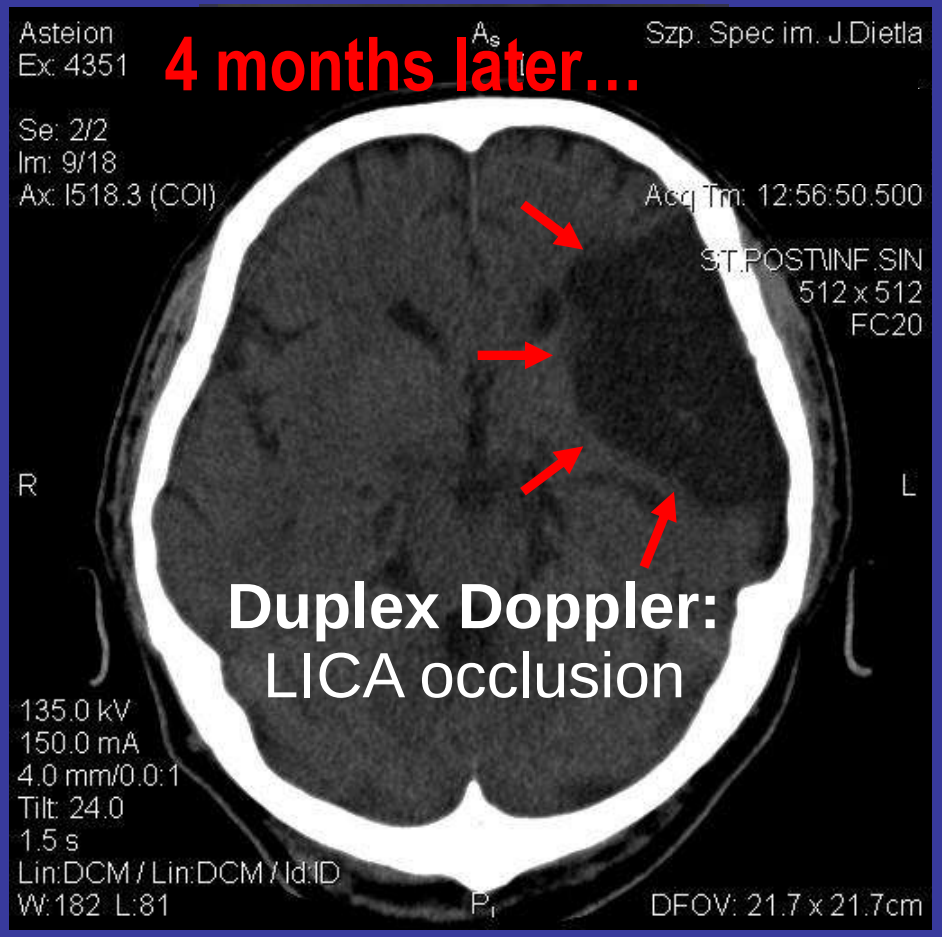

no indication
to CEA / CAS

NIH-SS 5
Rankin 3

motoric aphasia 4/5
right hemiparesis 3/5

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CRACK-VH

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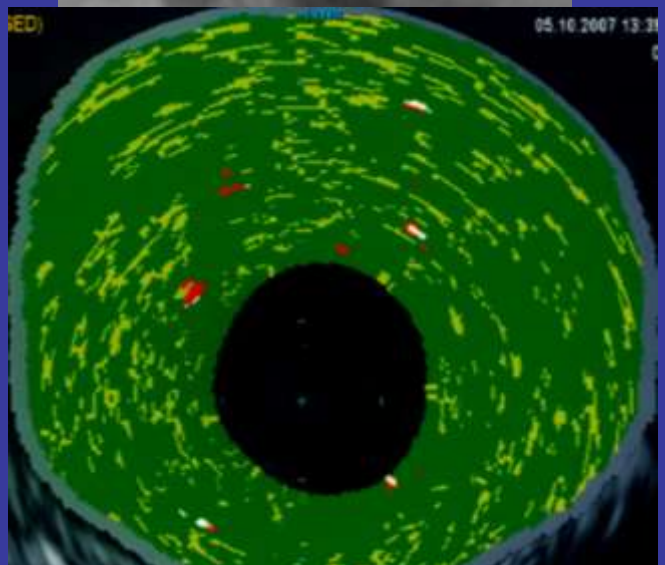

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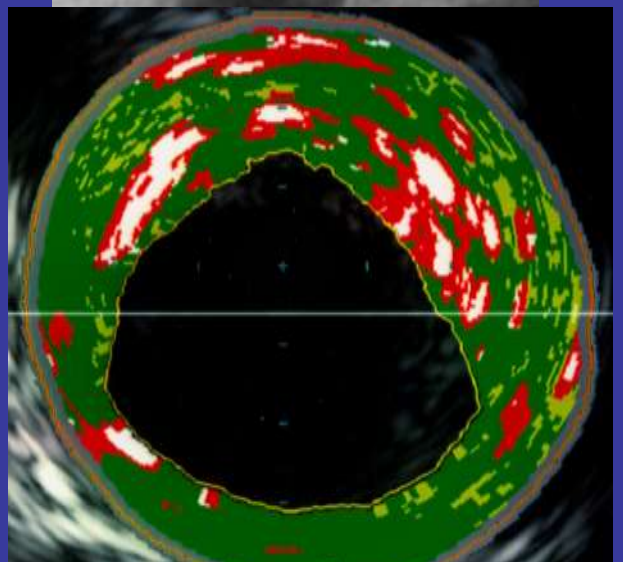
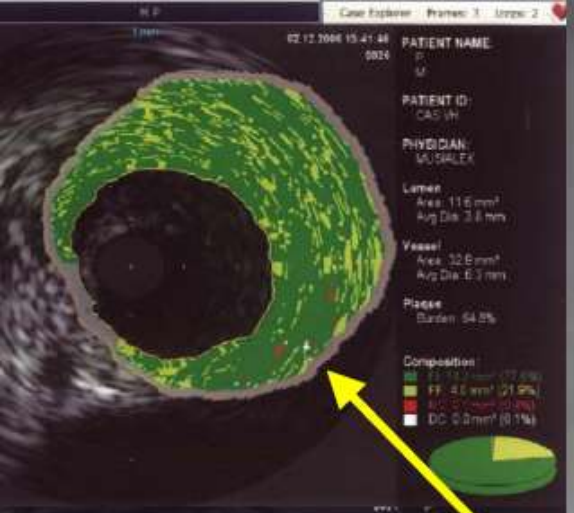


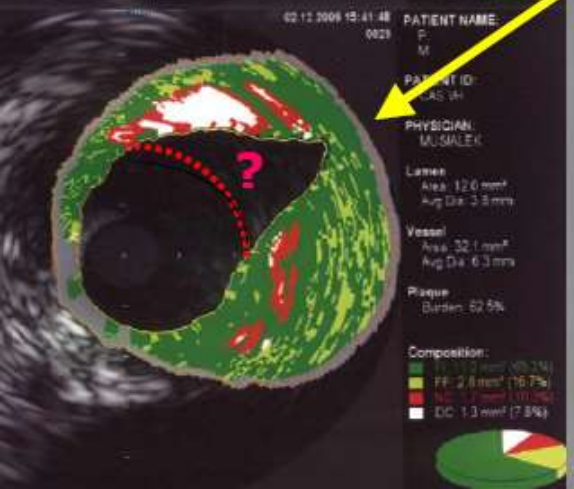
7th Interventional Cardiology Workshop November 30 - December 3, 2006 Kraków, Poland

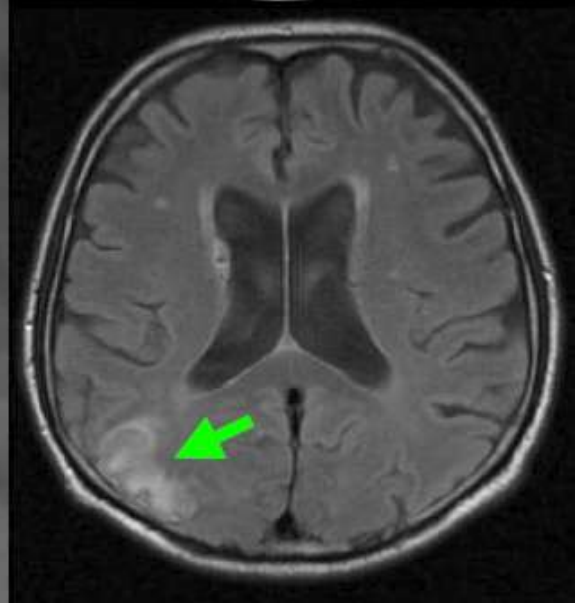
New Frontiers in Interventional Cardiology

LIVE CASE

December 2006







TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

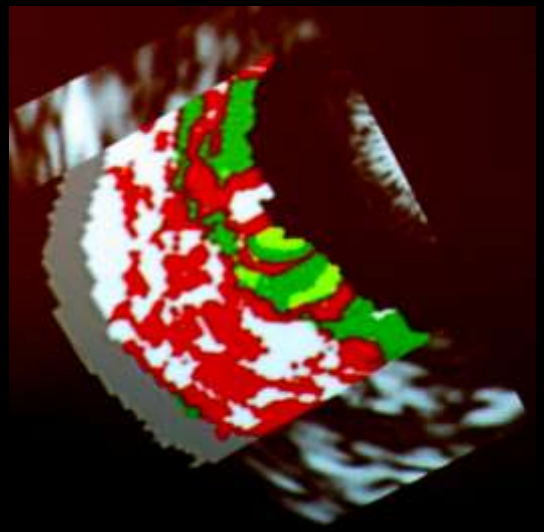
CRACK-VH

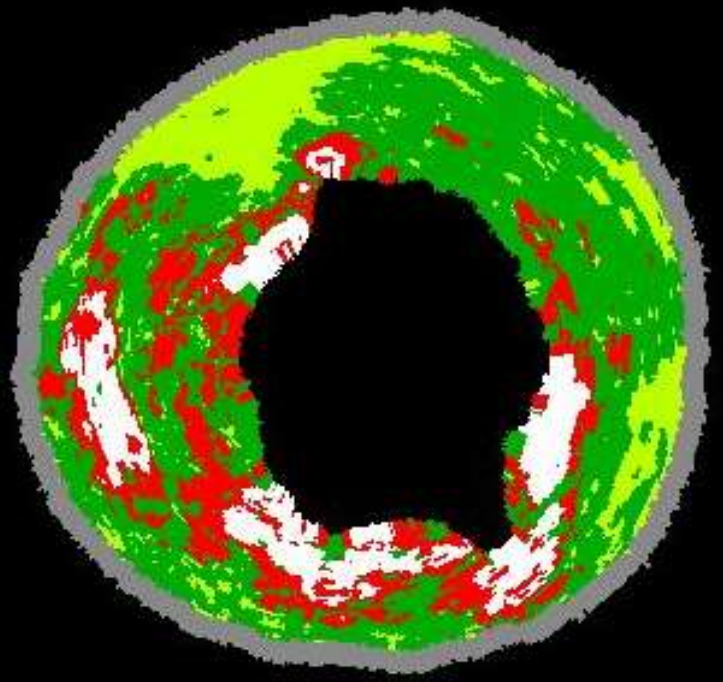
November 2006

COMPUTER DEFINED OBSTRUCTION ANALYSIS

MLD	:	**2.95** mm
% diameter stenosis	:	**51** %
Reference diameter	:	**5.98** mm
Length stenotic segment	:	**7.37** mm
Position of proximal border	:	2.97 mm
MLA densitometry	:	9.63 mm2
MLA circular	:	6.85 mm2
% area stenosis densitometry	:	**70** %
% area stenosis circular	:	**66** %
Reference area	:	22.26 mm2
Volume stenotic segment	:	83.11 mm3
Plaque area	:	10.23 mm2
Plaque volume	:	56.24 mm3

IVUS – Virtual Histology (VH)





- *Calcifications*
- *Fibrotic*
- *Fibro-fatty*
- *Necrotic core*

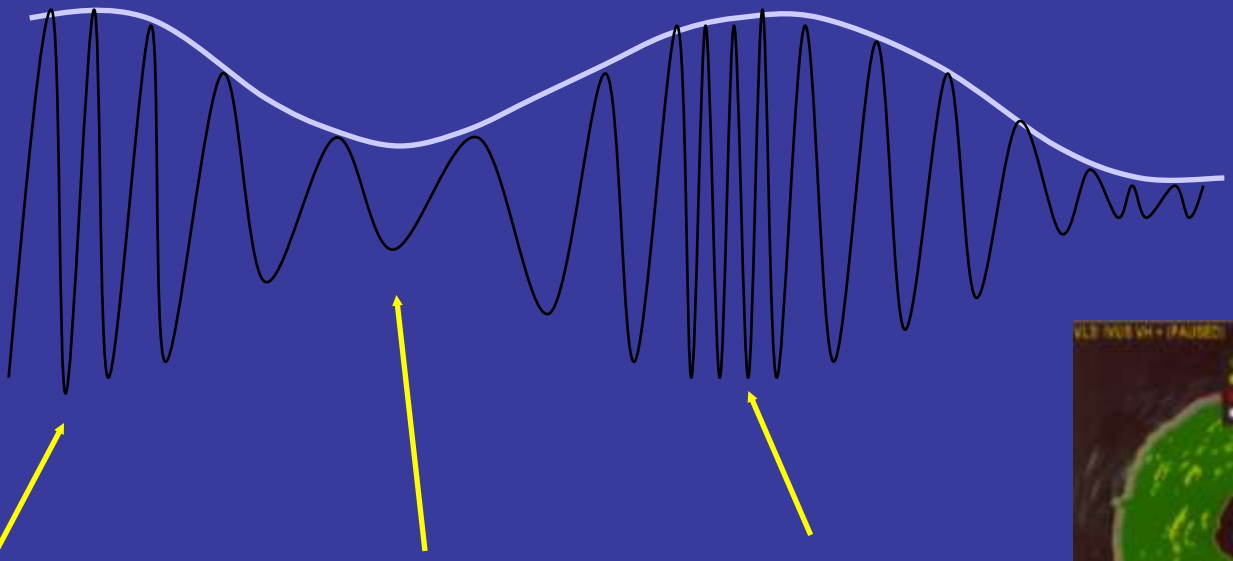
Volcano Corp.

IVUS – VH

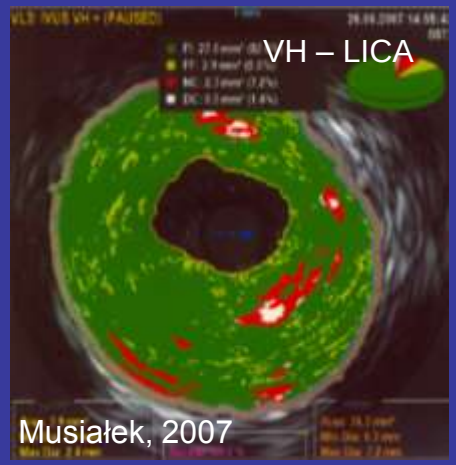
Combined analysis of

AMPLITUDE + FREQUENCY

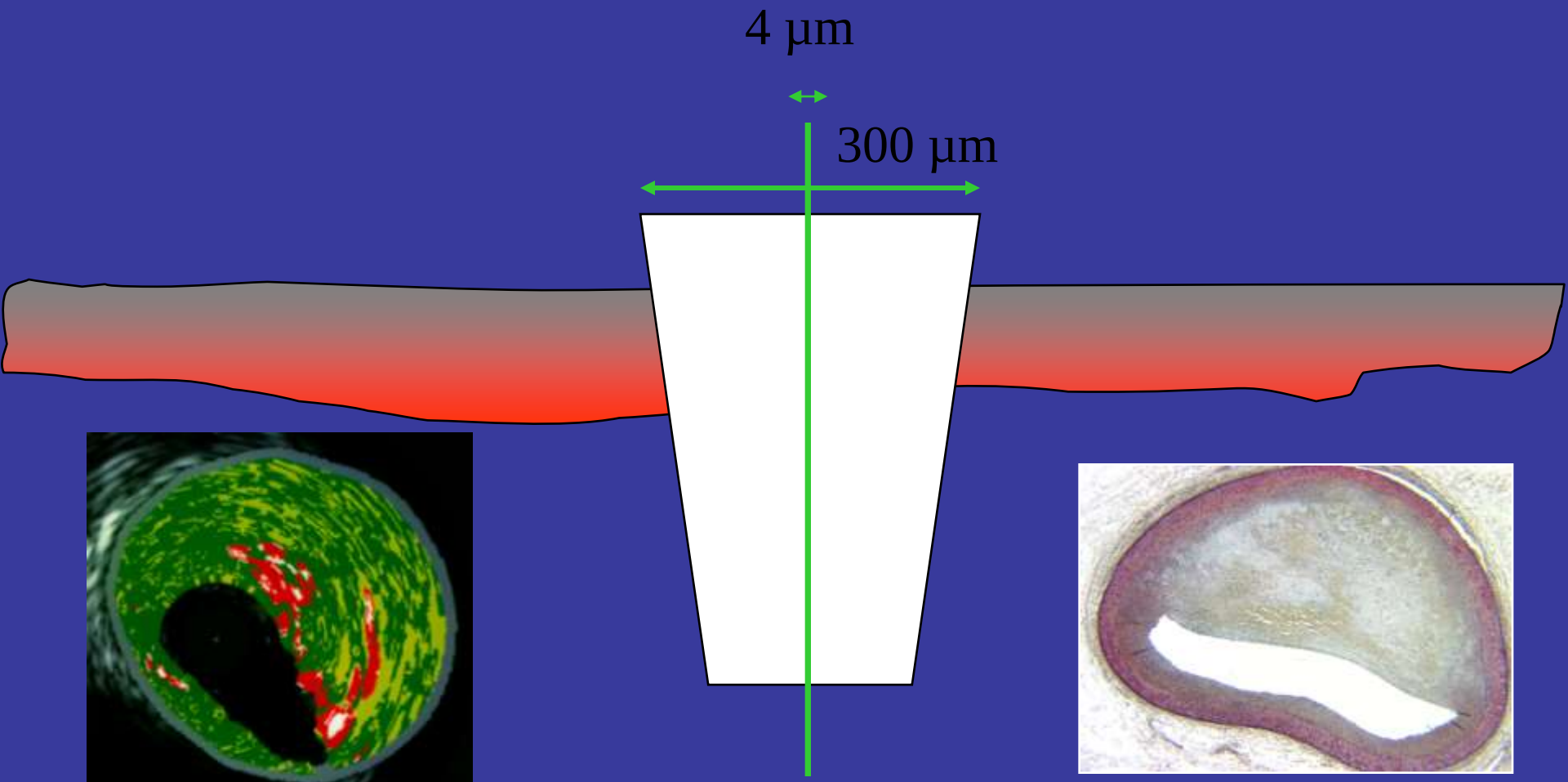
of tissue-reflected ultrasound



Volcano Corp.



VH ‘slice’ vs. histology slice



Volcano Corp.

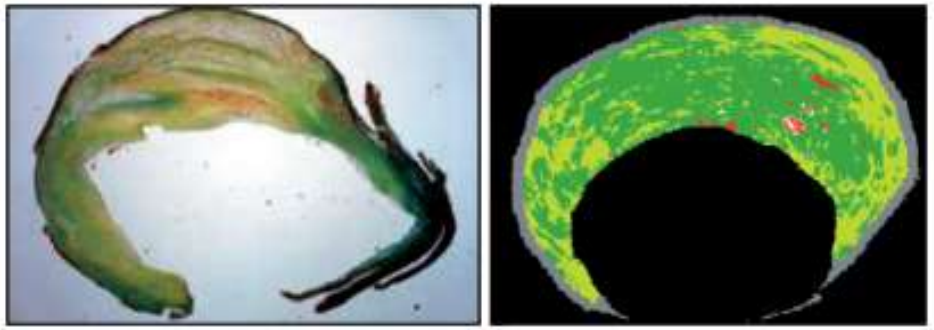
IVUS–VH: validated for the carotids

EB Diethrich et al.

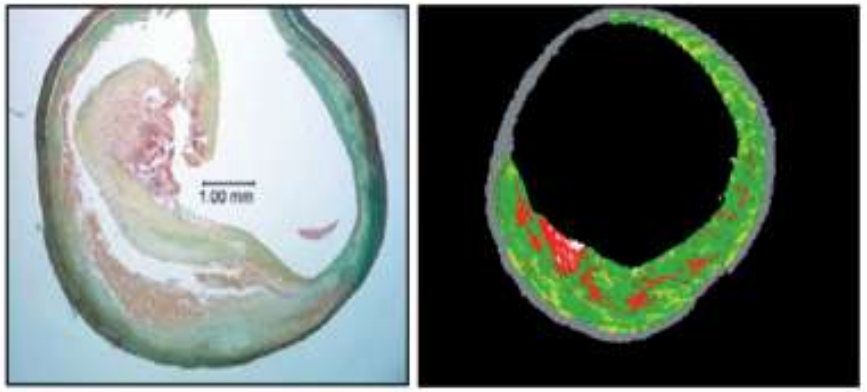
J ENDOVASC THER
2007;14:676–686

TABLE 3
VH IVUS Accuracy by Plaque Types

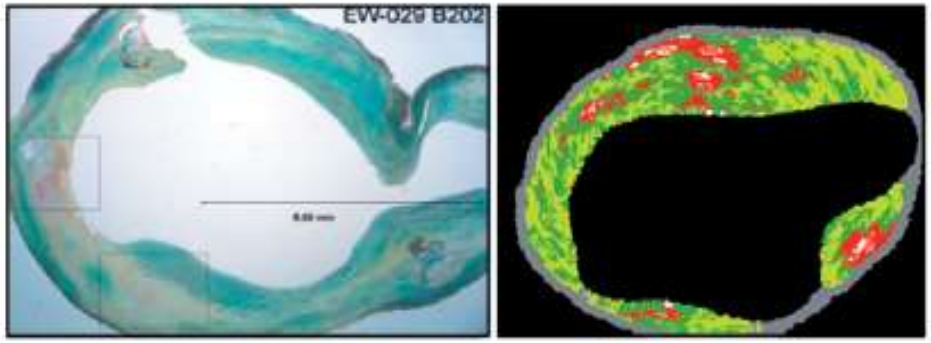
	Diagnostic Accuracy	Sensitivity	Specificity
Thin-cap fibroatheroma	99.4%	75.0%	100%
Calcified thin-cap fibroatheroma	96.1%	90.0%	97.1%
Fibroatheroma	85.9%	54.1%	96.9%
Fibrocalcific	85.5%	87.1%	84.5%
Pathological intimal thickening	83.4%	88.5%	82.0%
Calcified fibroatheroma	72.4%	32.5%	93.0%



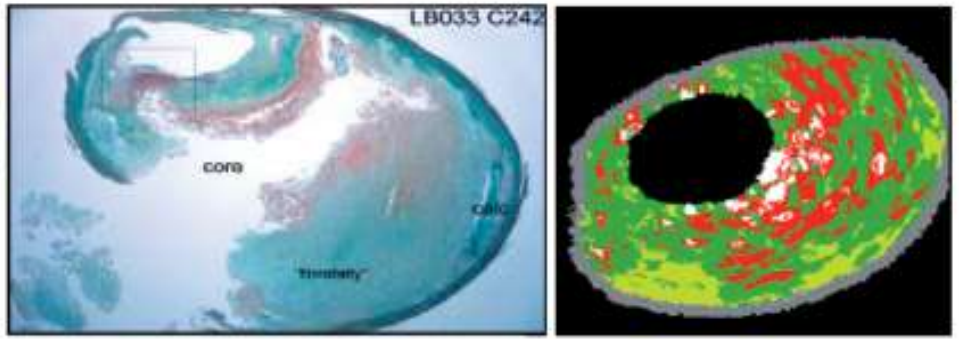
Pathological Intimal Thickening



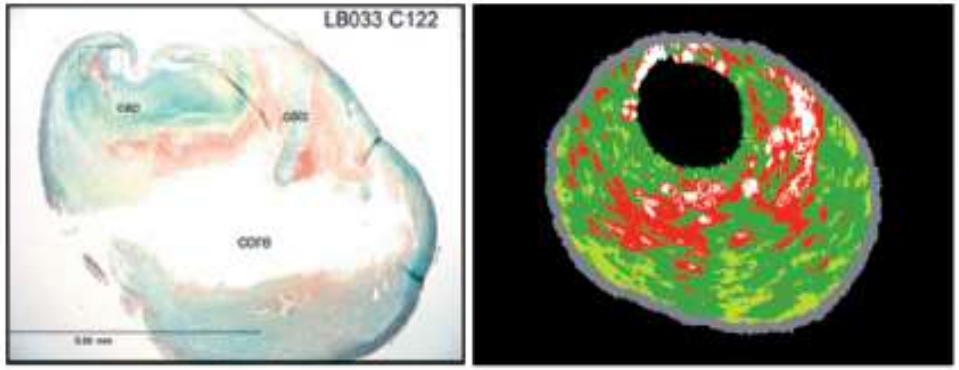
Thin-Cap Fibroatheroma



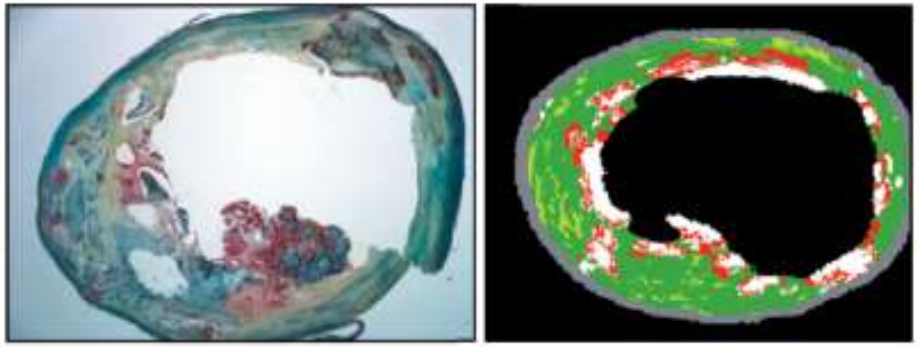
Fibroatheroma



Calcified Thin-Cap Fibroatheroma



Calcified Fibroatheroma



Fibrocalcific

EB Diethrich,
R Virmani, 2007

CRACK-VH

- a prospective academic study to establish the value of VH-carotid plaque characteristics combined with biomarkers in evaluating carotid atherosclerosis in relation to neurological symptoms/symptom risk

- study began in 2006, first CRACK-VH data submitted to NFIC (Nov 2007), ESC (Feb 2008) and TCT (April 2008)

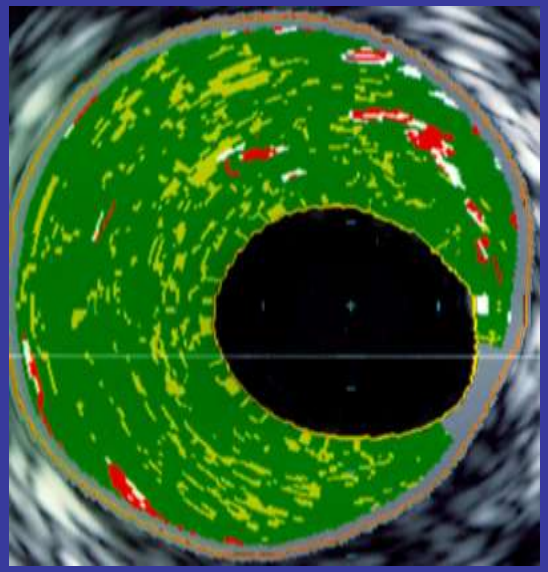
- **206** patients recruited (**102** symptomatic or previously symptomatic) (age 66±8 years, range 38-82y, 67% men)
  –all referred for CAS after consultation by independent neurologist–

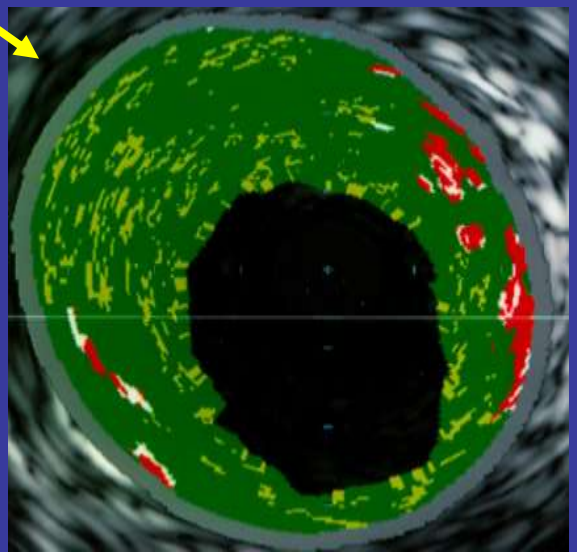
- **226** carotid arteries imaged with IVUS-VH { cross-sectional }
  in **64** IVUS imaging without EPD (28.3%)
  in **35** IVUS imaging under a proximal EPD (GoreFR or MoMa) (15.5%)

- **58** lesions (25.7%) not stented (i.e., left for f/u) { longitudinal, prosp.}
- Ethical Committe–approved, no industry funding/sponsorship

IVUS – VH: cross-section @ max stenosis site can be misleading!

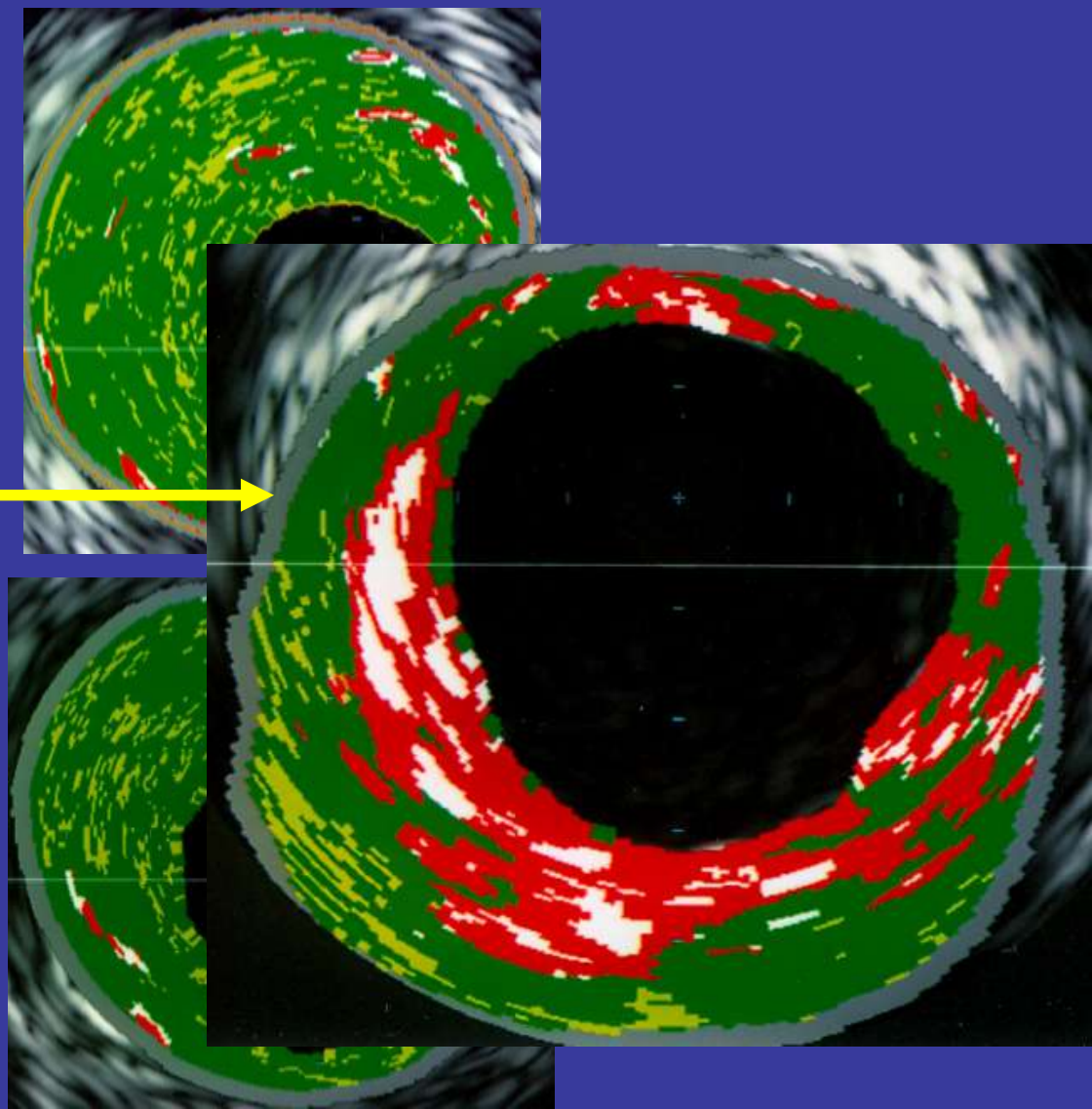
MR, man 54y
1 x TIA?





IVUS – VH: cross-section @ max stenosis site can be misleading!

MR, man 54y
1 x TIA?



TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

CRACK-VH

IVUS–VH acquired under proximal EPD (ICA fow reversal, Gore NPS)

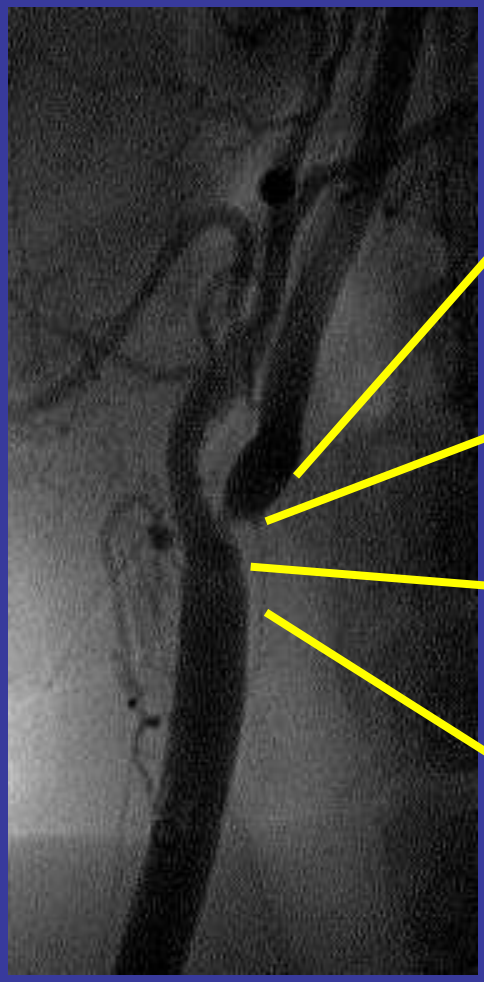
woman, 48y,
asympt. LICA
father – stroke 53 y.

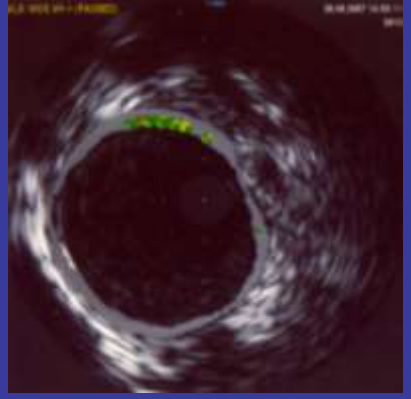
lesion crossing
with a guidewire

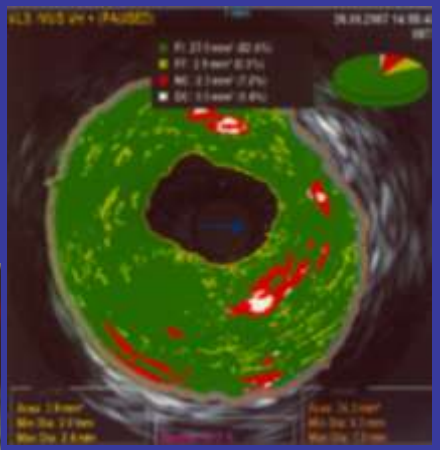
then IVUS-VH
acquisition

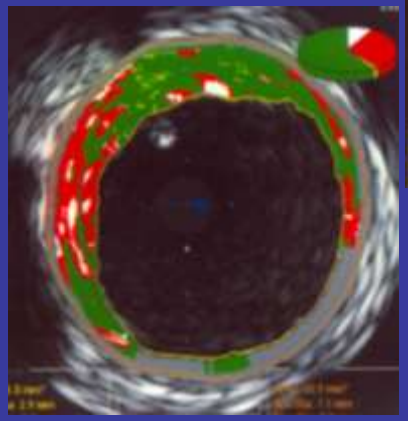
TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

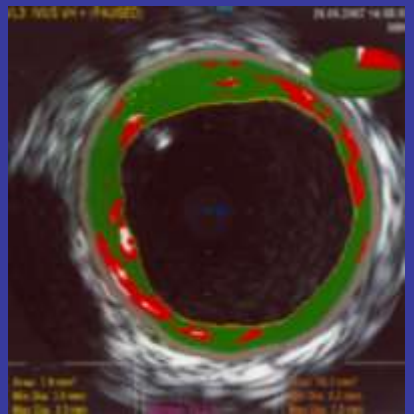
CRACK-VH









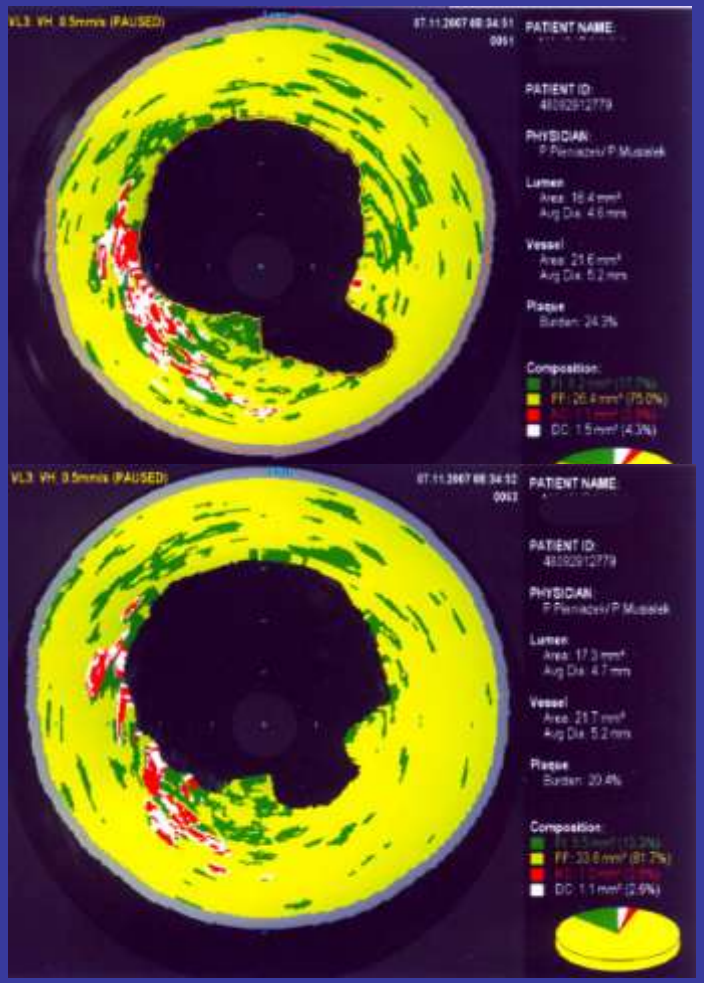


P. Musialek,
P. Pieniązek 2007

man 56y, bilateral carotid stenosis

RICA
(95% stenosis)

LICA
(TIAs – recurr. aphasia + R hand numbness)



LICA: highly lipidic, ulcerated plaque

1st stage: LICA-CAS

How to assess carotid plaques with VH?

- 'worst' frame (NC, TCFA?)
  single?
  average from 3-5 consecutive?
- volumetric analysis ('out of field' problem)
- how to reconcile divergent findings from the same plaque at different 'levels' – those are 'natural'
- virgin asymptomatic vs. past-symptomatic (>6mo)
- clinical symptoms or eg. brain MRI

Results

- IVUS-VH imaging was pefrormed w/o complications.

Pilot analysis indicated:

- No difference in angiographic stenosis severity between S and aS (52-84% vs. 49-88%, p=0.37).
- Plaque ulceration on IVUS more prevalent in S (63.2 vs. 29.0%, p<0.05).
- In aS, average MLA larger (7.1 vs. 5.8mm^2, p=0.02) and plaque burden lower (76.8% vs. 84.9%, p=0.01).

Results (pilot analysis, cont'd)

- Peak DENSE CALCIUM (DC) similar in both groups (S vs. aS): 3.3 (0.6–7.2) vs. 4.4 (0.3–18.2)%.
- Peak FIBRO-FATTY (FF) and Peak NECROTIC CORE (NC) tended to be higher in S 17.7 (4.3–81.7) vs. 15.1 (7.6–32.1)% and 10.2 (1.5–29.3) vs. 6.8 (2.0–17.3)% (but $p>0.05$)
- NECROTIC CORE in direct contact with the lumen (by VH), indicating fibrous cap <150μm, was more prevalent in S (89.5 vs. 52.9%, $p<0.01$).
- Macroscopic evidence of plaque debris captured by EPD was 57.9% in S and 35.3% aS ($p=0.06$).

TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

CRACK-VH

WG, woman 62y, L hemisph. stroke May 2009

RICA
2.28/0.95 m/s
'AS'

LICA
1.85/0.52 m/s
'S'

Neuro consultation Sept. 14, 2009

- R upper limb weakness
- motoric aphasia
- NIH-SS 4

Conclusion: Symptomatic LICA, Asymptomatic RICA stenosis

For **LICA-CAS** (RICA stenosis to be monitored)

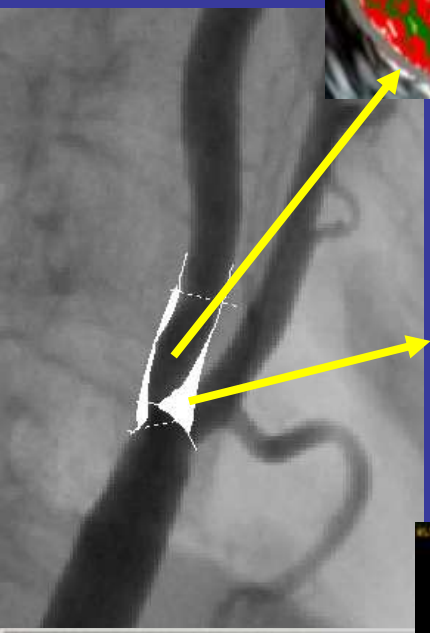
TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

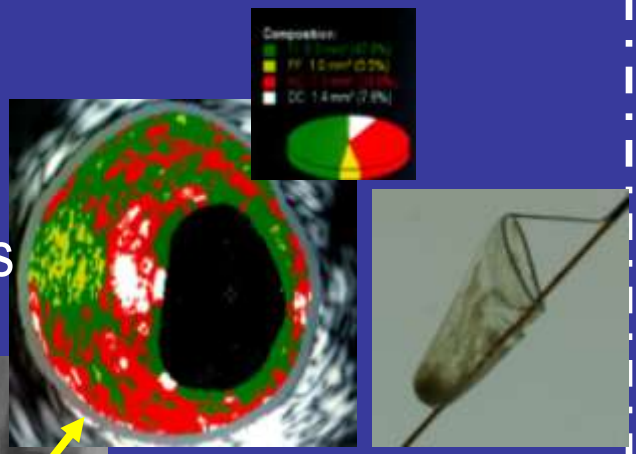
CRACK-VH

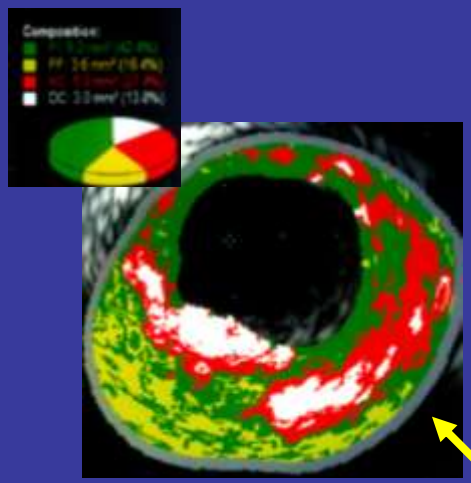
WG, woman 62y, L hemisph. stroke May 2009

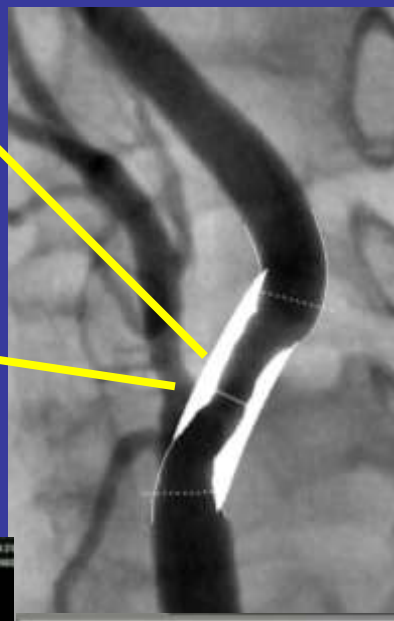
RICA
2.28/0.95 m/s

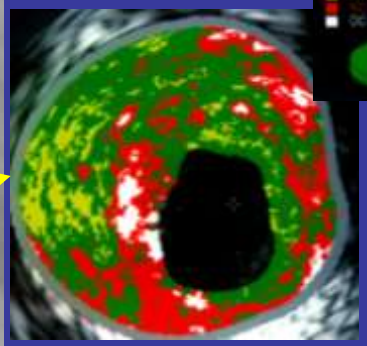
LICA
1.85/0.52 m/s

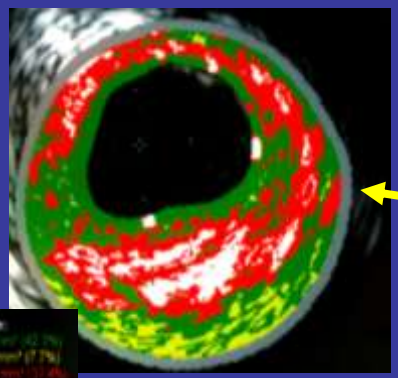


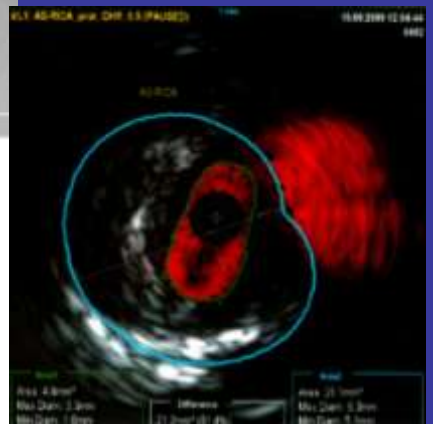












MLD	0.86	mm
% diameter stenosis	77	%
Reference diameter	3.80	mm
Length stenotic segment	9.16	mm
Position of proximal border	2.72	mm
MLA densitometry	2.55	mm2
MLA circular	0.58	mm2
% area stenosis densitometry	78	%
% area stenosis circular	95	%

15.09.2009

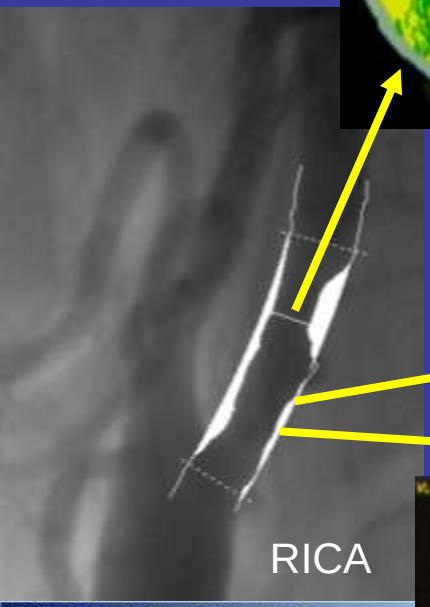
MLD	2.61	mm
% diameter stenosis	48	%
Reference diameter	5.05	mm
Length stenotic segment	15.89	mm
Position of proximal border	5.46	mm
MLA densitometry	10.26	mm2
MLA circular	5.33	mm2
% area stenosis densitometry	49	%
% area stenosis circular	73	%

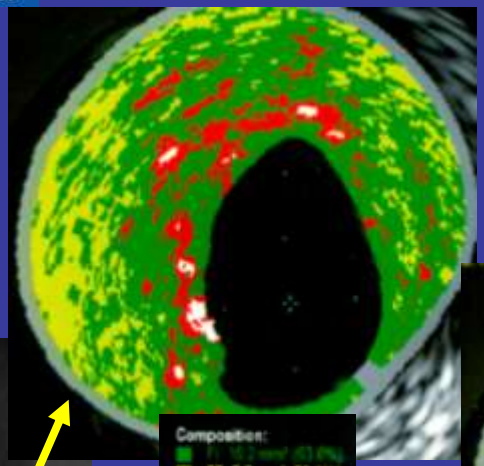
TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

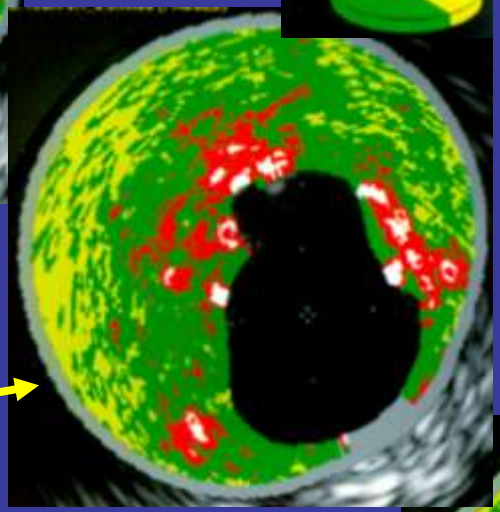
PC, man 51y, R hemisph. stroke Feb. 8, 2008

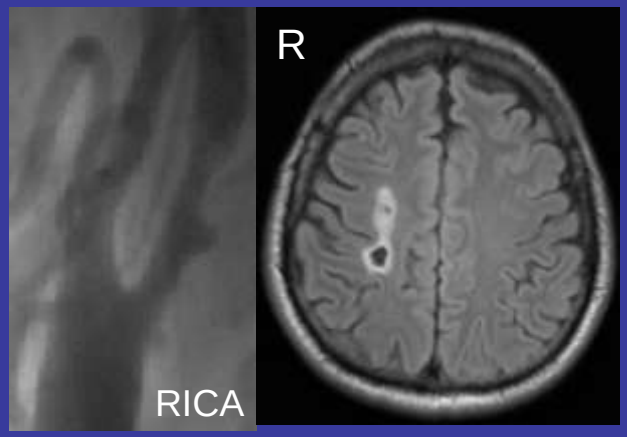
CRACK-VH

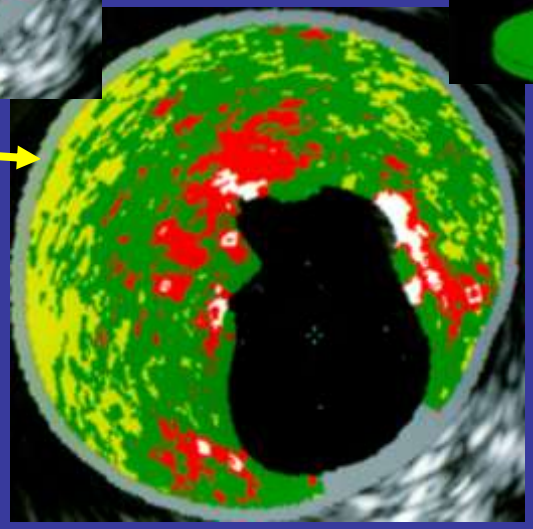
RICA
0.85/0.38 m/s











COMPUTER DEFINED OBSTRUCTION ANALYSIS

MLD	3.13	mm
% diameter stenosis	38	%
Reference diameter	5.05	mm
Length stenotic segment	20.73	mm
Position of proximal border	5.29	mm
MLA densitometry	9.37	mm2
MLA circular	7.67	mm2
% area stenosis densitometry	53	%
% area stenosis circular	62	%

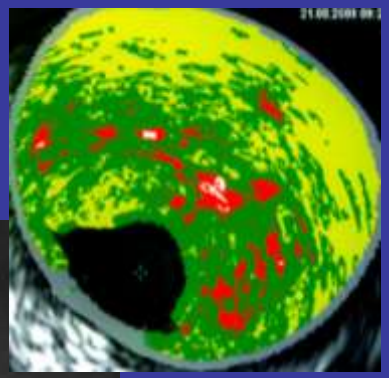
05.03.2008

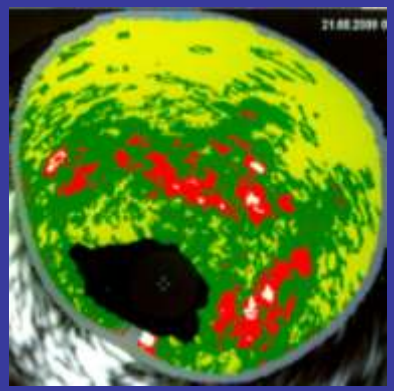
TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

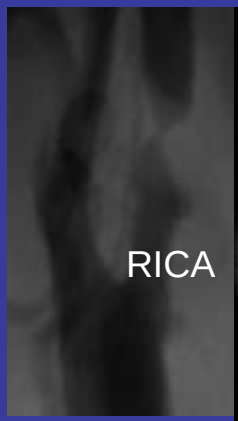
PC, man 52y, R hemisph. stroke Feb. 8, 2008

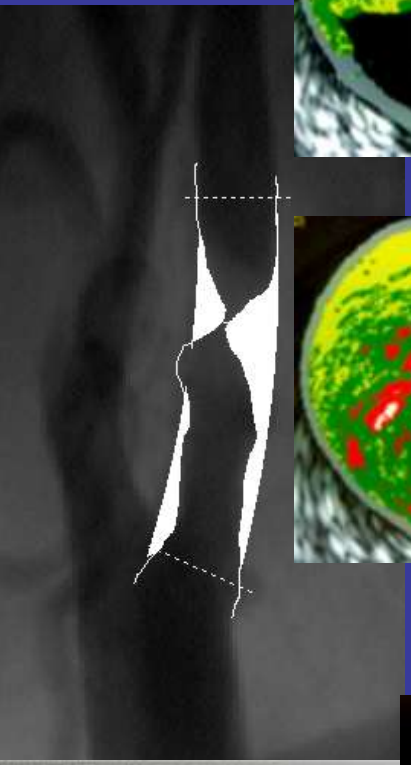
CRACK-VH

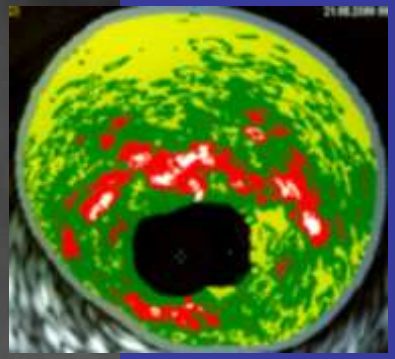
+ 3 x TIA Aug. 2009

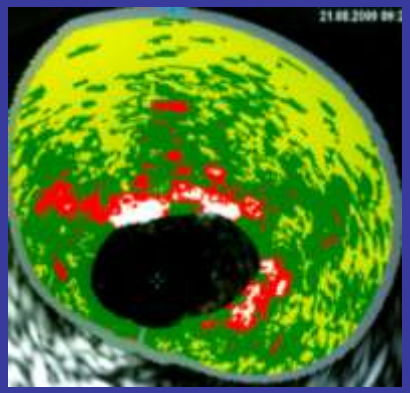


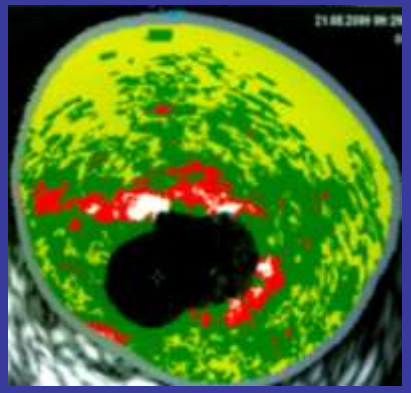




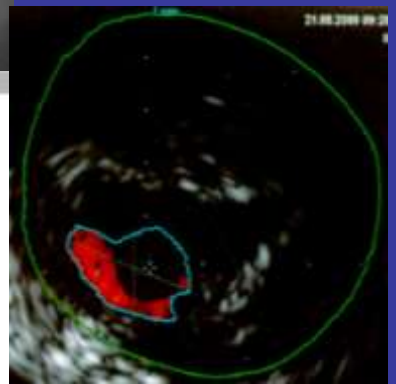


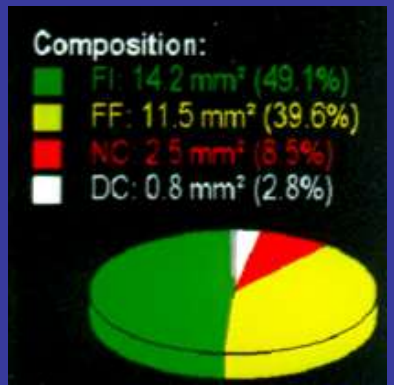


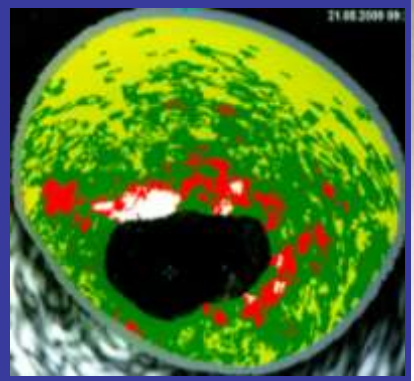




MLD	0.48	mm
% diameter stenosis	91	%
Reference diameter	5.35	mm
Length stenotic segment	25.25	mm
Position of proximal border	1.82	mm
MLA densitometry	0.78	mm2
MLA circular	0.18	mm2
% area stenosis densitometry	97	%
% area stenosis circular	99	%







Biomarkers (first n=75 pts)

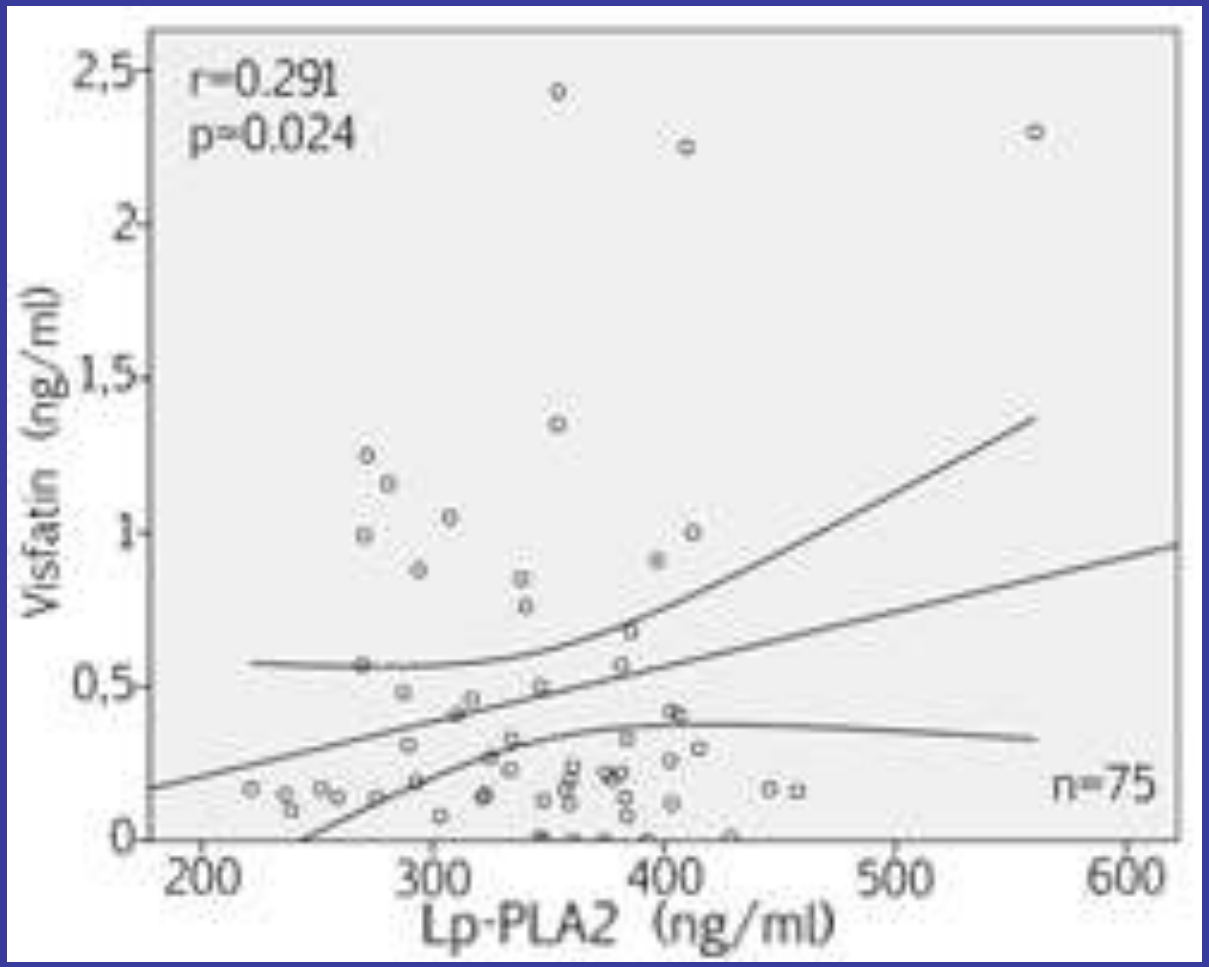
• hsCRP	(ng/mL)	5.01 ± 8.19	(0.50 – 74.20)
• IL-1B	(pg/mL)	0.12 ± 0.27	(0.00 – 1.90)
• IL-6	(pg/mL)	3.93 ± 7.83	(0.02 – 52.69)
• IL-8	(pg/mL)	11.37 ± 1.50	(9.00 – 21.25)
• CD 40L	(pg/mL)	321.13 ± 252.8	(42.5 – 1238.6)
• MMP-9	(ng/mL)	123.47 ± 79.4	(13.0 – 444.0)
• MMP-10	(pg/mL)	665.59 ± 373.8	(223.4 – 2156.3)
• Visfatin	(ng/mL)	0.967 ± 3.59	(0.00 – 29.87)
• Lp-PLA_2	(ng/mL)	349.39 ± 63.4	(221.4 – 560.6)
• MCP-1	(pg/mL)	284.16 ± 112.9	(75.86 – 657.4)
• sVCAM	(ng/mL)	836.55 ± 112.9	(0.0 – 2101.0)

P. Musialek et al. 2009

Pilot biomarker analysis

indicated significant correlations between:

- CD40L/IL-1ß r=0.44
- IL-8/IL-1ß r=0.46
- IL-8/CD40L r=0.42
- Visfatin/Lp-PLA2 r=0.29 (p<0.05 for all)



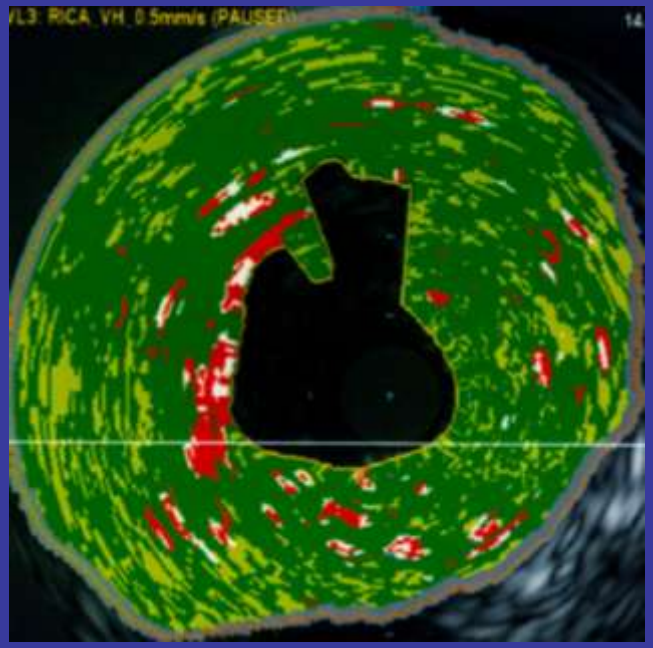
P. Musialek et al. 2009

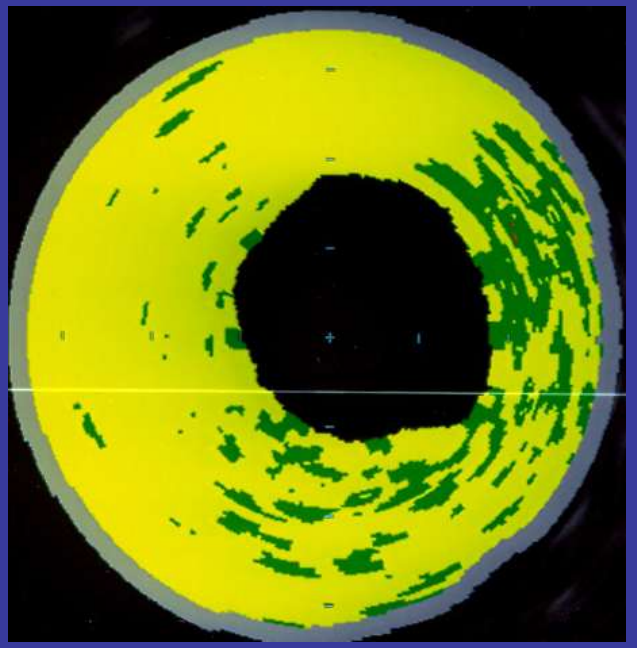
CRACK-VH

TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

EPD-captured embolic particles vs. VH

CRACK-VH





Carotid VH: current limitations

- thrombus imaging, stent imaging
- 'out of field' (10mm) problem
- no metabolic or vasa vasorum imaging
- need for manual contour adjustment (each frame) => v. laborious
- carotid media often difficult to define
- v. tight plaques should not be imaged (unless predilated) (risk of iatrogenic embolization!)
- fibrous cap of 150μm: thin enough or thick enough?
- massive calcifications are a problem

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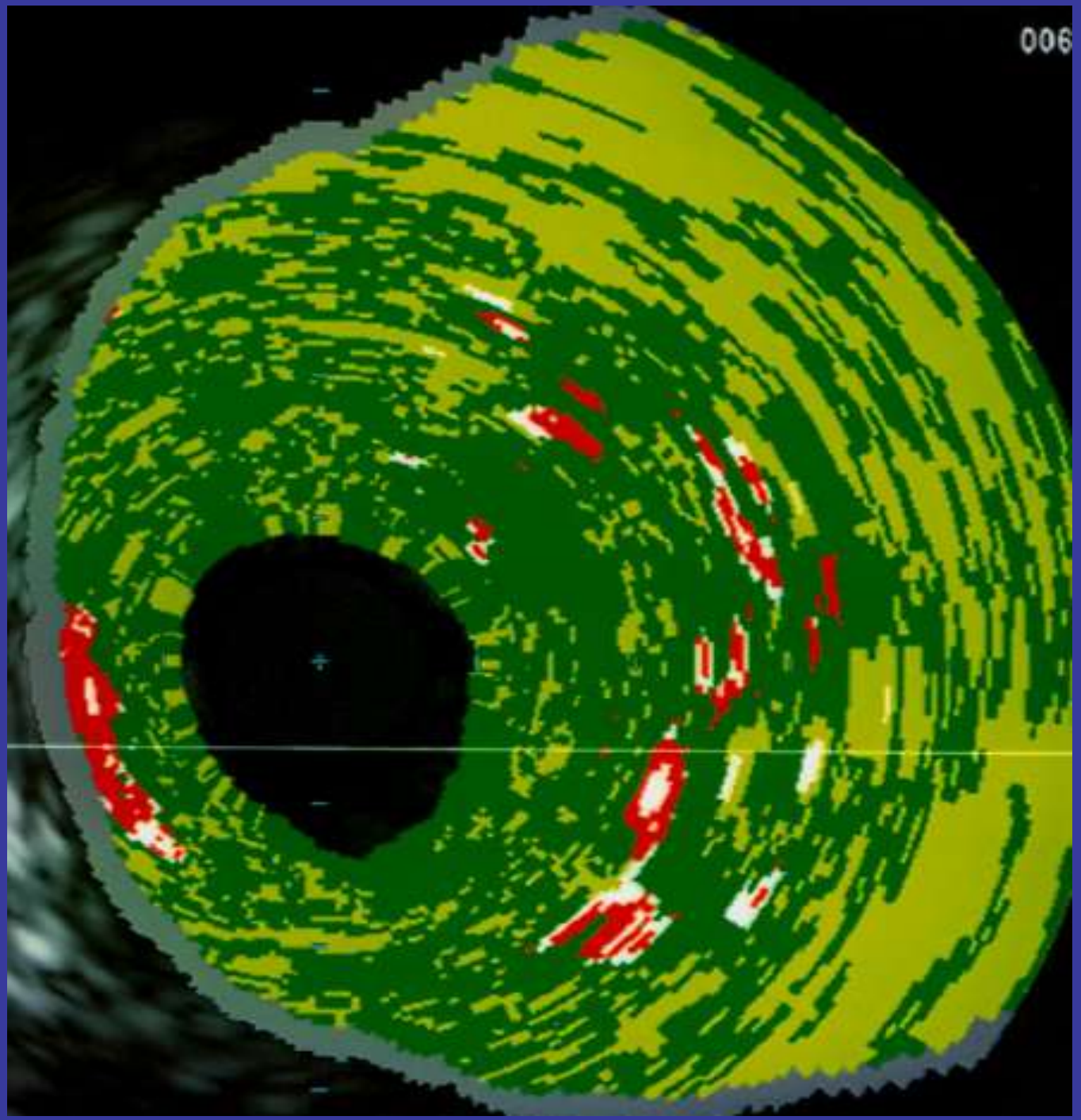


TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

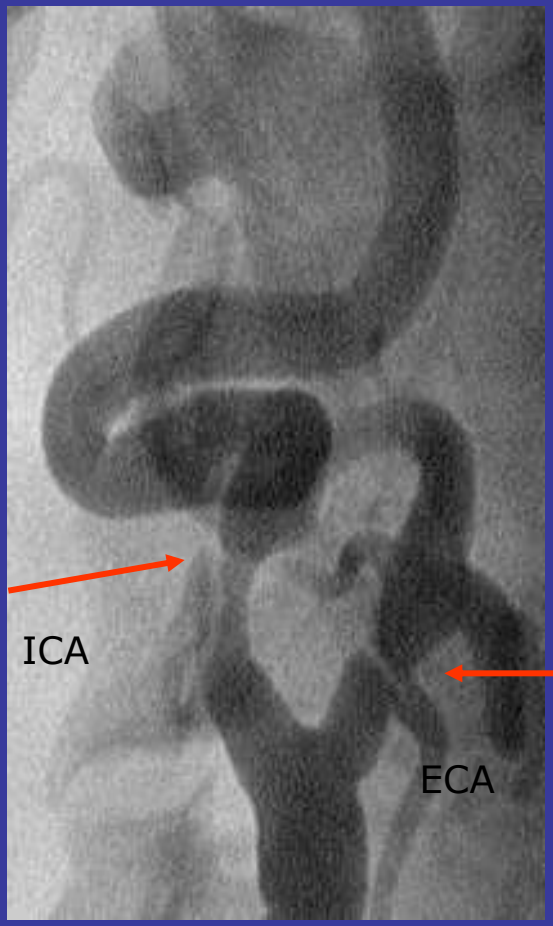
CRACK-VH

Conclusions

- Carotid plaque evaluation with IVUS-VH is safe.
- IVUS-VH can be acquired under proximal EPDs
- Plaque ulceration and the thin fibrous cap appeared more prevalent in the symptomatic carotid plaques.
- Initial findings seem consistent with the role of carotid plaque rupture and distal (brain) embolization as a mechanism of ischaemic stroke in a proportion of patients with non-critical carotid artery stenosis.

Supported by the 2007 Polish Cardiac Society/Servier Grant (PM) and Ministry of Science Grant #N 402184234 (WT, PM)

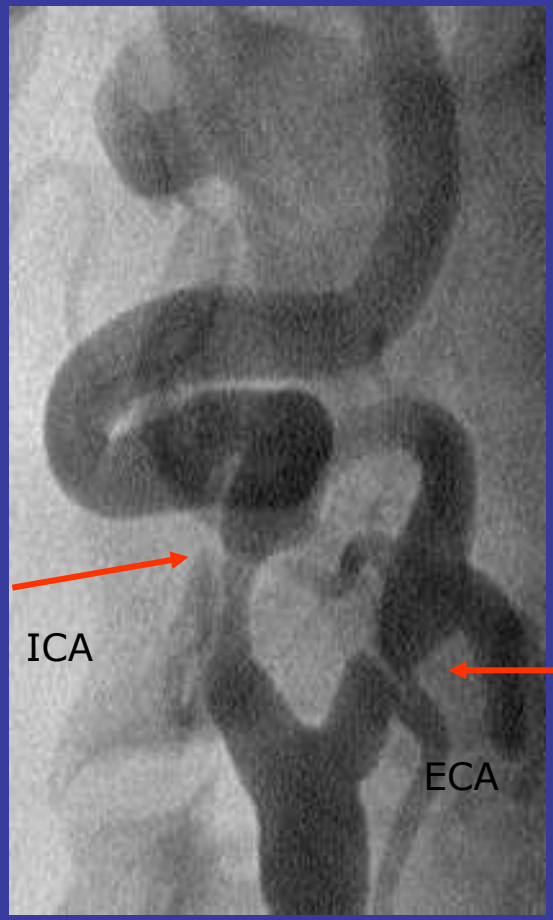
Woman, 68y, asymptomatic lesion



2009

- CAS (or CEA) ?
- Clinical & DD follow-up
  + pharmacotherapy ?

Woman, 68y, asymptomatic lesion



Within the next 5 years…

- CAS (or CEA) ?
- Clinical & DD follow-up
  + pharmacotherapy ?

- RISK of symptoms ?
  (MRI? CT? IVUS-VH ?)
  ('biomarkers' ?)
- IVUS-VH for decision-making?

Man, 63y, 'asymptomatic' RICA lesion (in 2001 CEA for a tight LICA stenosis + TIAs)

Duplex Doppler (July 2008): RICA 2.1 / 0.6 m/s

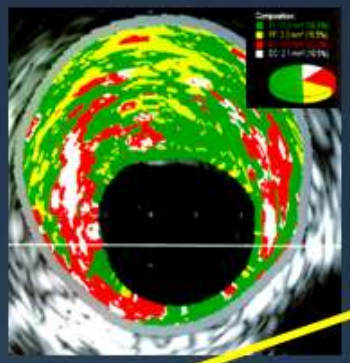
A. Kabłak-Ziembicka, Sept 17, 2008

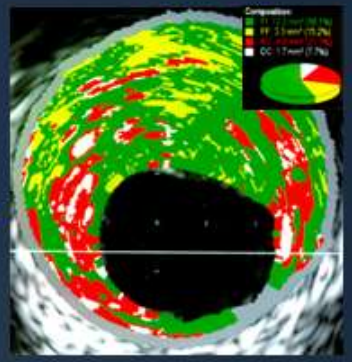
Man, 63y, 'asymptomatic' RICA lesion (in 2001 CEA for a tight LICA stenosis + TIAs)

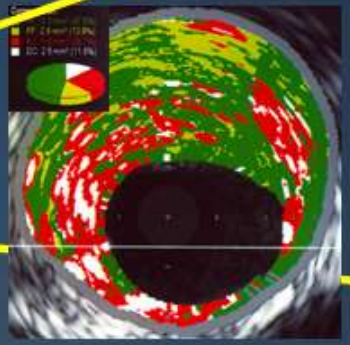
Duplex Doppler (July 2008): RICA 2.1 / 0.6 m/s

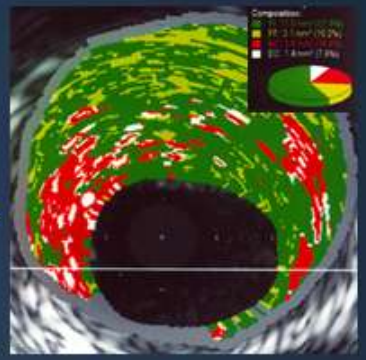
20 YEARS OF INNOVATION TCT 2008

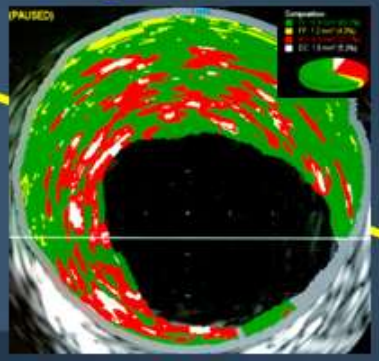
what would **you** do ?

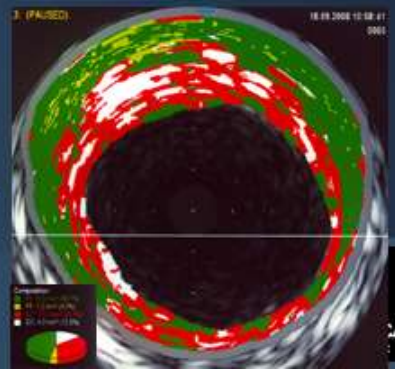






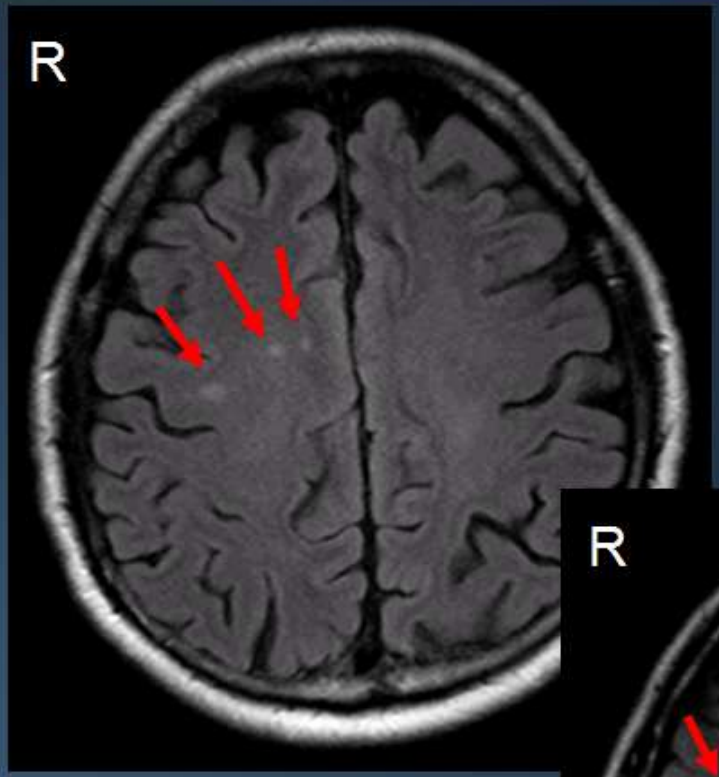


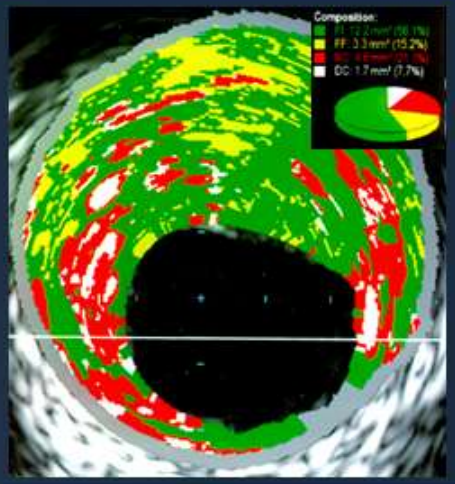




CARDIOVASCULAR RESEARCH FOUNDATION

MZ, man 63y, lesion clinically asymptomatic





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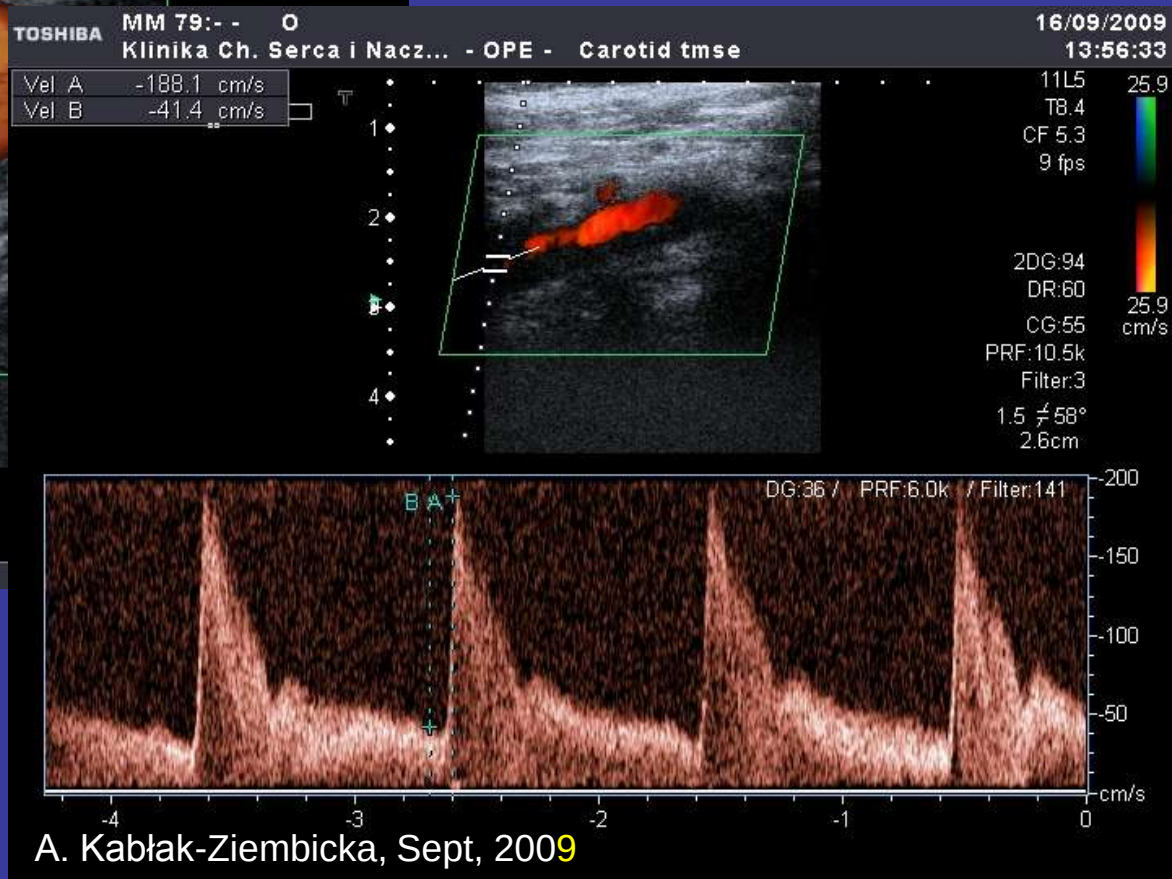
CRACK-VH

MM, man, 64y, RICA lesion **still** 'asymptomatic'

Duplex Doppler (Sept 2009): RICA 1.9 / 0.4 m/s



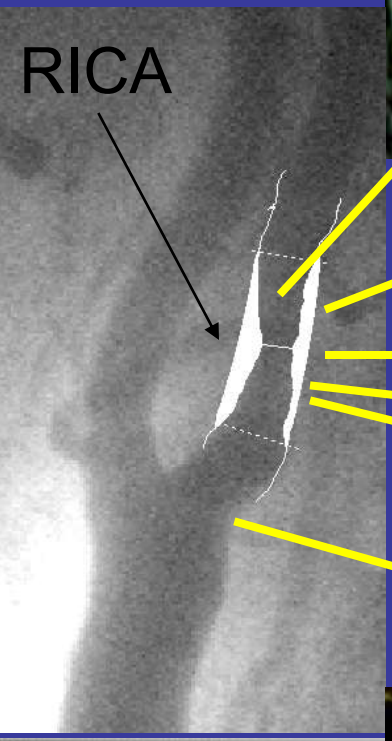
'mild RICA stenosis progression'

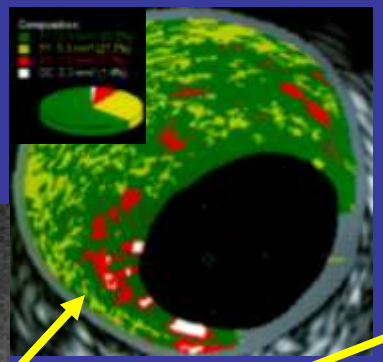
A. Kabłak-Ziembicka, Sept, 2009

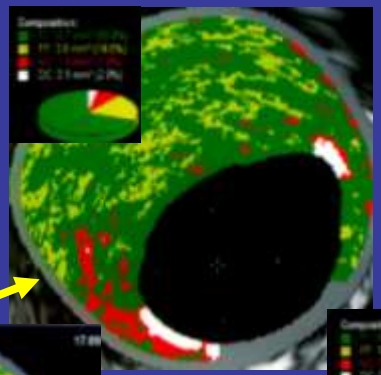
TCT2009 TRANSCATHETER CARDIOVASCULAR THERAPEUTICS

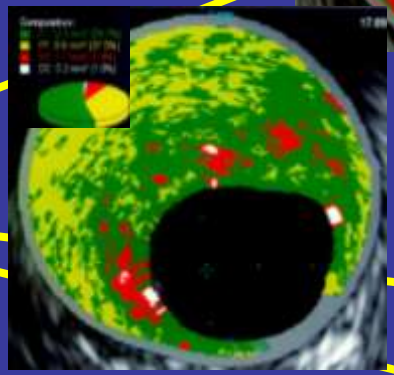
CRACK-VH

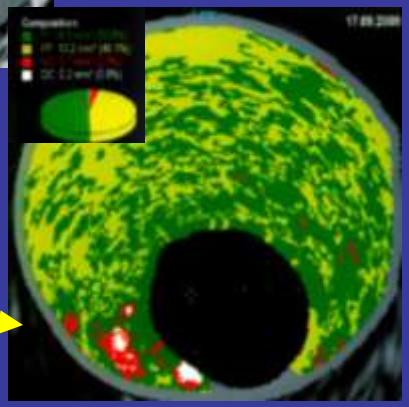
what would **you** do **now** (Sept 17, 2009)?

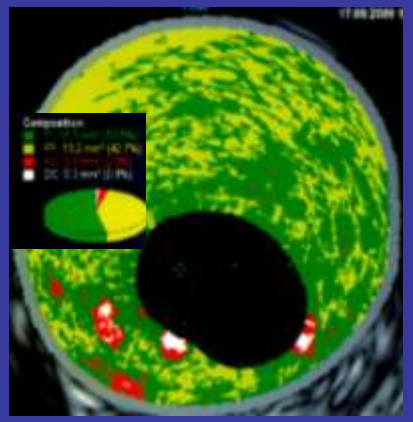


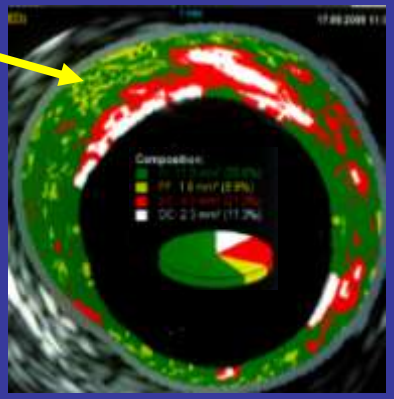


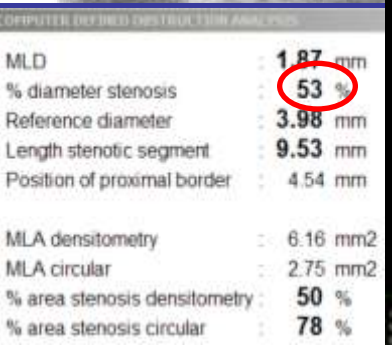


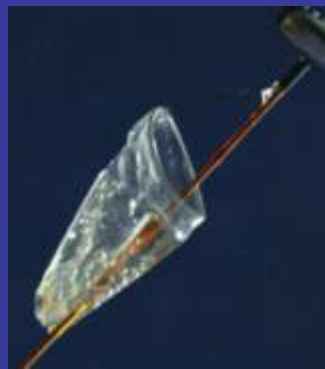












P. Musiałek, Sept 17, 2009