WCN 2013, Vienna
TC 34 Ultrasound of extra-and intracranial vessels

Non-atherosclerotic disease of cranial arteries

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WCN 2013, Vienna
TC 34 Ultrasound of extra-and intracranial vessels

Non-atherosclerotic disease of cranial arteries

- DISCLOSURES K.Niederkorn

NONE

WCN 2013, Vienna
TC 34 Ultrasound of extra-and intracranial vessels
Non-atherosclerotic disease of cranial arteries

• LEARNING OBJECTIVES

Presentation of possibilities and limitations of ultrasound based diagnosis in

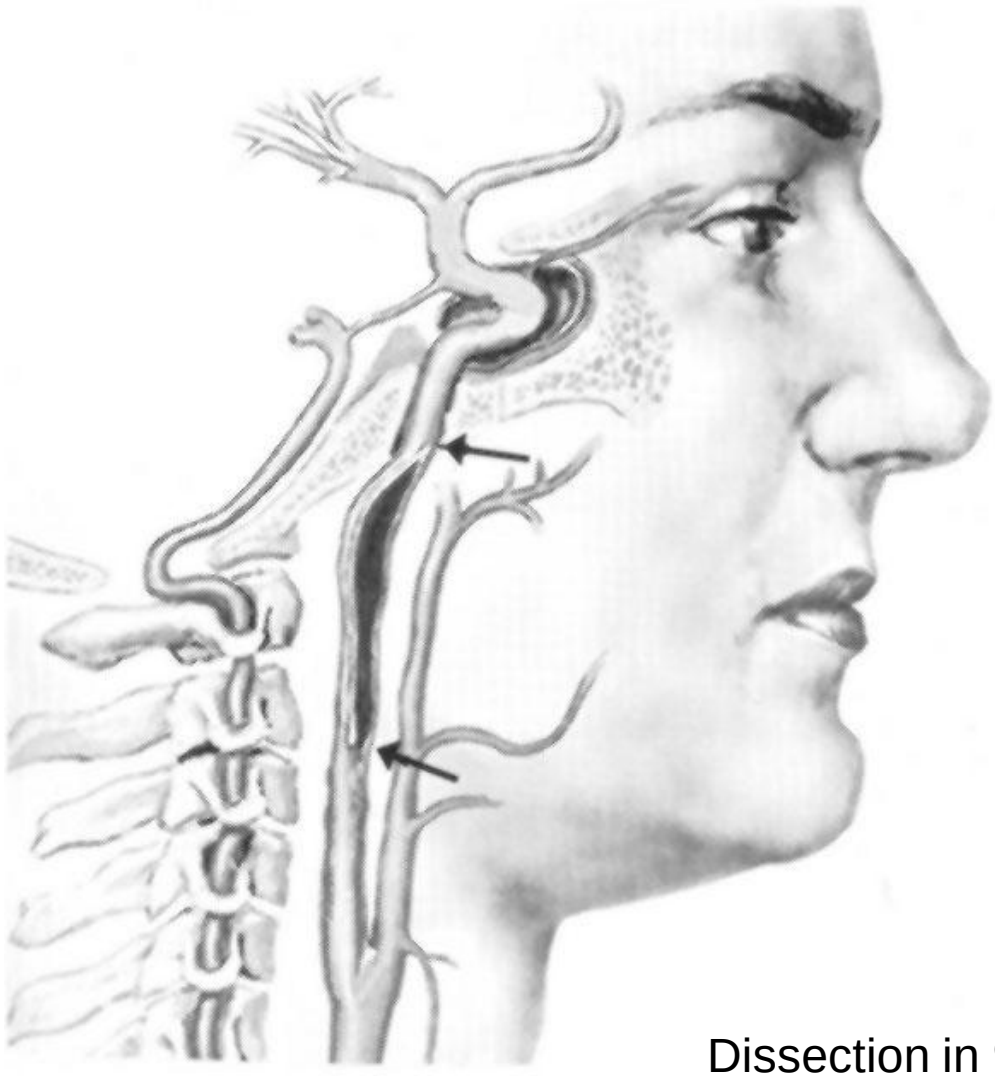
Dissection

SAH

follow up after stenting

Arteritis

Presentation and discussion of illustrative cases

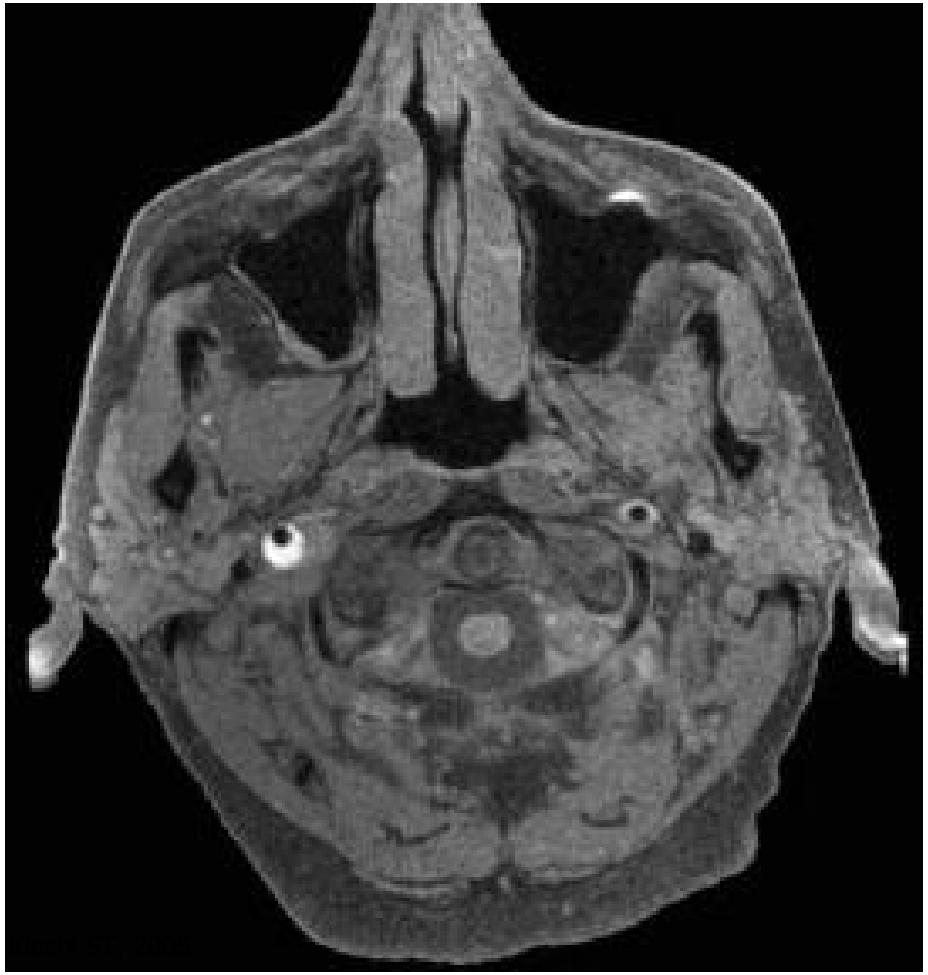


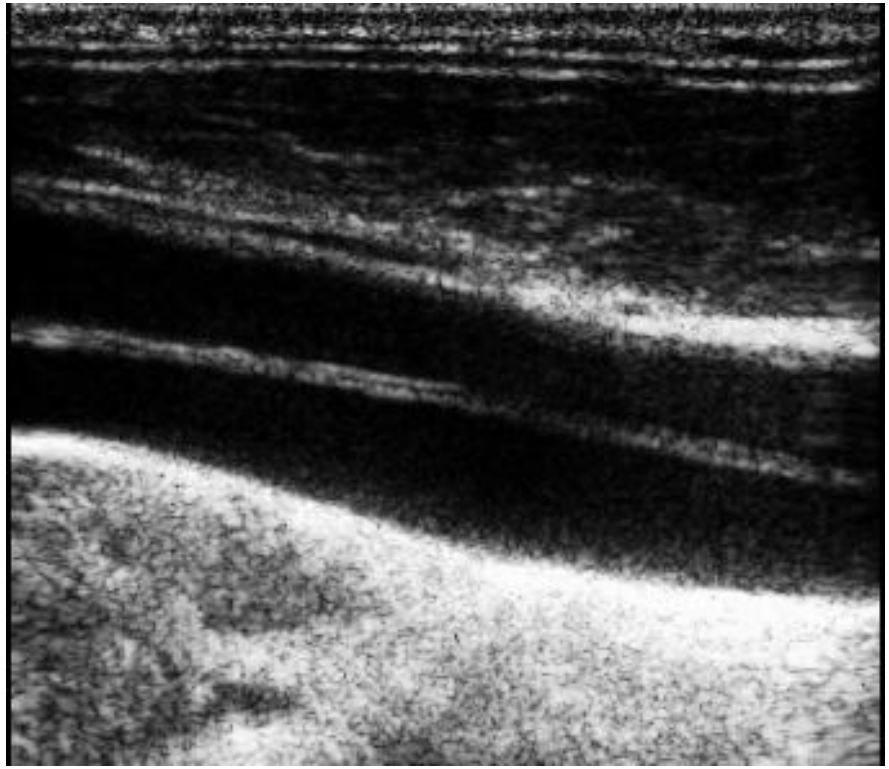
ICA Dissection

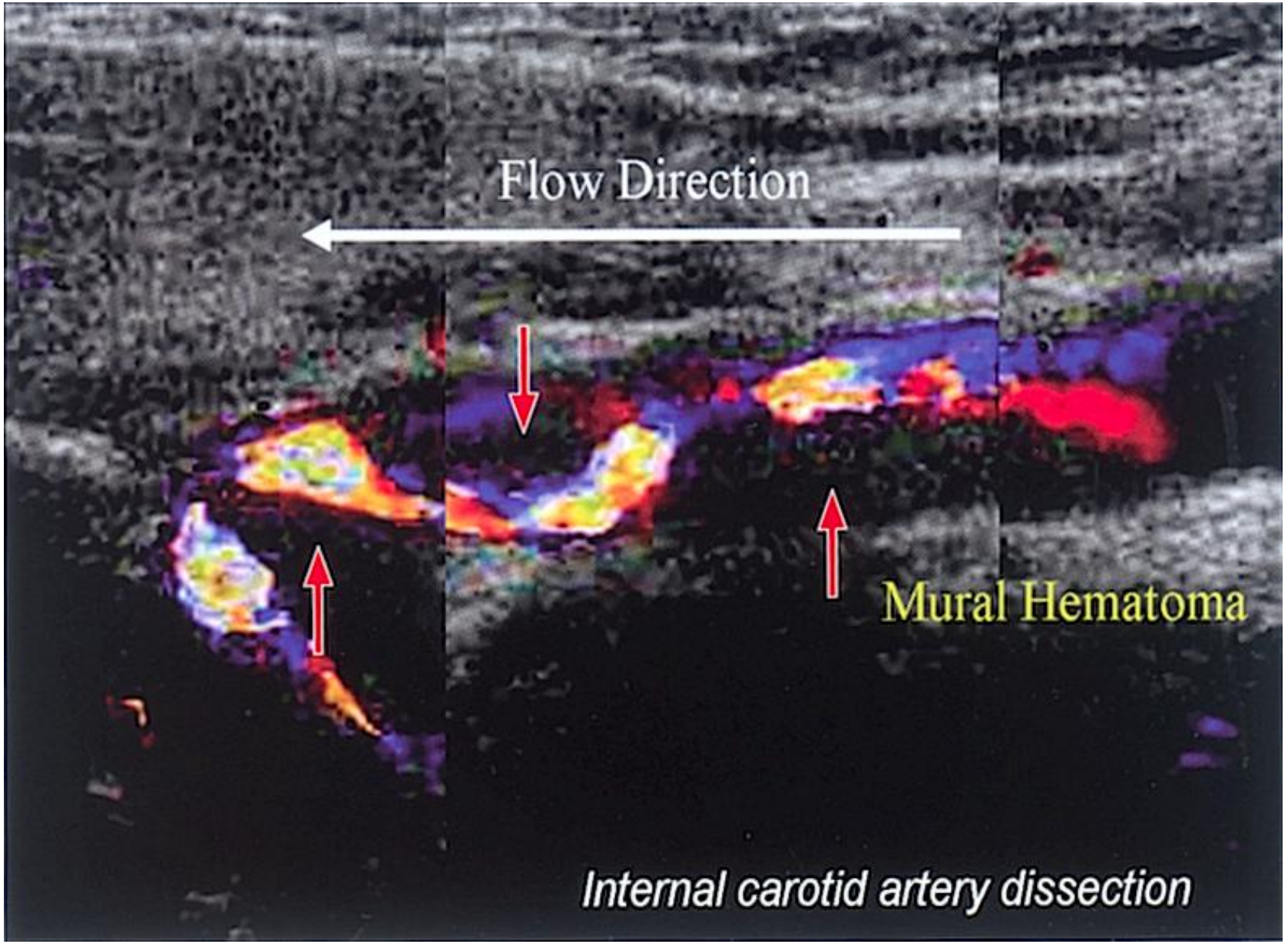
Dissection in 9.9% of juvenile stroke patients <55y

Rolfs et al, Stroke 2013: 44:340-49)

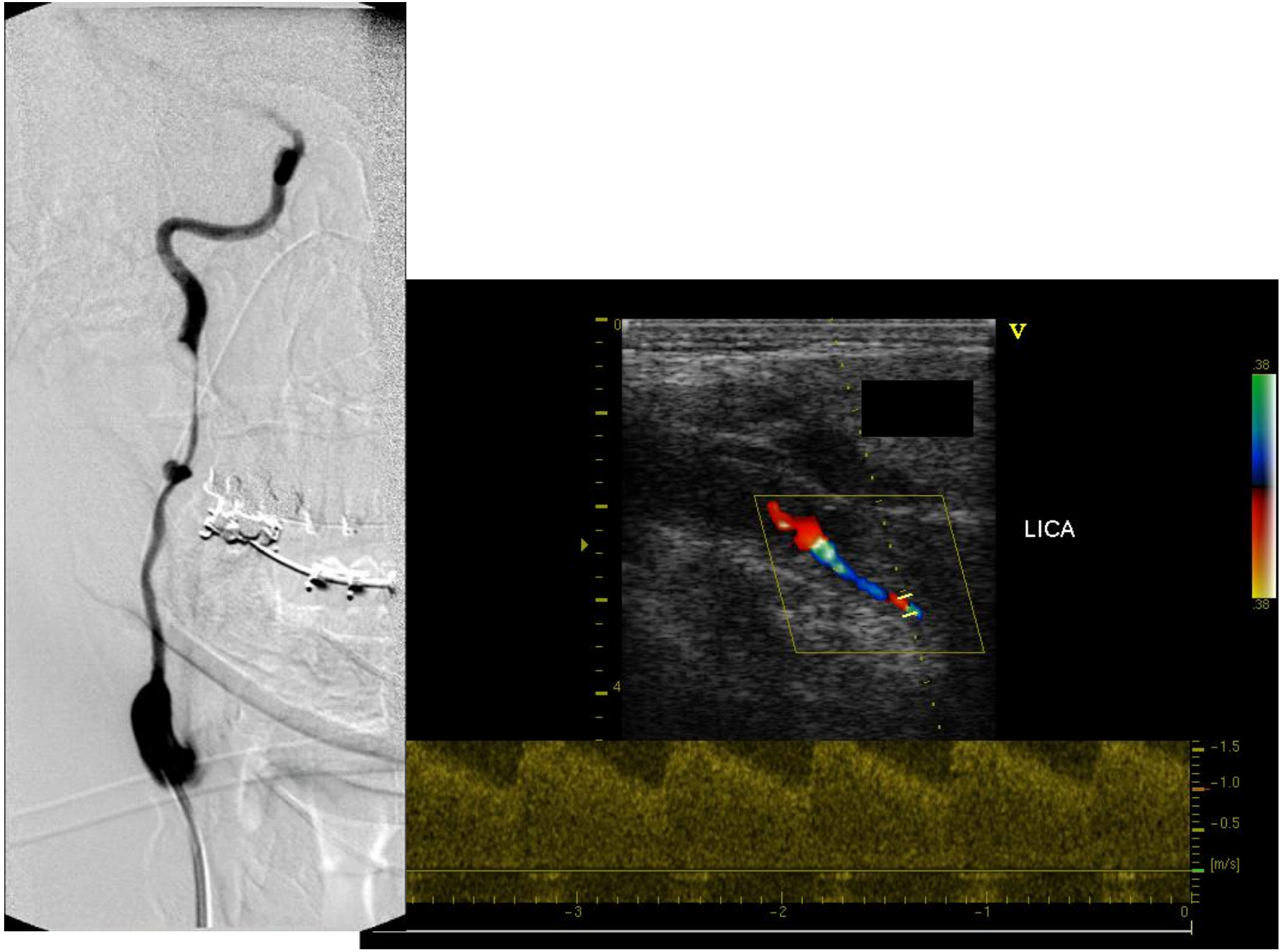
ICA Dissection



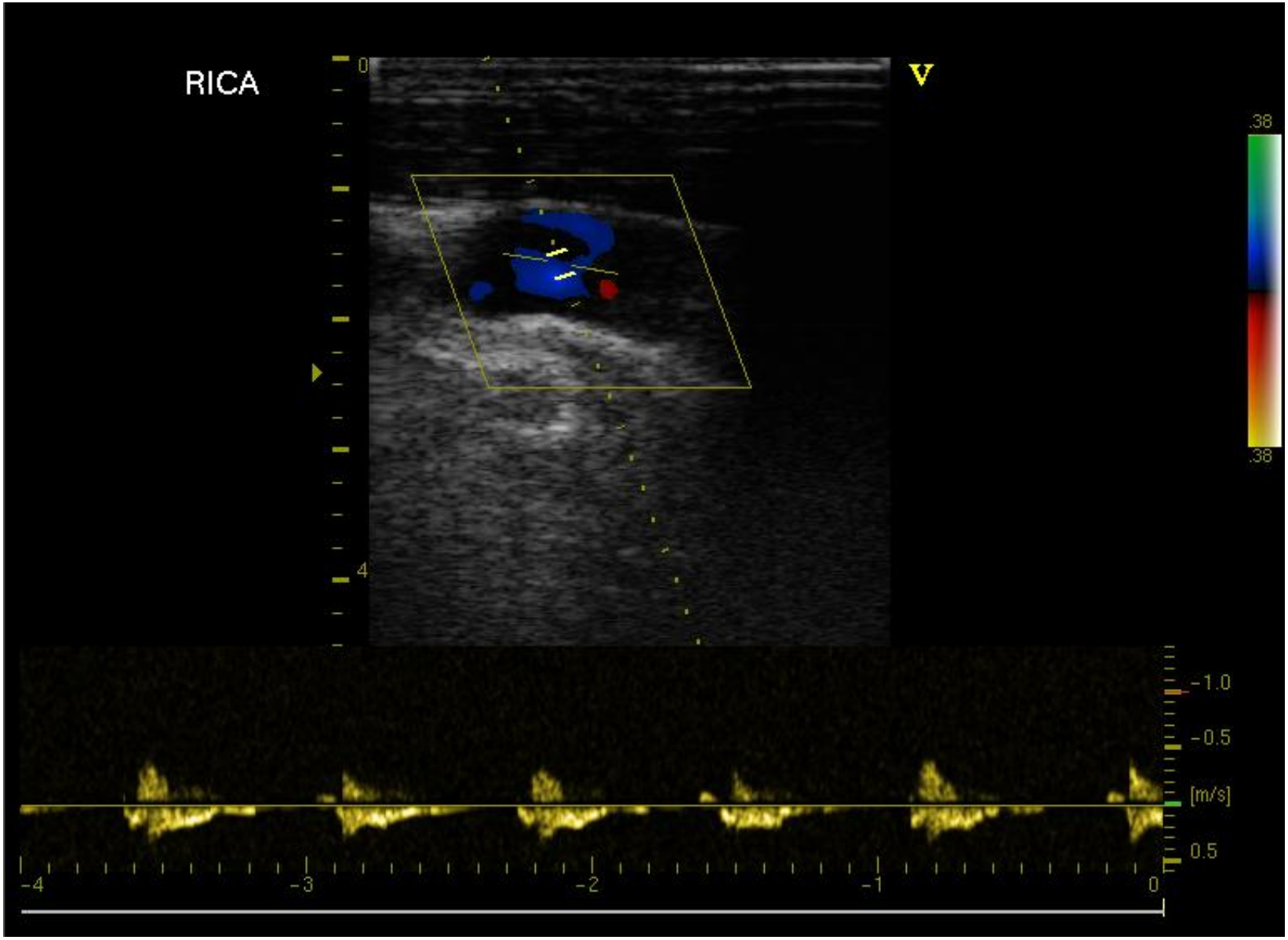


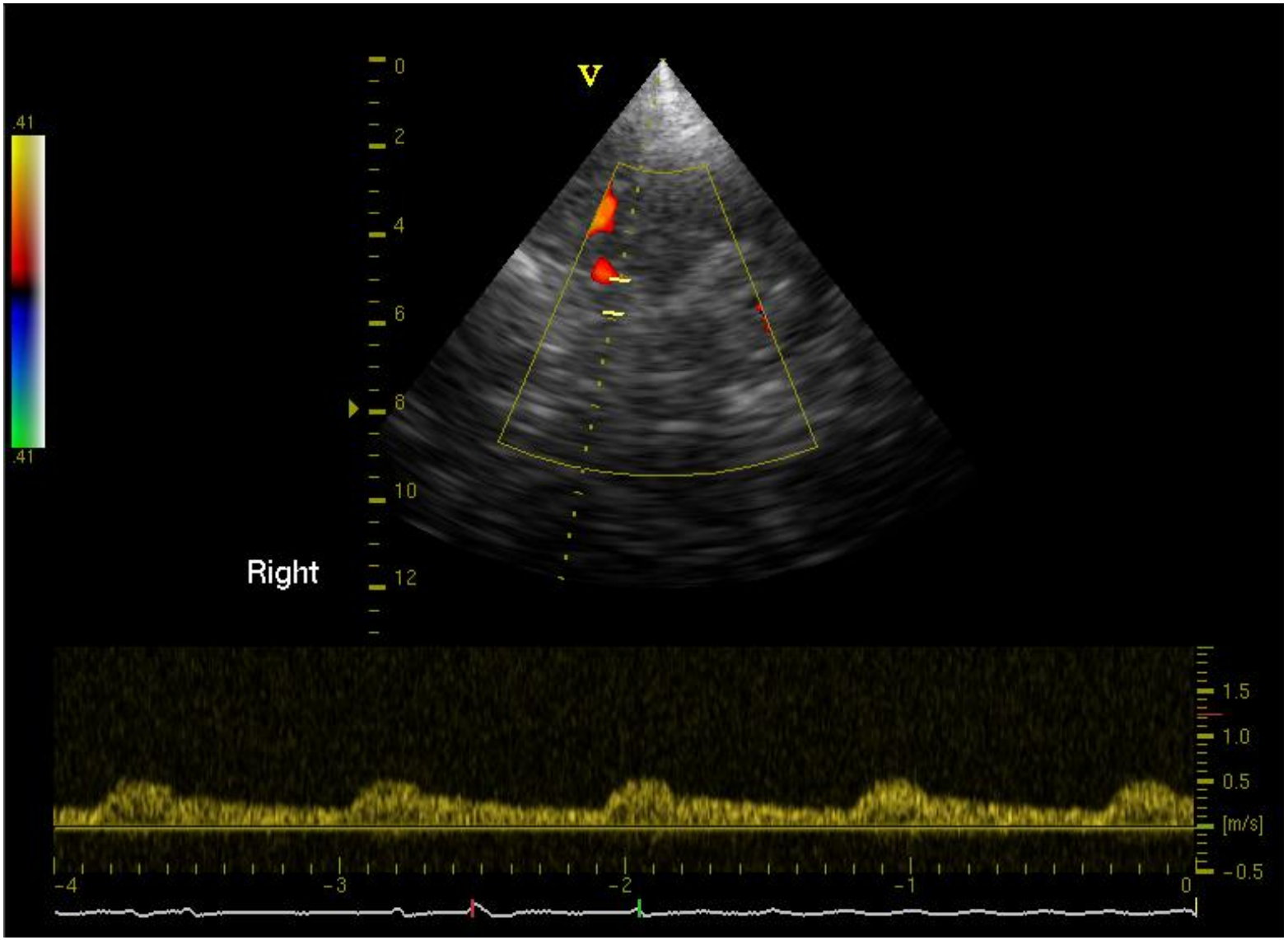


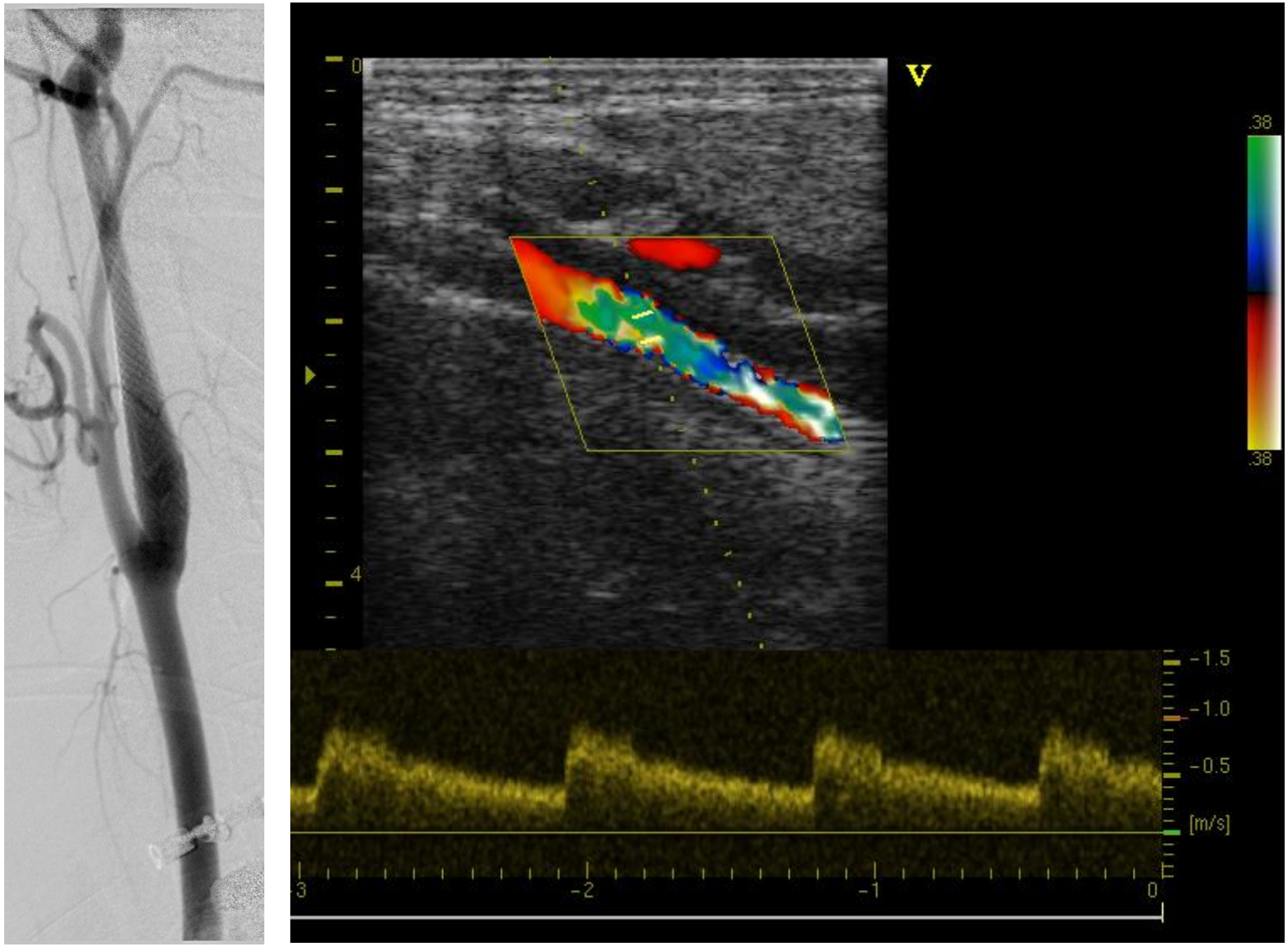
From: Titianova, Niederkorn, Christova, Ringelstein; Coty, 2008



SYMPTOMATIC ICA DISSECTION WITH PSEUDOANEURYSM


RICA
0
4
.38
.38
-1.0
-0.5
[m/s]
0.5
-4
-3
-2
-1
0


.41
.41
0
2
4
6
8
10
12
Right
1.5
1.0
0.5
[m/s]
-0.5
-4
-3
-2
-1
0



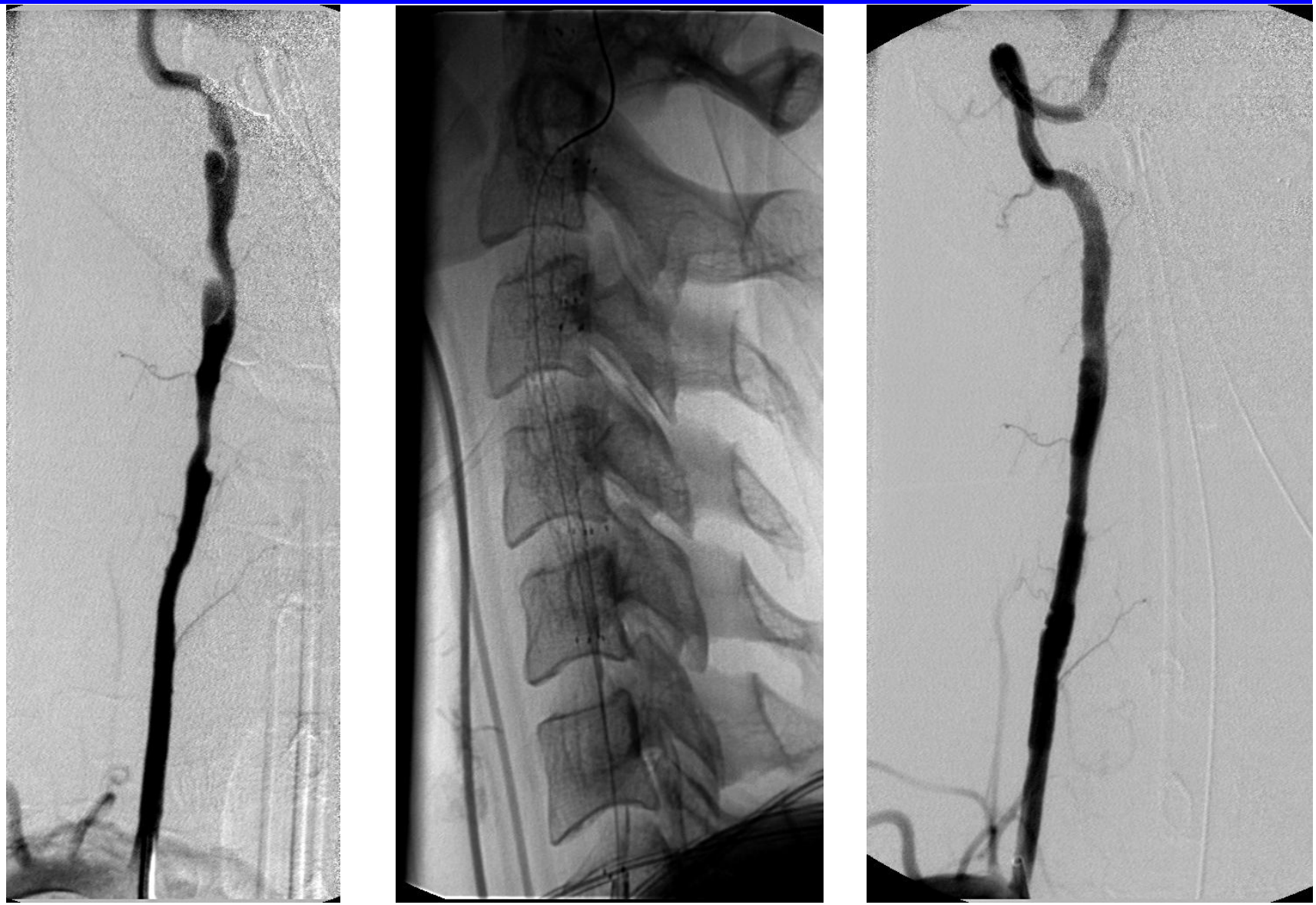
SYMPTOMATIC ICA DISSECTION WITH PSEUDOANEURYSM AFTER STENT-PTA

Table 3. Color duplex ultrasound findings at presentation and one-year follow-up in 200 spontaneous carotid dissections[1]

	Presentation (n = 200) n (%)	Follow-up (n = 188) n (%)
Atherosclerotic carotid artery plaque	15 (8)	19 (10)
Cervical ICA-vessel wall thickened and hypoechogenic	48 (24)	0
Second lumen	4 (2)	0
Dissecting aneurysm	1/17 (6)	1/17 (6)
Normal	24 (12)	110 (59)
Stenosis		
≤50%	16 (8)	17 (9)
51–80%	18 (9)	3 (2)
81–99%	75 (38)	17 (9)
Occlusion	77 (34)	41 (22)
Intracranial stenosis or occlusion[2]	45 (23)	0

From: Handbook on Cerebral Artery Dissection; Baumgartner et al, Karger 2005

DISSEKTION HVART.: EVT



From: Seifert T, Klein E, Legat-Wallner S, Krenn U, Brussee H, Lueger A, Niederkorn K, Fazekas F. J Neurol Neurosurg Psychiatry. 2008 Apr;79(4):480-1.

J Neurol (2006) 253 : 424–433
DOI 10.1007/s00415-005-0051-5

ORIGINAL COMMUNICATION

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E. B. Ringelstein
D. G. Nabavi

Negative ultrasound findings in patients with cervical artery dissection

Negative ultrasound in CAD

Table 2 Ultrasound findings in 86 patients with CAD

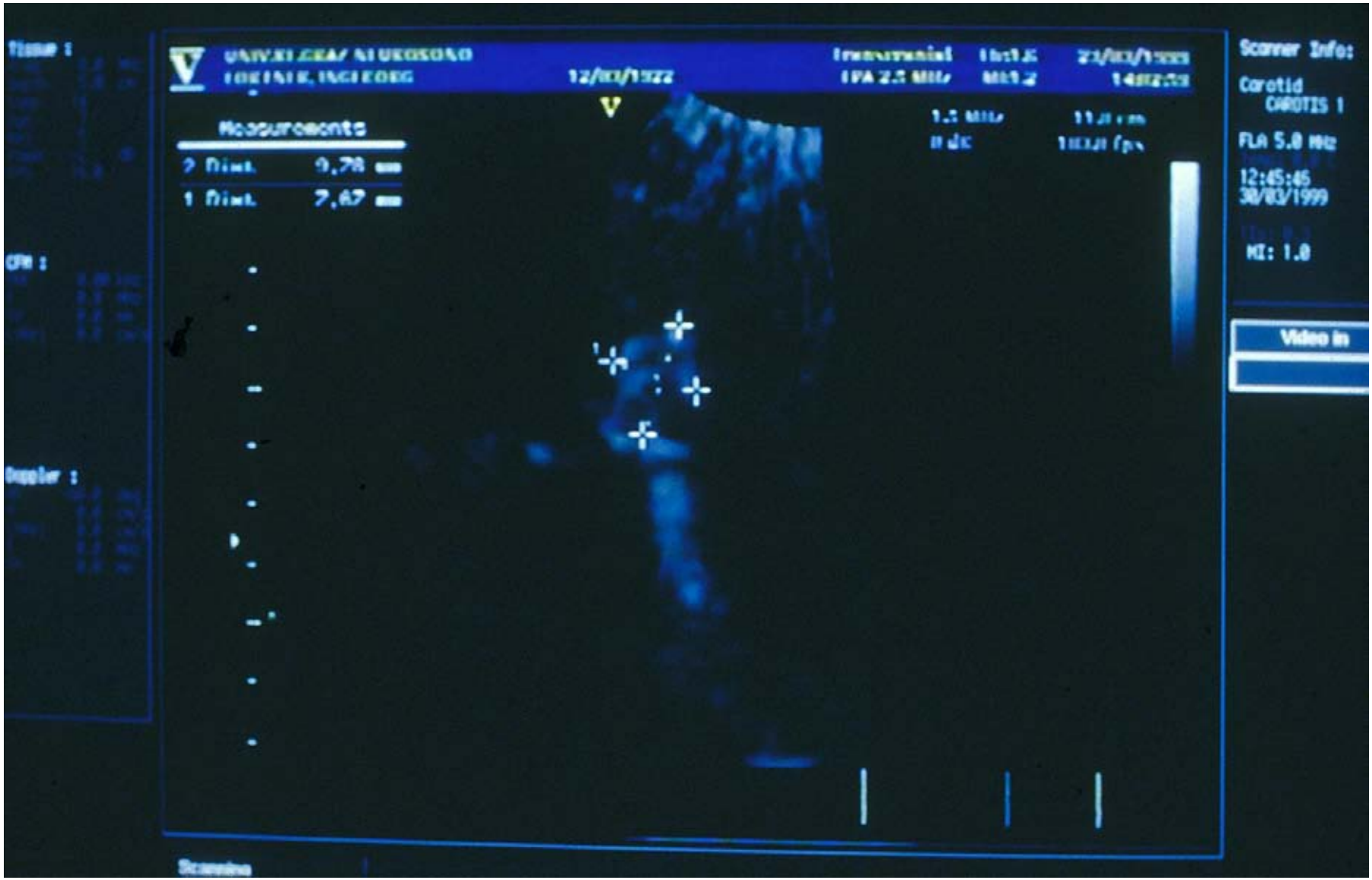
	Internal Carotid artery	Vertebral artery	All
Ultrasound findings			
Vessel occlusion	25 (29.1%)	12 (13.9%)	37 (43%)
Vessel stenosis	22 (25.6%)	16 (18.6%)	38 (44.2%)
Normal findings	9 (10.5%)	2 (2.3%)	11 (12.8%)

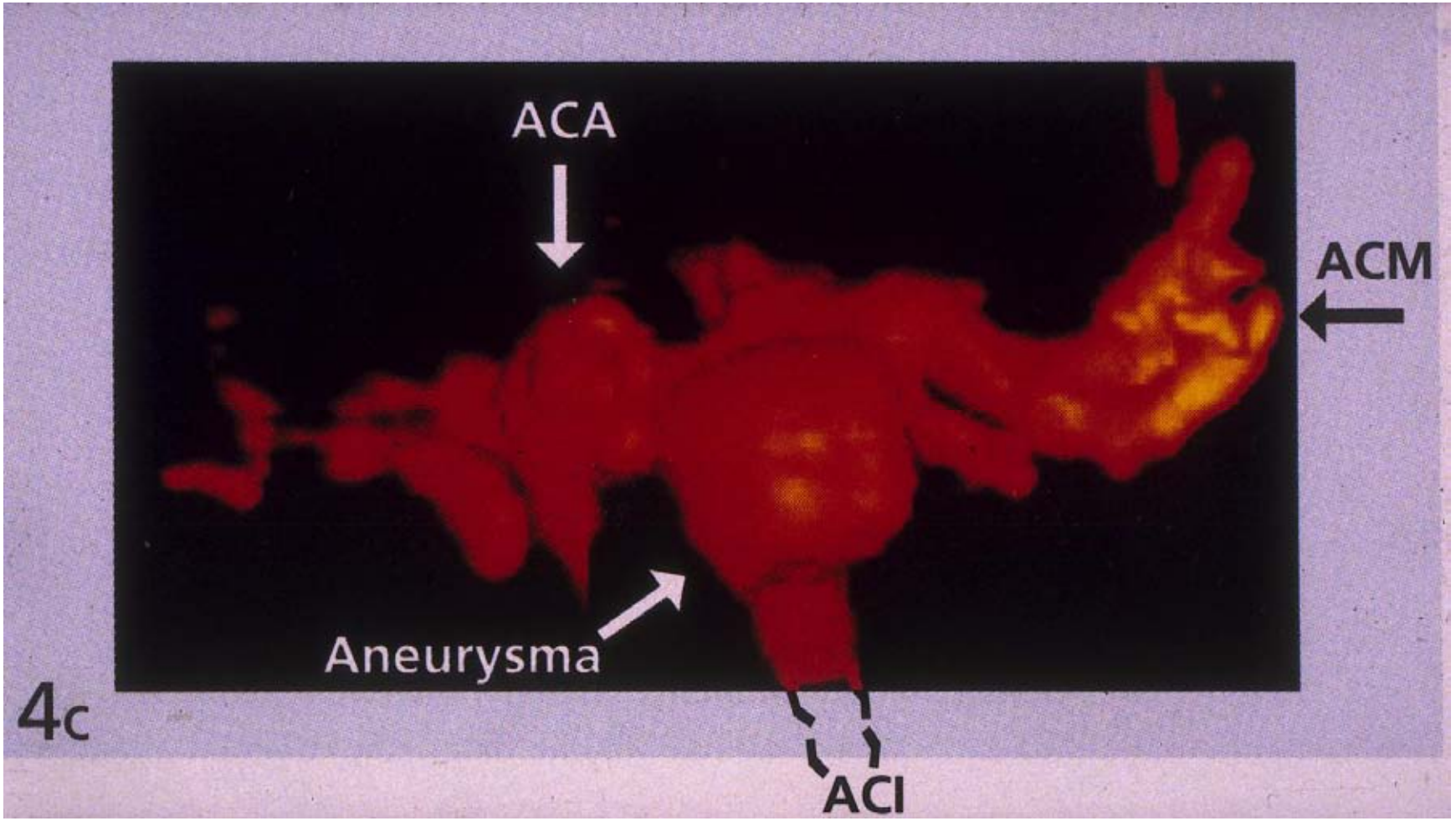
VASOSPASM

- Occurs in approximately 70% of persons with ruptured aneurysms
- Rare with non-aneurysmal hemorrhages
- Appears after 3-4 days, peaks at 7-10 days, and resolves over 2-4 weeks
- Can be localized or involves several arteries
- Release of factor at the time of bleeding that induces contraction of the lumen and decreased blood flow

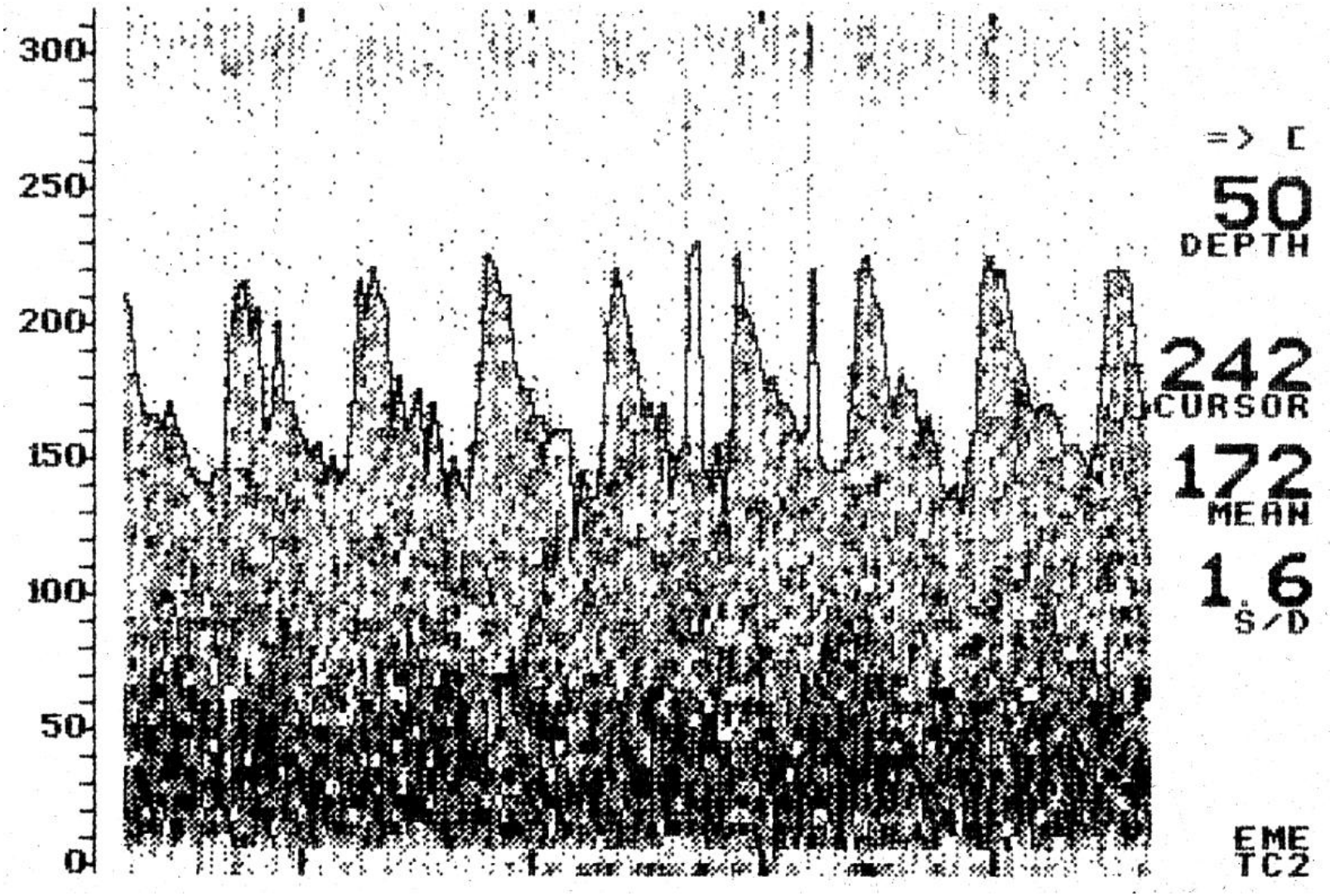

MOERTH ERIK
14.6.1930
RUN 24
02 JUL 86
AC/LI
I.A.
FT 1
FG 0.4


Scanner Info:
Carotid
CAROTIS I
FLA 5.0 MHz
17:46:51
29/03/1999
MI: 1.0
Video in

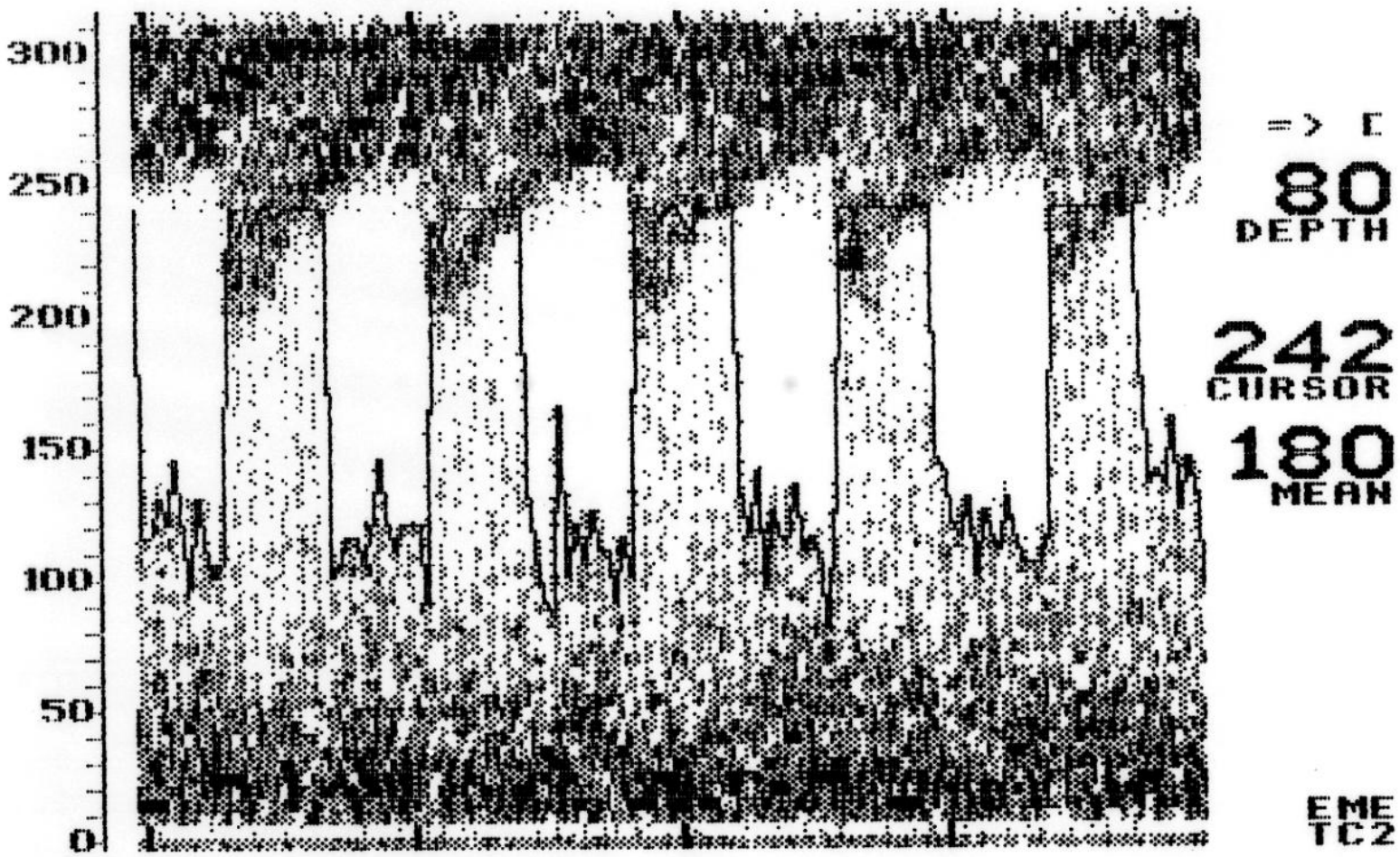

Measurements
2 Dist. 9,78 cm
1 Dist. 7,67 cm
Scanning
Scanner Info:
Carotid
CAROTIS 1
FLA 5.0 MHz
12:45:45
30/03/1999
MI: 1.0
Video in



4c

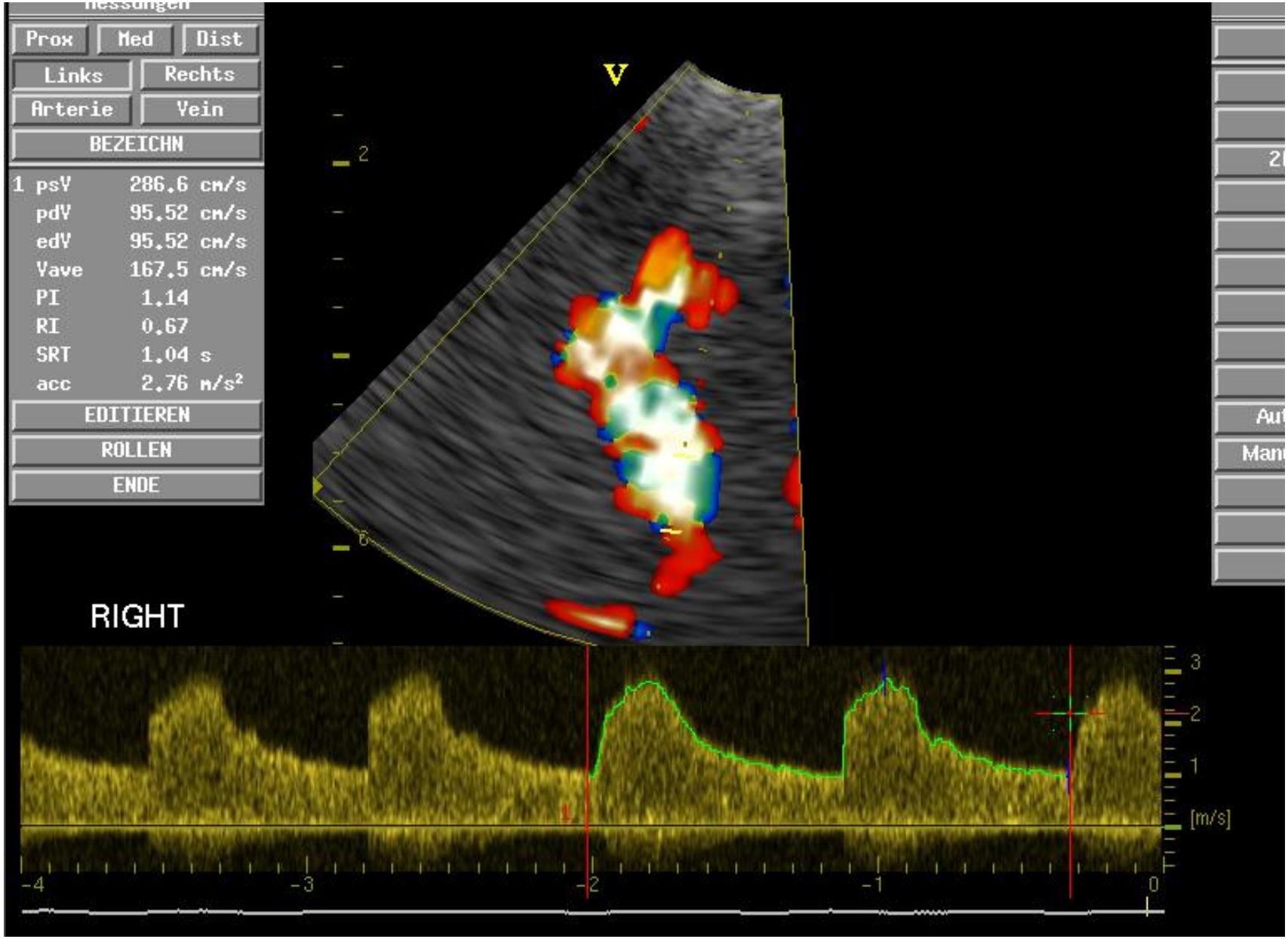


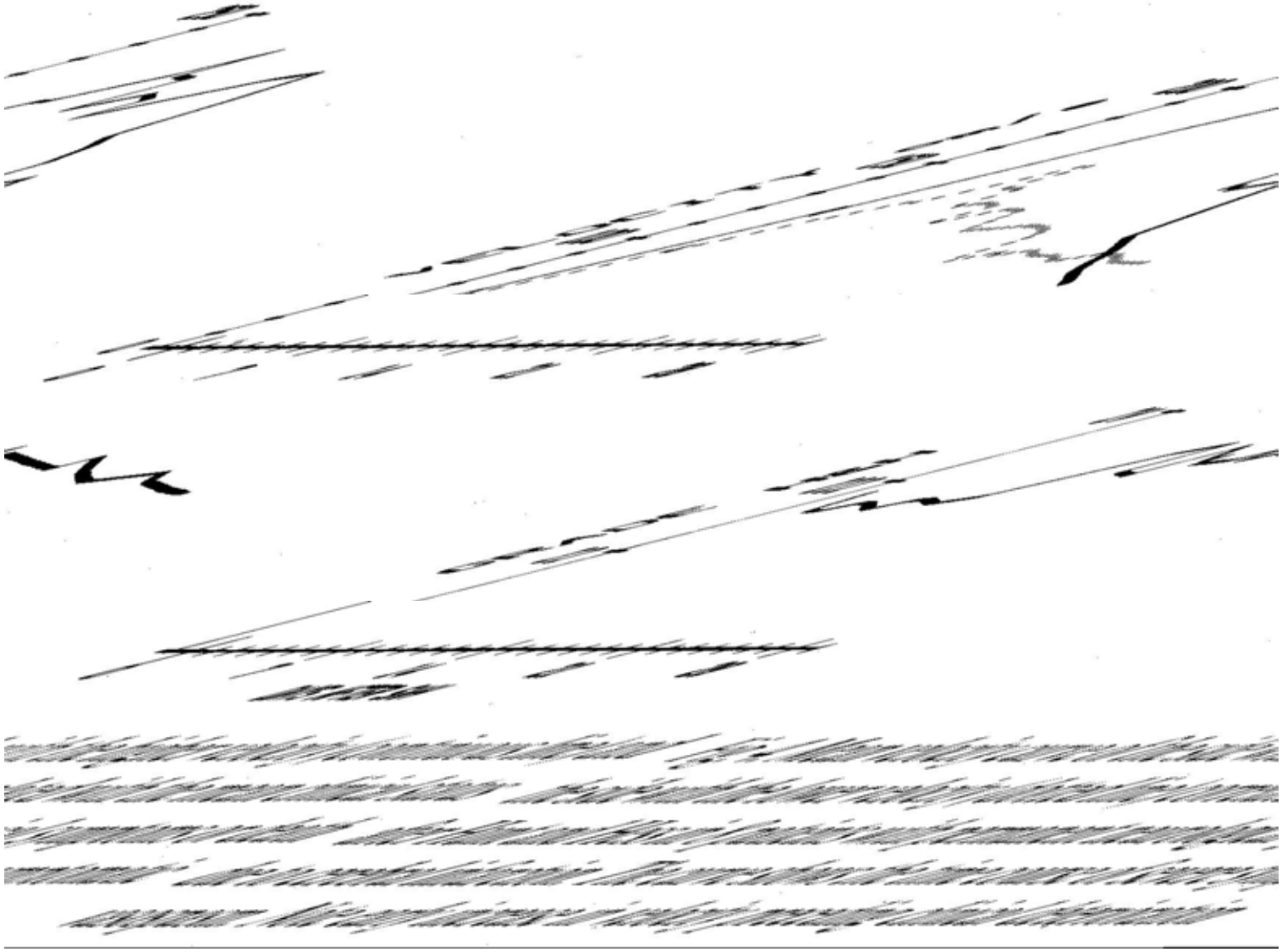
VASOSPASM MCA



VASOSPASM ACA

MCA VASOSPASM





From: Harders AG, **Gilsbach** JM.
J Neurosurg. 1987 May;66(5):718-28.

SAH
Detection of vasospasm

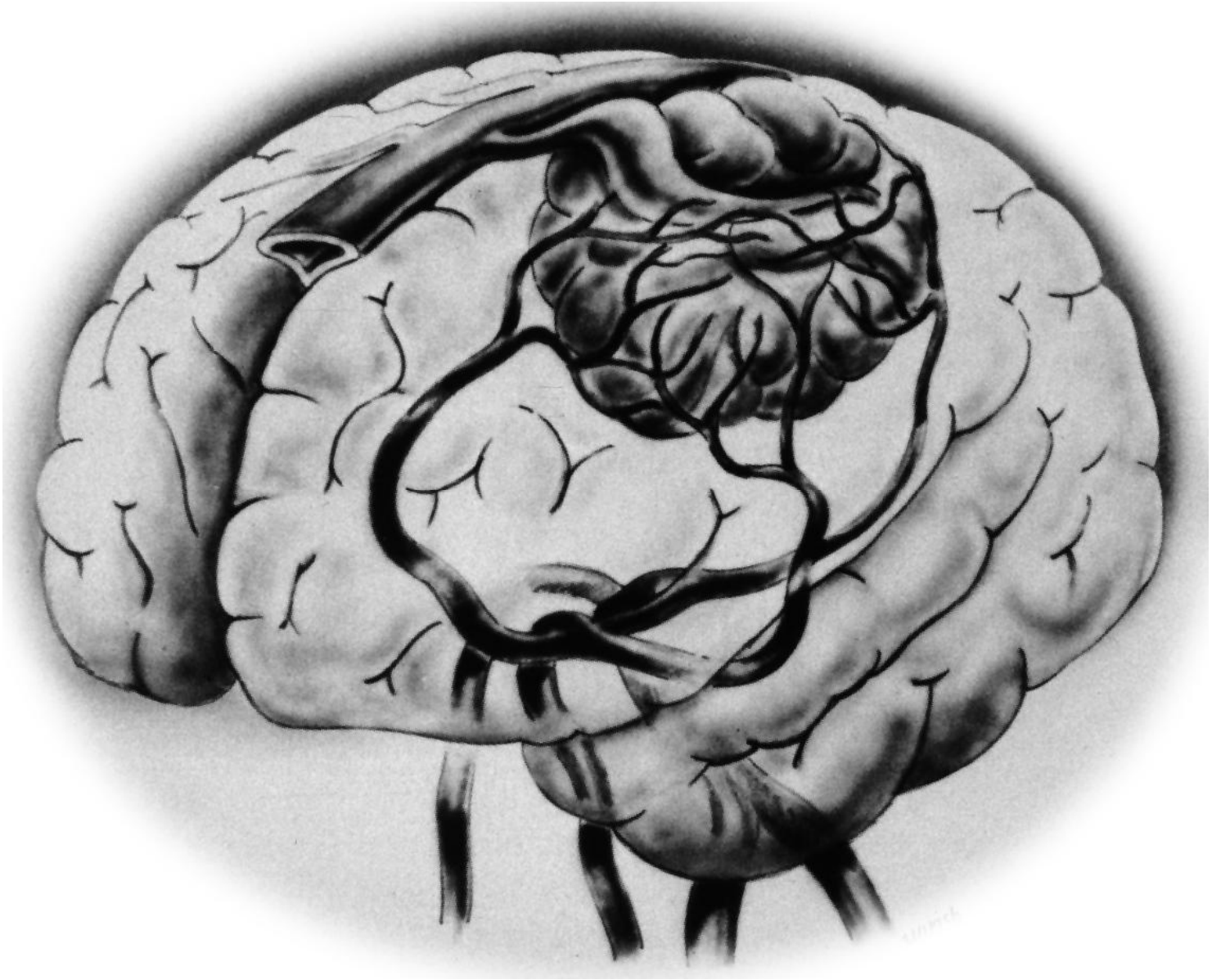
- Sensitivity (MCA) 80-90%, (ACA) 15%, (VB) 77%
- Specificity (MCA) 90%, (ACA) 95%, (VB) 80%
- MCA mean vel >120 mild, > 200 cm/sec severe vasospasm
- TCD not useful for distal vasospasm

Transcranial Doppler Findings in MeningitisAccording to Pathogenic Agent*

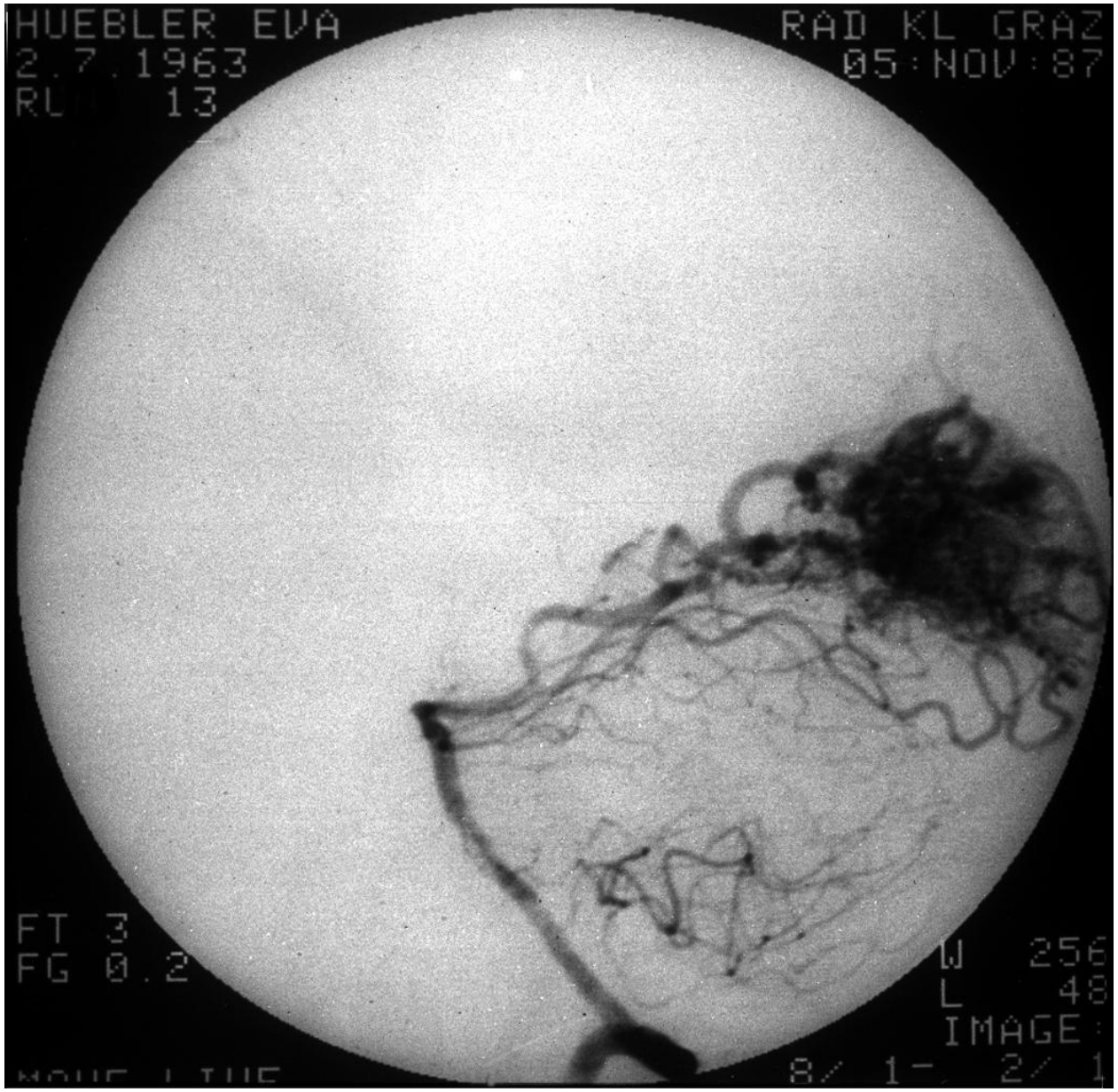
	No. (%)		
MCA Velocity (p)	Bacterial	Viral	Unclassified
Significantly increased (<.05)	32 (77)	0 (0)	0 (0)
Normal (>.05)	9 (23)	26 (100)	43 (100)

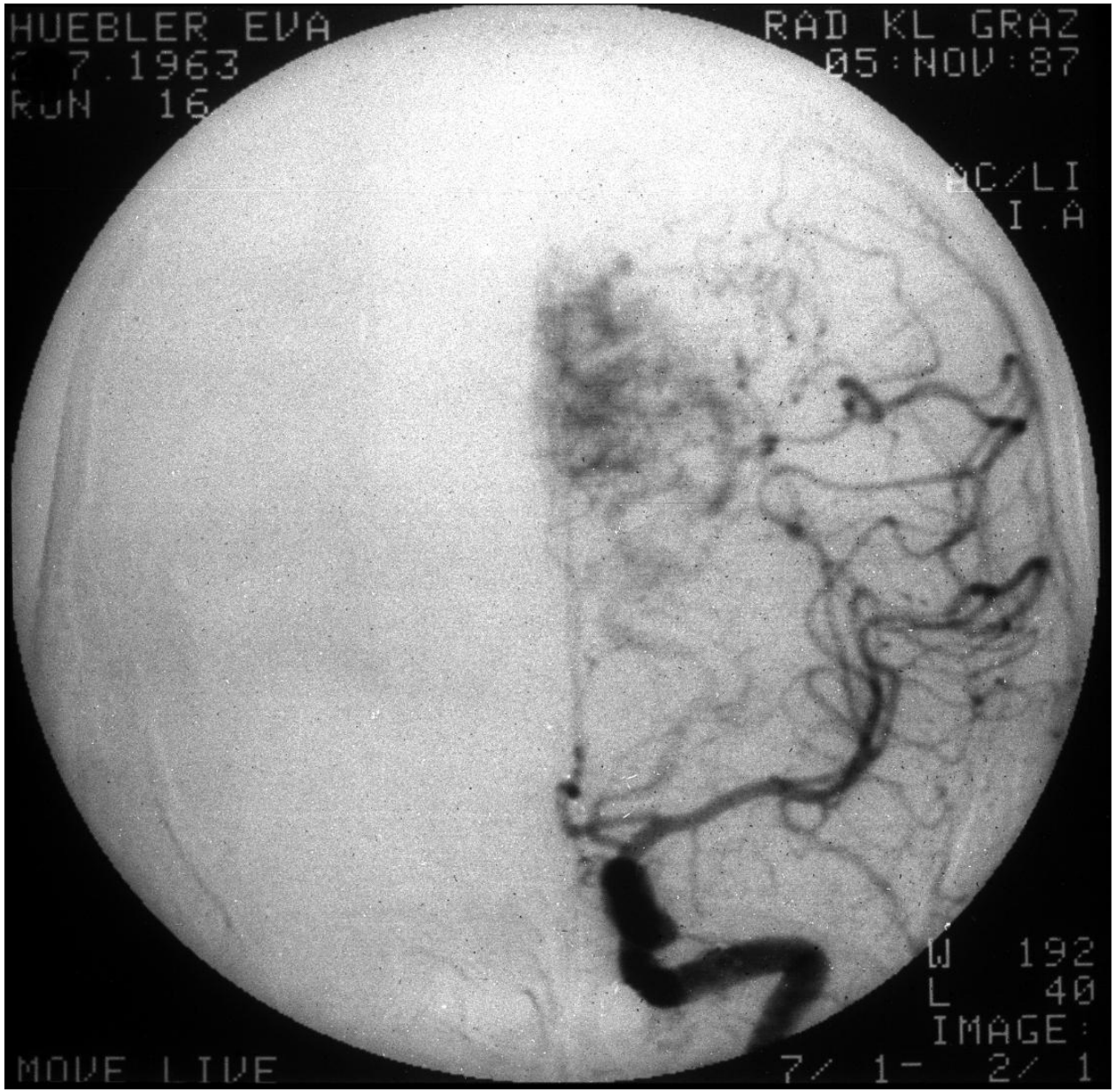
* MCA indicates middle cerebral artery

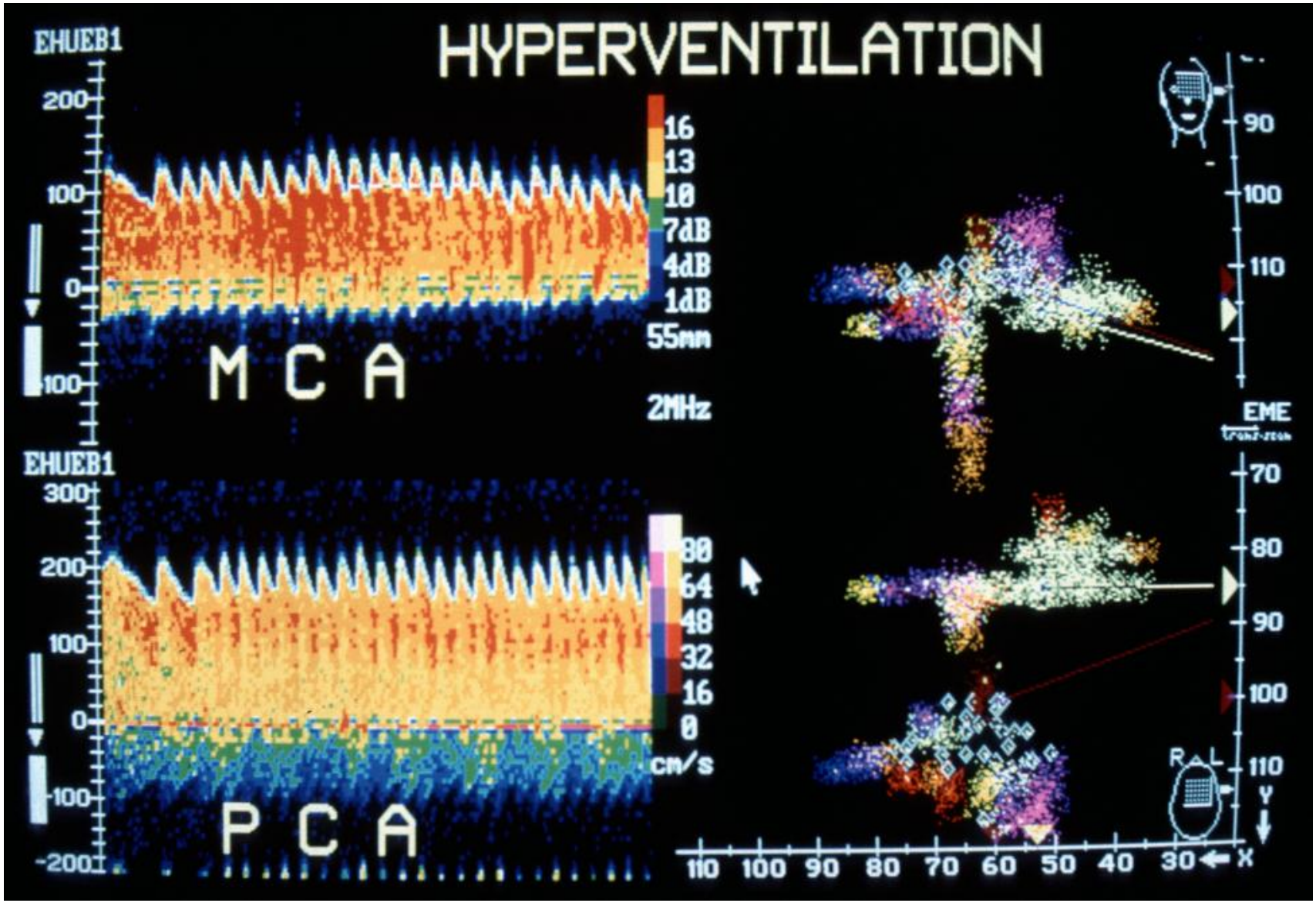
From; Haring H, Kampfl A, Grubwieser G, Donnemiller E, Pfausler B, **Schmutzhard** E. Eur J Neurol. 1998 Jan;5(1):75-81.

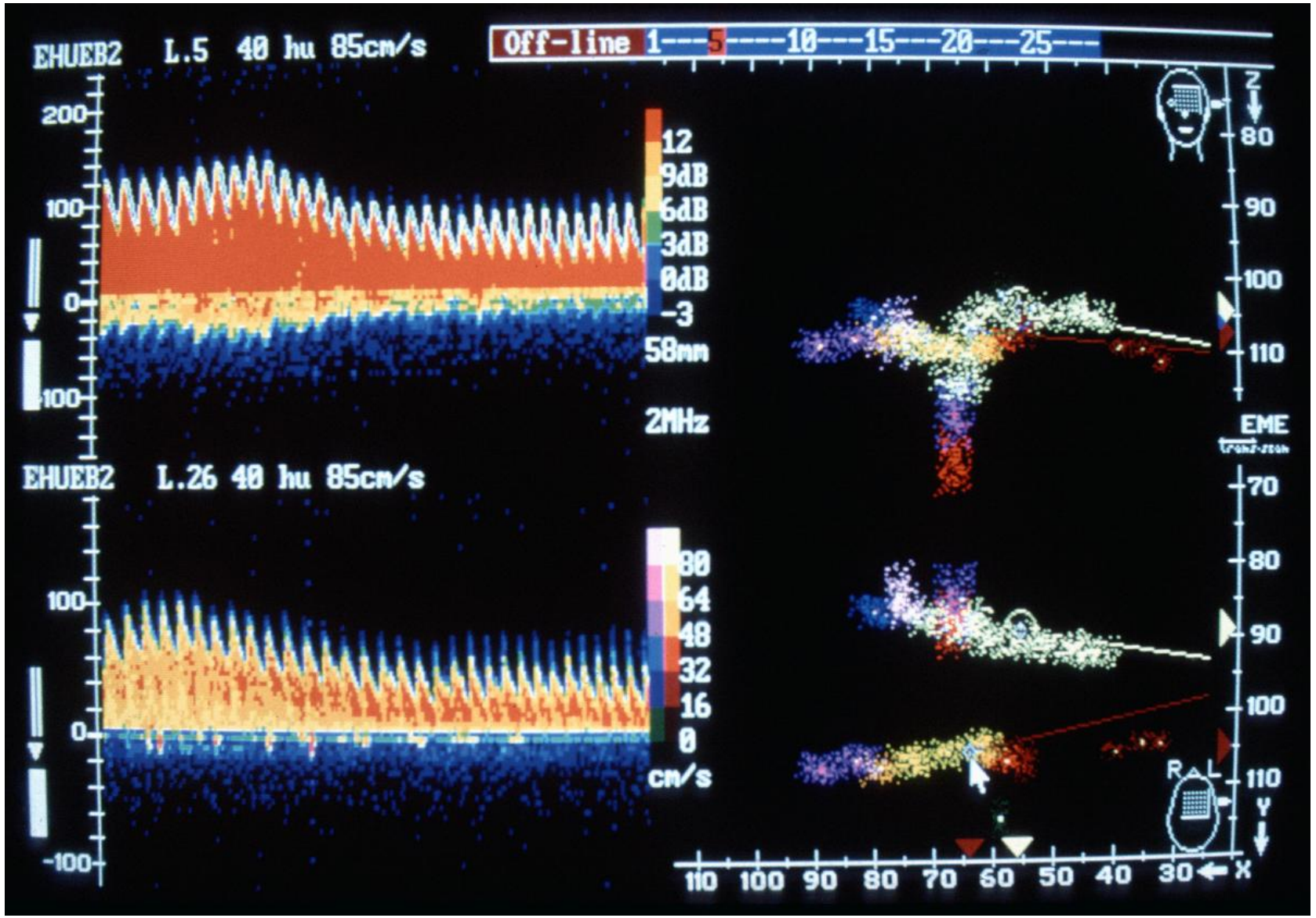



MR UNI KLIN GRAZ
2-DEC-1963
0000002211 f
Ex no 1959
21-OCT-87
1.5 Tesla
FOV 230 x1.0
Sl Th 5.8
No of meas 4
TR SE 600
TE 30
sagittal
Offc Ang
AP 16 0
CC 10 0
LR -11 0
WW 1198 16
WL 721 16
Neurologie
A
S: 7
E: 1
Philips Gyroscan

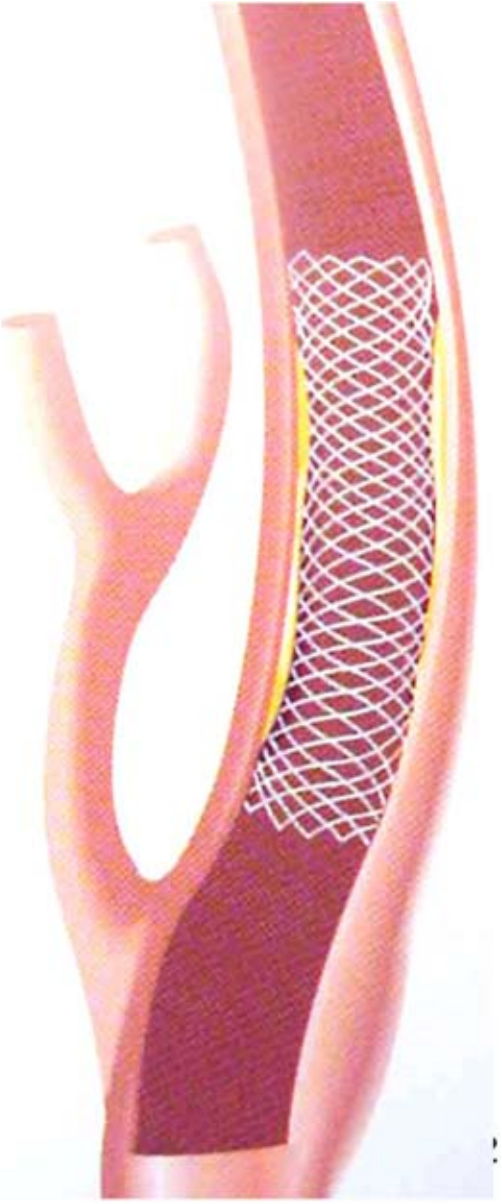

HUEBLER EVA
2.7.1963
RL 13
RAD KL GRAZ
05:NOV:87
FT 3
FG 0.2
W 256
L 48
IMAGE:
8/ 1- 2/ 1


HUEBLER EVA
7.1963
RUN 16
RAD KL GRAZ
05:NOV:87
C/LI
I.A
W 192
L 40
IMAGE:
MOVE LIVE
7/ 1- 2/ 1

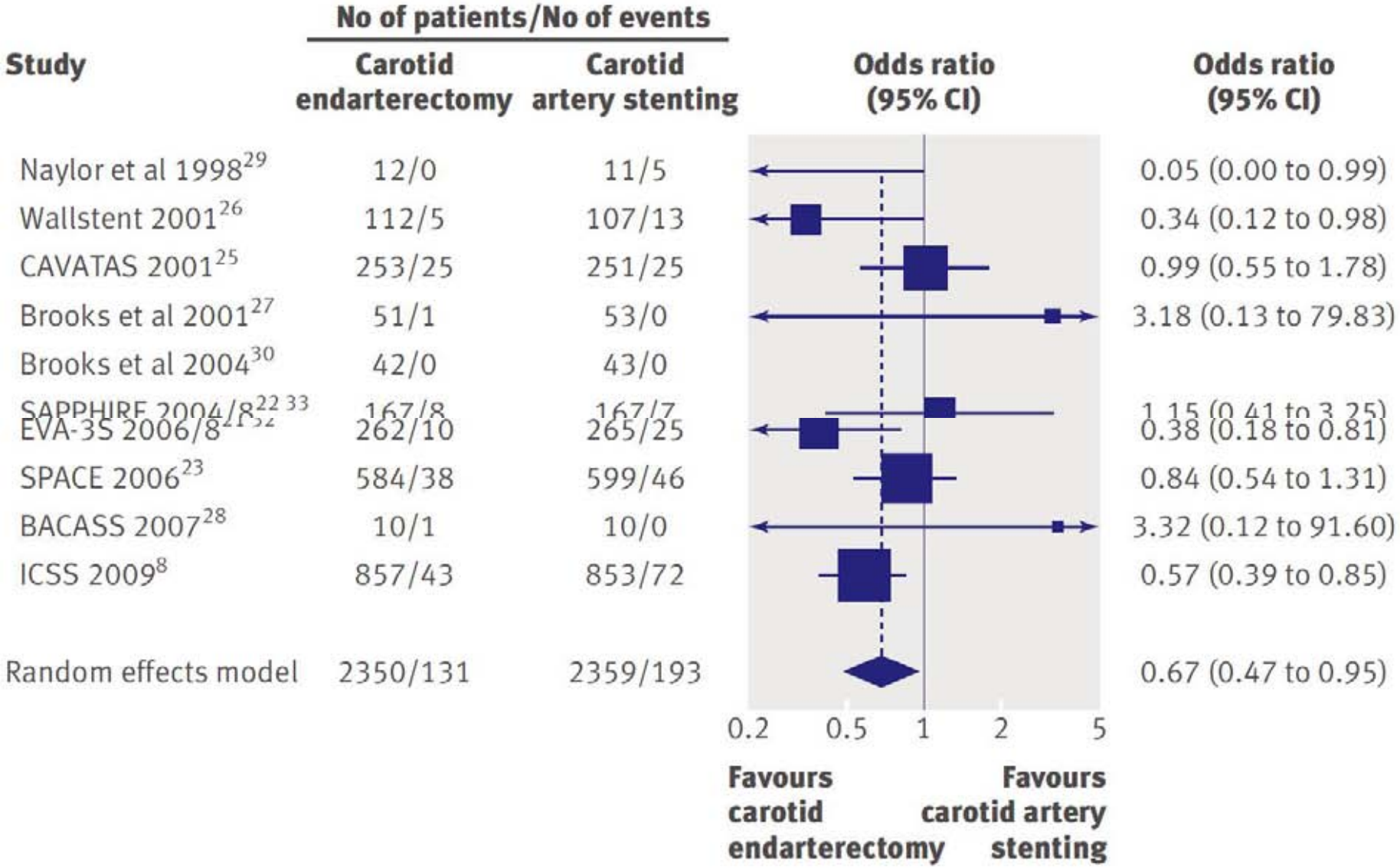

HYPERVENTILATION
EHUEB1
200
100
0
100
16
13
10
7dB
4dB
1dB
55mm
2MHz
M C A
EHUEB1
300
200
100
0
100
200
80
64
48
32
16
0
cm/s
P C A
90
100
110
EME
70
80
90
100
110
R
L
Y
110 100 90 80 70 60 50 40 30
X


EHUEB2 L.5 40 hu 85cm/s
Off-line 1---5----10---15---20---25---
200
100
0
-100
12
9dB
6dB
3dB
0dB
-3
58mm
2MHz
EHUEB2 L.26 40 hu 85cm/s
100
0
-100
80
64
48
32
16
0
cm/s
Z
80
90
100
110
EME
70
80
90
100
110
R L
Y
110 100 90 80 70 60 50 40 30 X

CAROTID STENTING

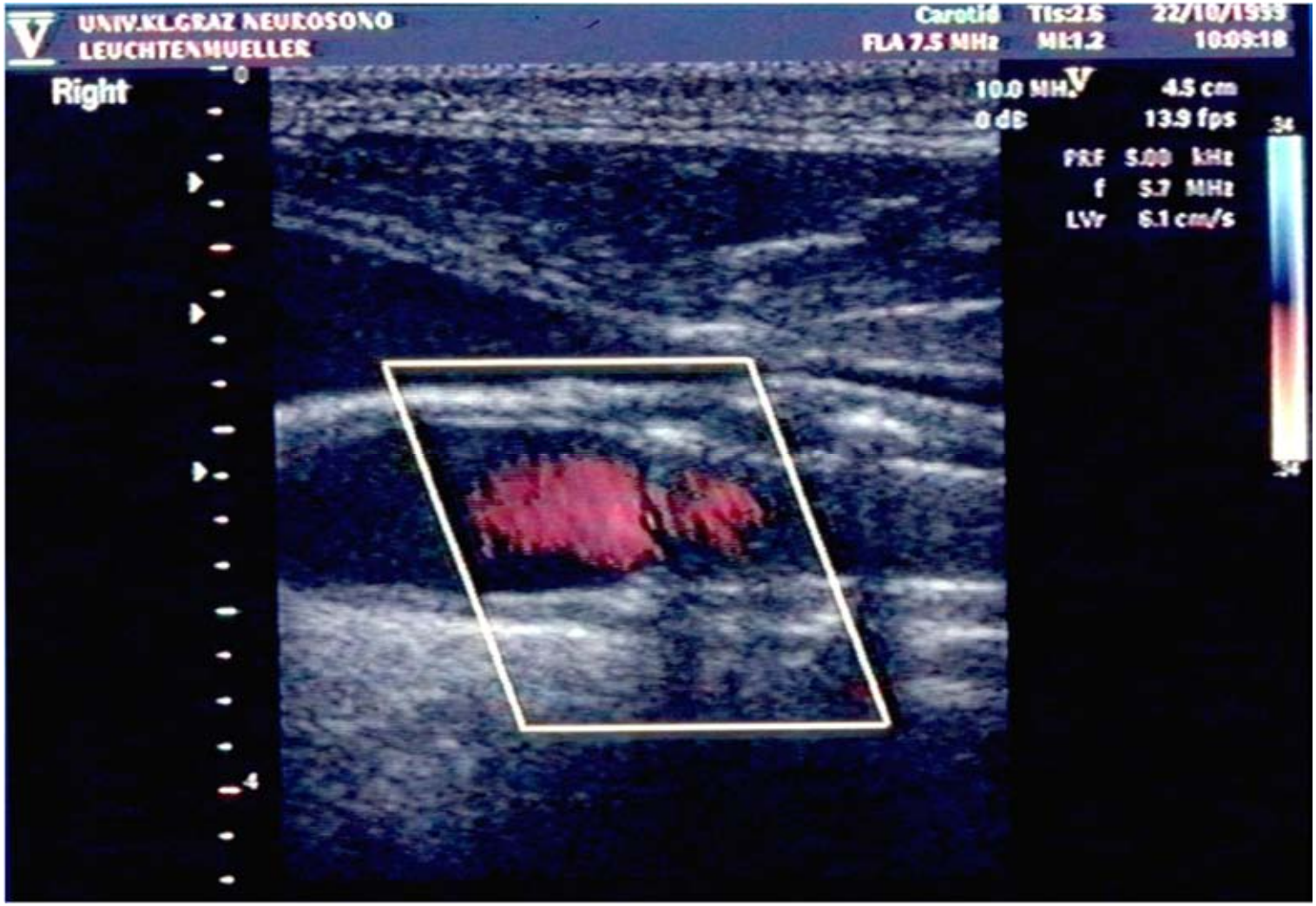


30 d Stroke and Death risk



Meier et al, BMJ2010;340:c148

ICA BIFURCATION AFTER STENT-PTA



Results

ICA + CCA

pre-interventional stenosis distribution (angio):

Category 0 = 6 (2,2%); Category 1 = 18 (6,5%)

Category 2 = 253 (91,3%)

Residual Stenosis

(sonographical) day 1 post Stent:

N= 277

Categ. 0 (0-49%): 244 (88,0%)

Categ. 1 (50-69%): 22 (7,9%)

Categ. 2 (70-99%): 11 (4,1%)

Categ. 3 (Occlusion): 0 (0,0%)

Re-Stenosis

(1-6 months follow-up)

N= 218

Categ. 0: 203 (93,1%)

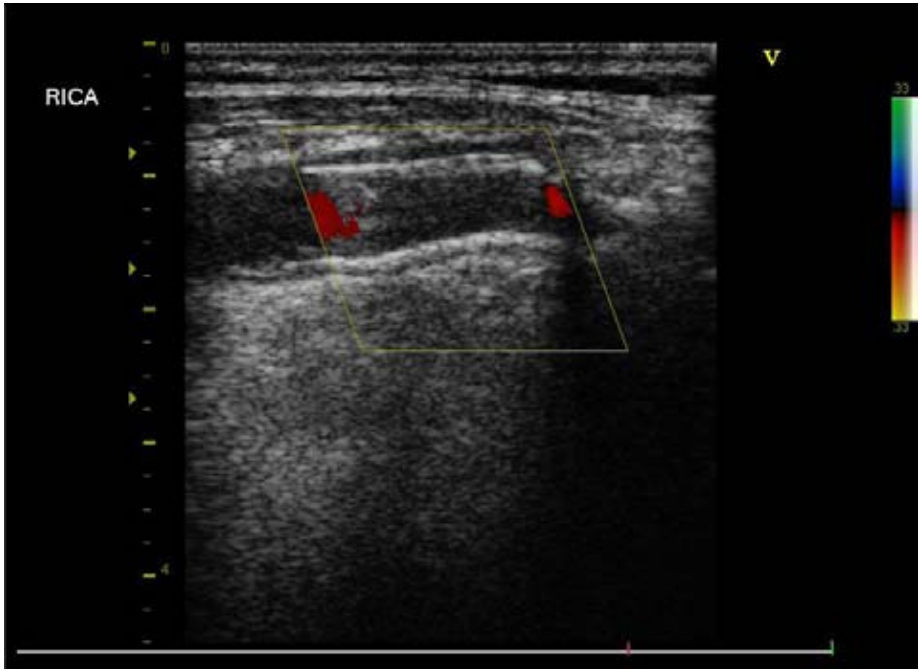
Categ. 1: 6 (2,8%)

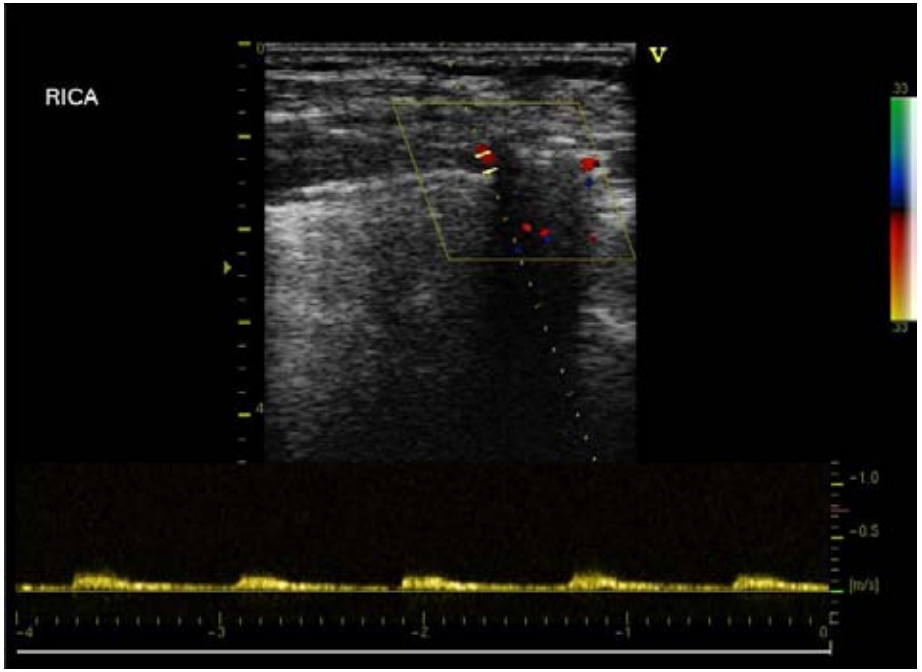
Categ. 2: 7 (3,2%)

Categ. 3: 2 (0,9%)

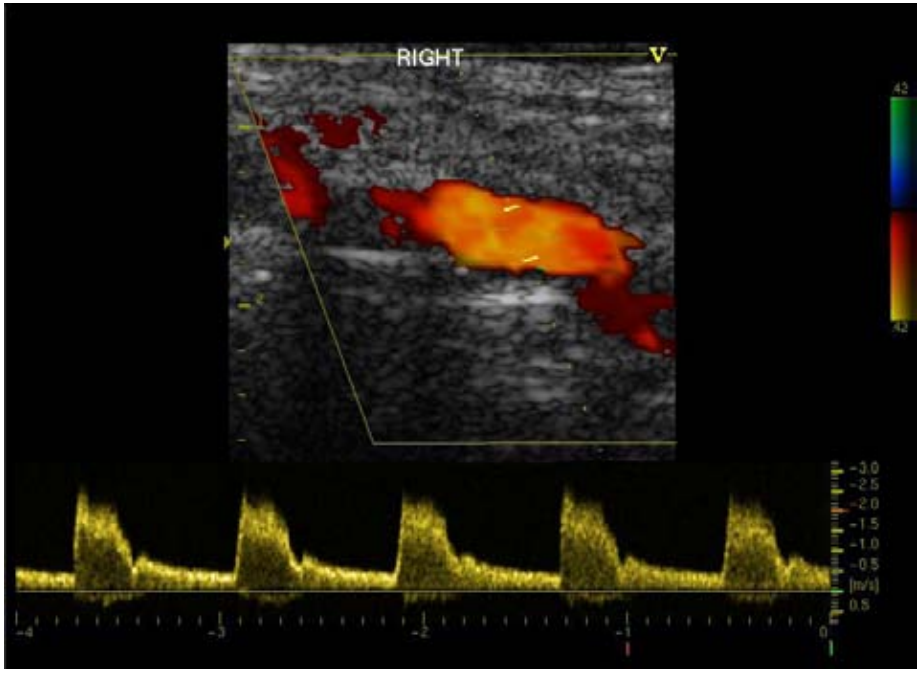
Residual stenosis -sonographical and clinical assessment

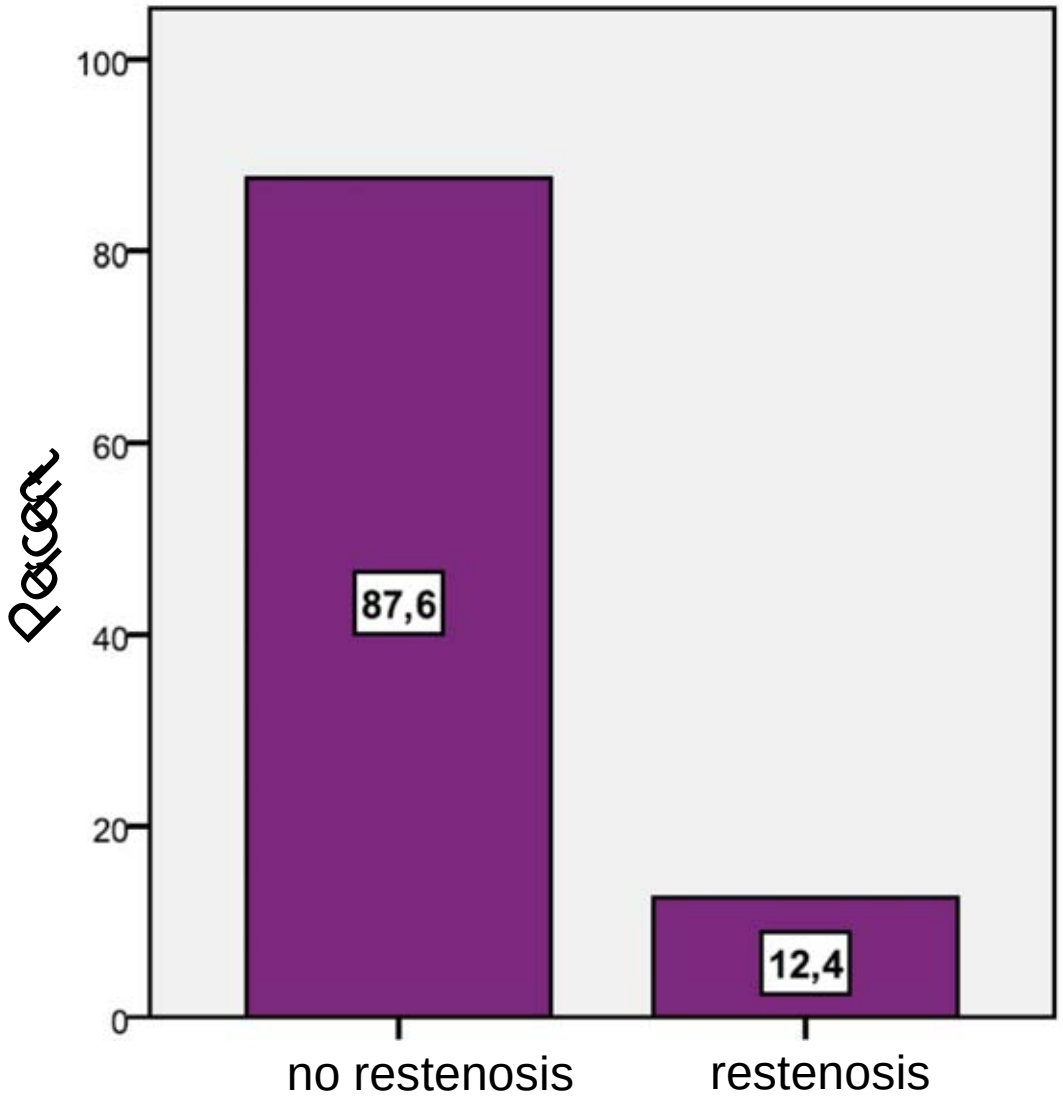
	Preproced.	Day 1	Day 30	Month 3	Month 6	Protect.	Stent
Cat. 0 N=161							
Cat. 1 N=13	70%	60%	50-60	50-60	50-60	no	W
	90%	50%	0	0	0	Accunet	AC
	90%	50-60%	x	x	x	0	W
	80%	50-60%	=	=	=	S	AC
	80%	50-60%	=	=	=	0	W
	80%	50%	x	x	x	N	W+AC
	70%	50%	=	=	=	N	AC
	90%	60%	Stroke,MI (died)	x	x	N	AC
	90%	50-60%	50%	50-60%	50-60%	0	W
	80%	60%	TIA	50%	60-70%	A	W
	>80%	50%	=	60%	60%	A	W
	70%	50%	=	=	=	A	P
	>90%	50%	=	=	=	0	W
Cat. 2 N=9	80%	70-80%	x	=	=	A	W
	80%	70%,TIA	x	70%	70%	E	W
	80%	Thromb,Stroke	0%	=	=	A	W
	>90%	70%, Stroke	70%	=	0% Redil.	N	AC
	80%	60-70%	0	0	0	no	W+AC
	severe(2)	severe (2)	x	X	X	no	Neuroform
	70-80%	60-70%	=	died (Pneumonia)	X	Epifilter	Silver
	70-80%	60%	50%	50%	50%	Spider	Precise/Yo
	70-80%	50%	50%	50%	X	Spider	Exact
Cat. 3 (0)							





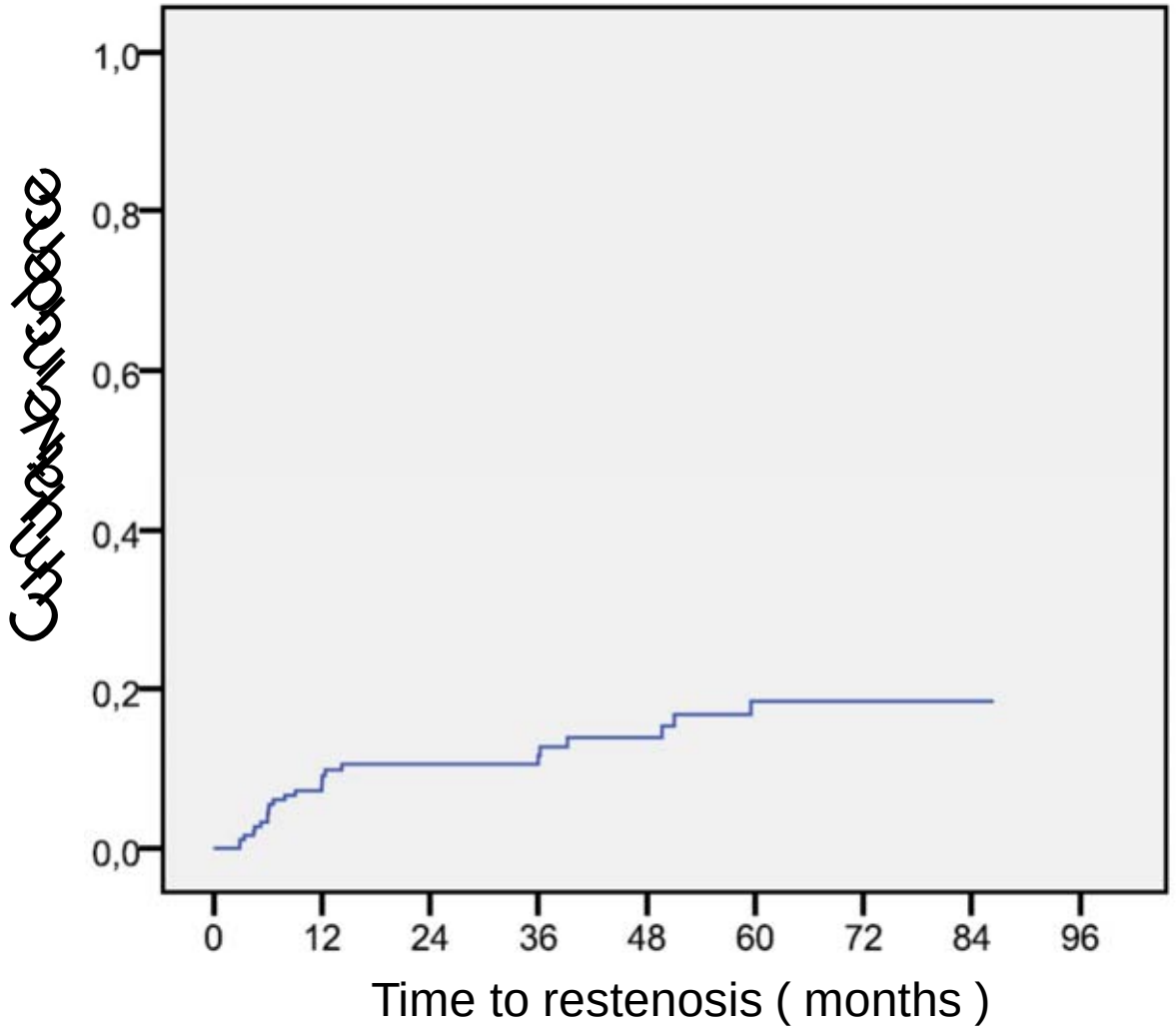
PARTIAL STENT THROMBOSIS- BEFORE AND AFTER TREATMENT WITH RHEOPRO



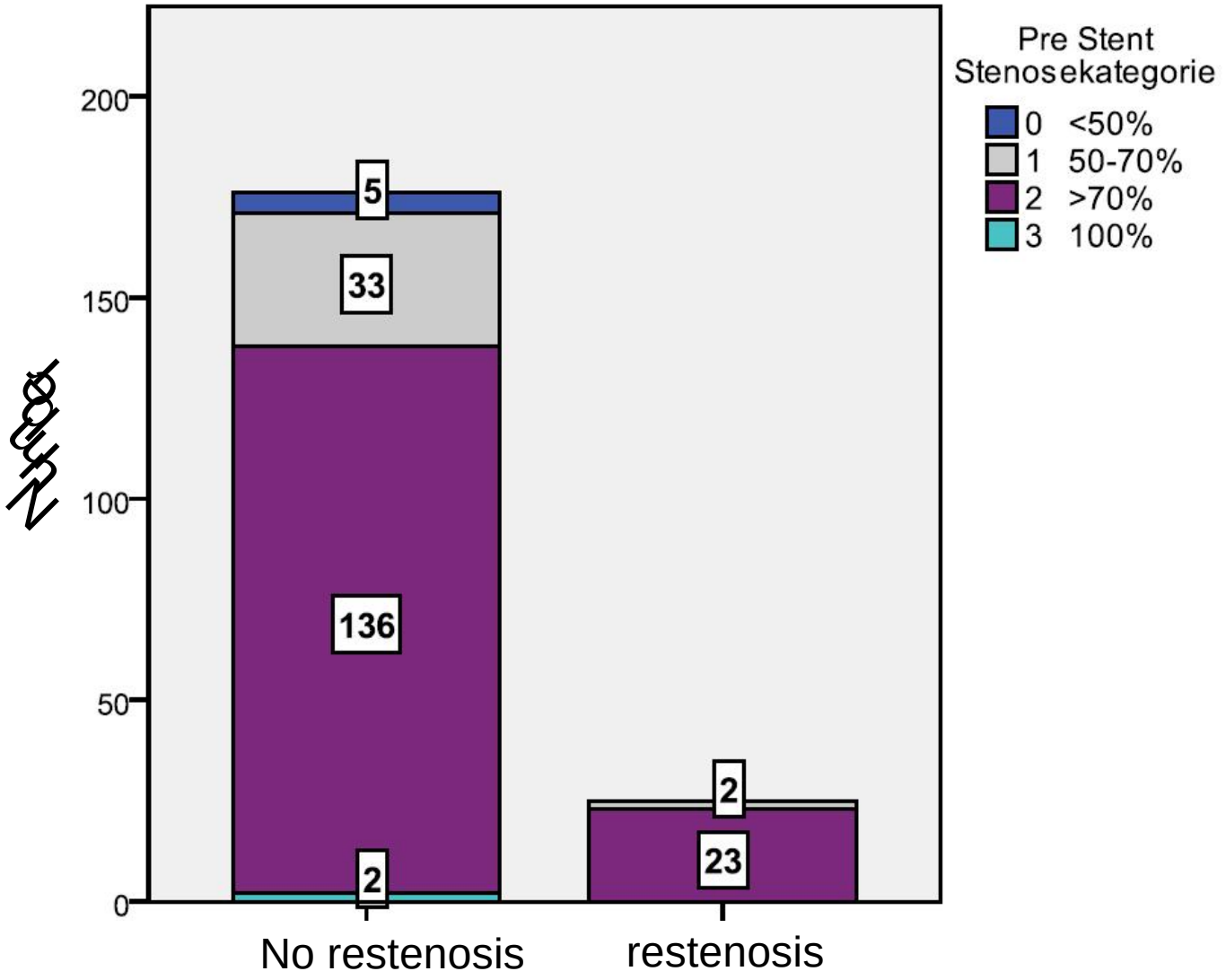


Symptomatic
14.7%
Asymptomatic
9.8%

CAS Stenting, N= 201, mean FU time 37 mo; mean time to resten. 14 .5 mo



CAS Stenting, N= 201, mean FU time 37 mo; mean time to resten. 14 .5 mo



CAS Stenting, N= 201, mean FU time 37 mo; mean time to resten. 14 .5 mo

SPACE- Restenoses at 24 months

	CAS	CEA	OR (95% CI)
Intention-to-treat	54 / 607 (8.9%)	23 / 589 (3.9%)	2.40 (1.46 - 3.97)
Per-protocol	54 / 573 (9.4%)	23 / 563 (4.1%)	2.44 (1.48 - 4.04)

Two (both after CAS) were symptomatic !

From :Eckstein HH, **Ringleb** P, Allenberg JR, Berger J, Fraedrich G, Hacke W, Hennerici M, Stingele R, Fiehler J, Zeumer H, Jansen O Lancet Neurol. 2008 Oct;7(10):893-902.

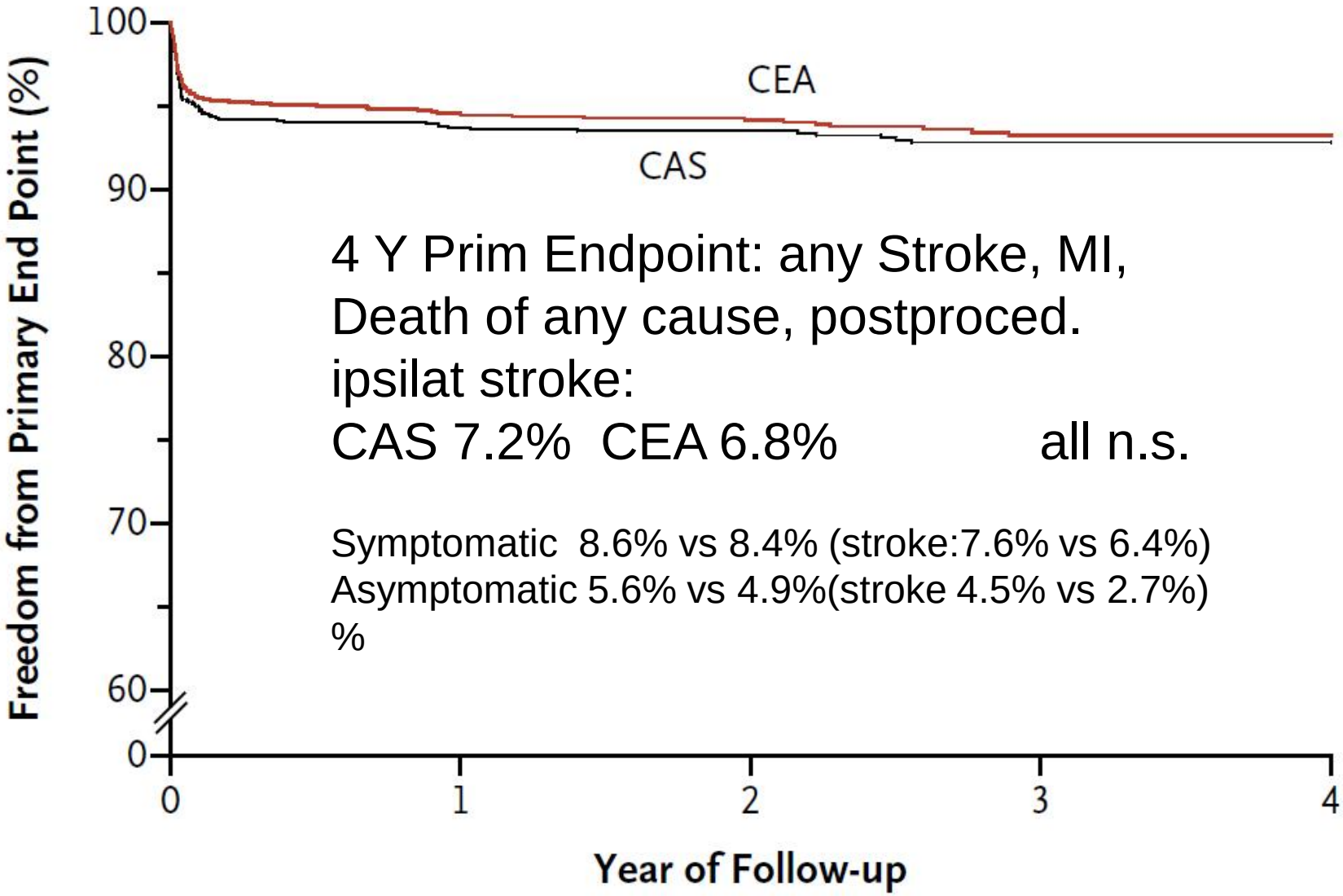
CREST-Risk Factors for All Restenosis Patients

2 y FU Sten/Occl, CAS 6.0(0.3%)% vs TEA 6.3(0.5%)

Factor	No Restenosis (n=2071)	Restenosis (n=120)	Multivariable Hazard Ratio (95% CI)
Female sex (%)	33,1	46,7	1,83 (1,3-2,7)
Diabetes (%)	29,4	50,0	2,22 (1,5-3,3)
Dislipidemia(%)	84,9	93,3	1,97 (0,9-4,3)

Interestingly, smoking increased the risk of restenosis in endarterectomy patients but appeared protective in the stenting group

B. Lal, International Stroke Conference (ISC) 2012: Abstract #3. Presented February 1, 2012.

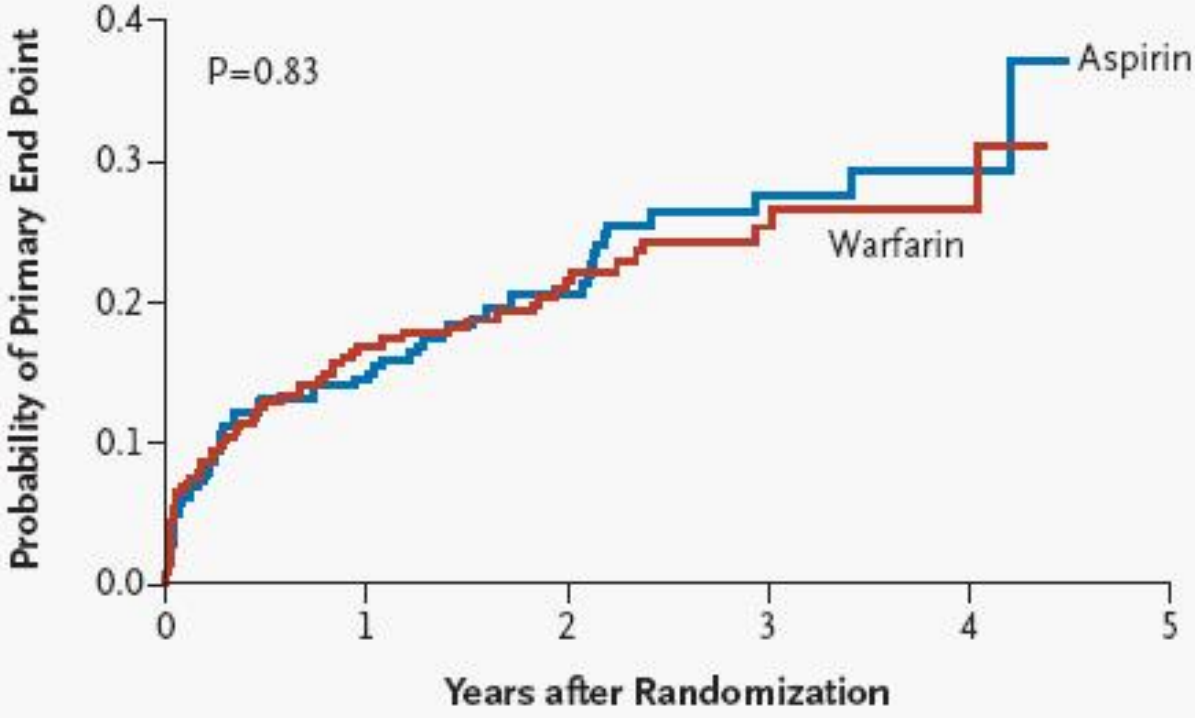


4 Y Prim Endpoint: any Stroke, MI, Death of any cause, postproced. ipsilat stroke:
CAS 7.2% CEA 6.8% all n.s.

Symptomatic 8.6% vs 8.4% (stroke:7.6% vs 6.4%)
Asymptomatic 5.6% vs 4.9%(stroke 4.5% vs 2.7%)
%

No. at Risk					
CAS	1262	1100	787	460	162
CEA	1240	1099	770	430	145

Thomas G. Brott et al, N Engl J Med 2010;363:11-23

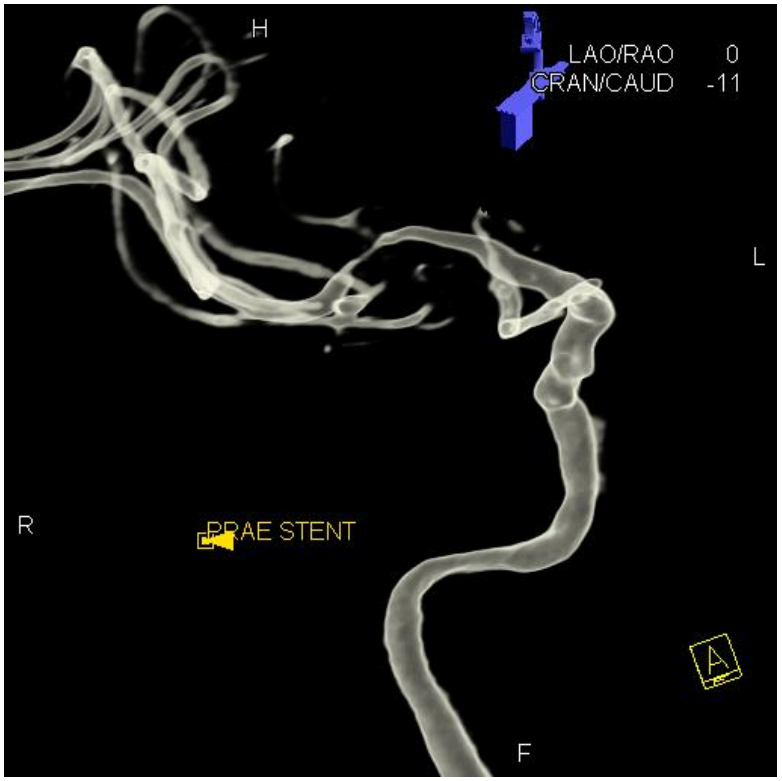


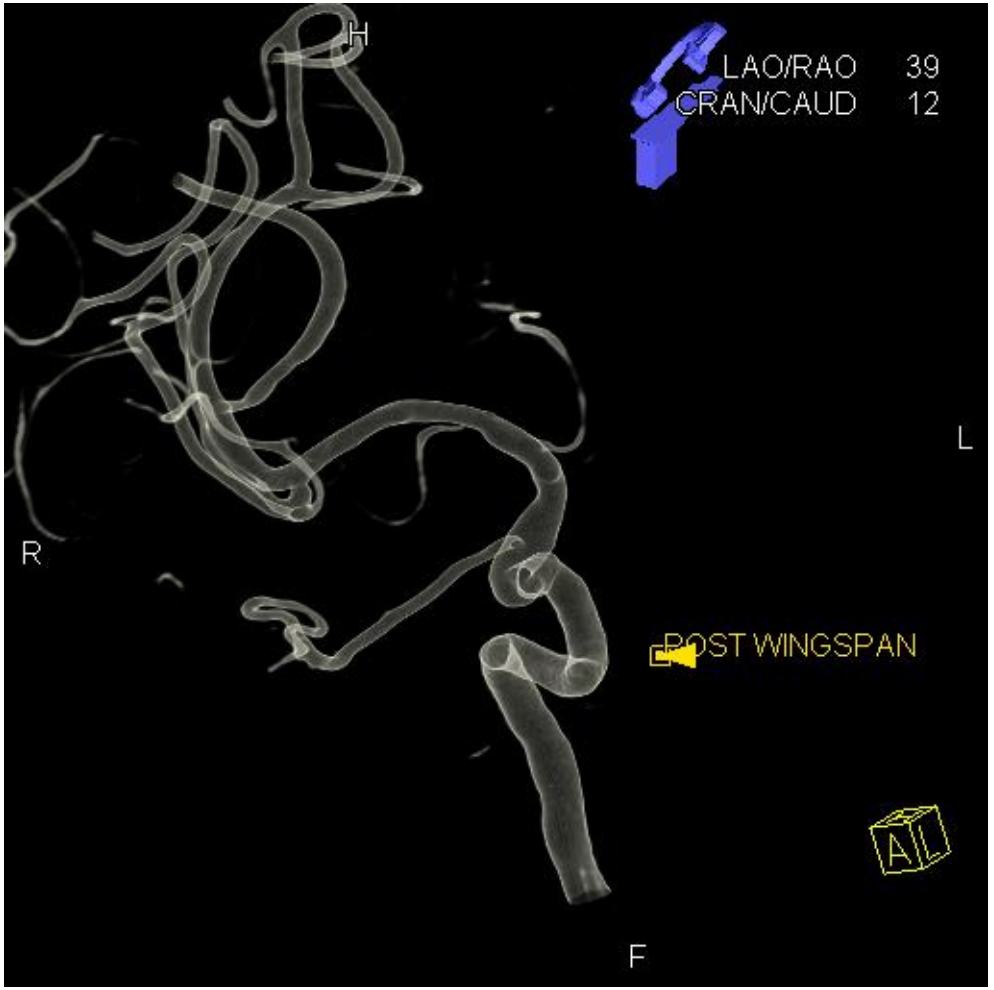
No. at Risk					
Aspirin	280	192	120	59	18
Warfarin	289	202	130	66	16

Figure 2. Cumulative Incidence of the Primary End Point after Randomization, According to Treatment Assignment.

The primary end point was ischemic stroke, brain hemorrhage, or death from vascular causes other than stroke.

Chimowitz et al,WASID; NEJM 2002;352:1305-1316

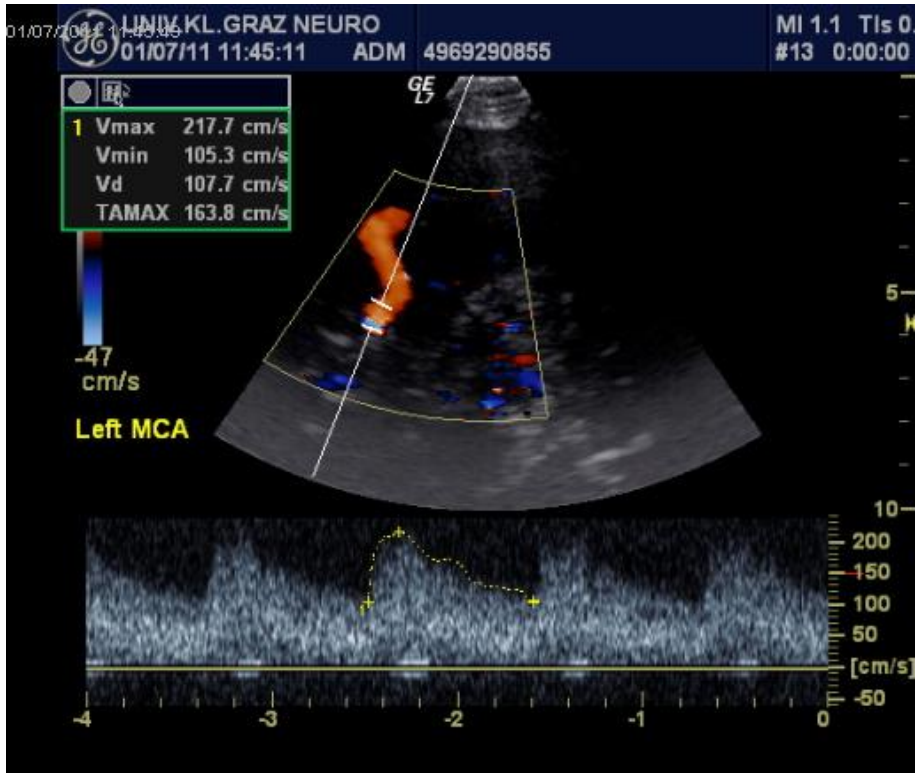

H
LAO/RAO 0
CRAN/CAUD -11
L
R
PRAE STENT
A
F


H
LAO/RAO 39
CRAN/CAUD 12
L
R
POST WINGSPAN
AL
F

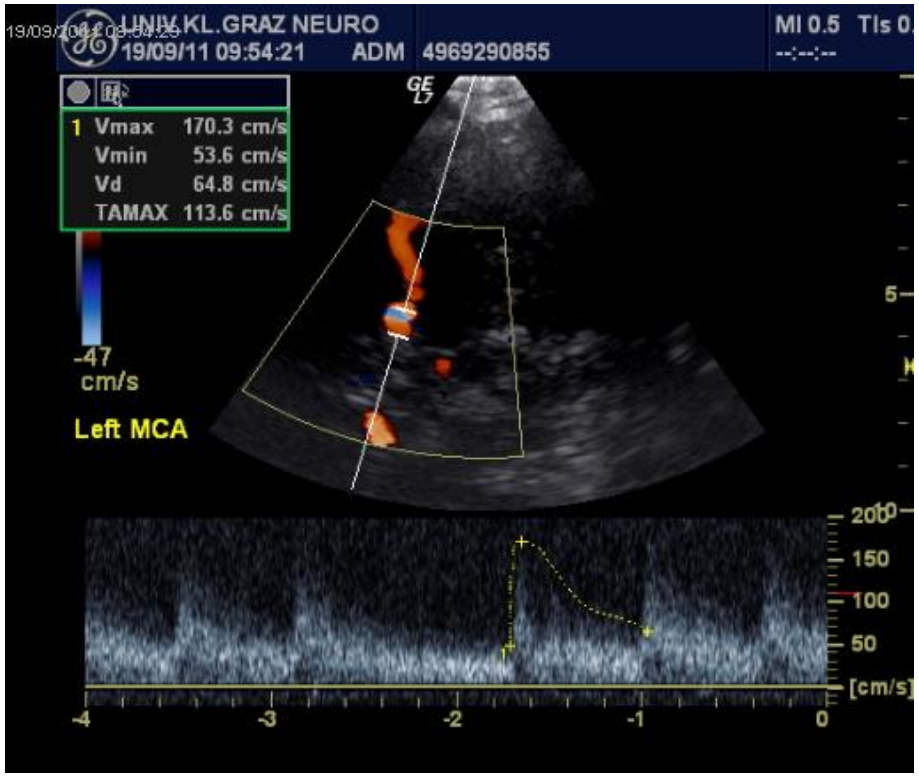
The NIH registry on use of the Wingspan stent for symptomatic 70–99% intracranial arterial stenosis

Results: A total of 129 patients with symptomatic 70% to 99% intracranial stenosis were enrolled. The technical success rate was 96.7%. The mean pre and post-stent stenoses were 82% and 20%. The frequency of any stroke, intracerebral hemorrhage, or death within 30 days or ipsilateral stroke beyond 30 days was 14.0% at 6 months (95% CI = 8.7% to 22.1%). The frequency of ≥50% restenosis on follow-up angiography was 13/52 (25%).

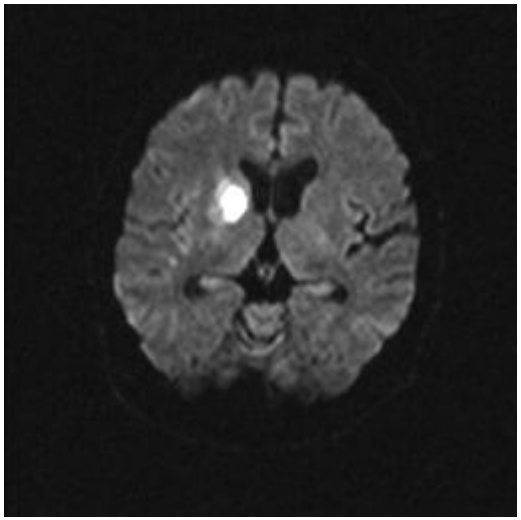
Zaidat et al, Neurology 2008 70(17):1518-24

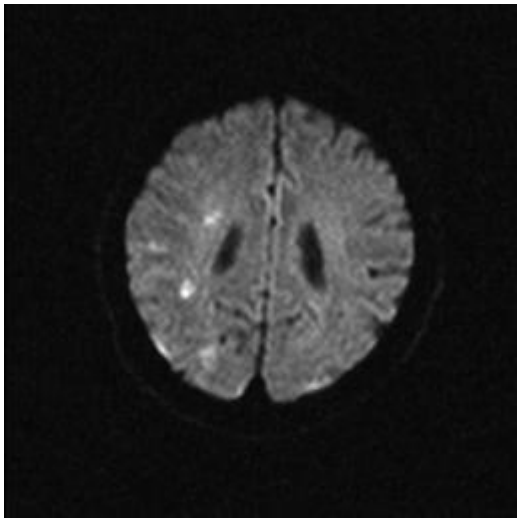


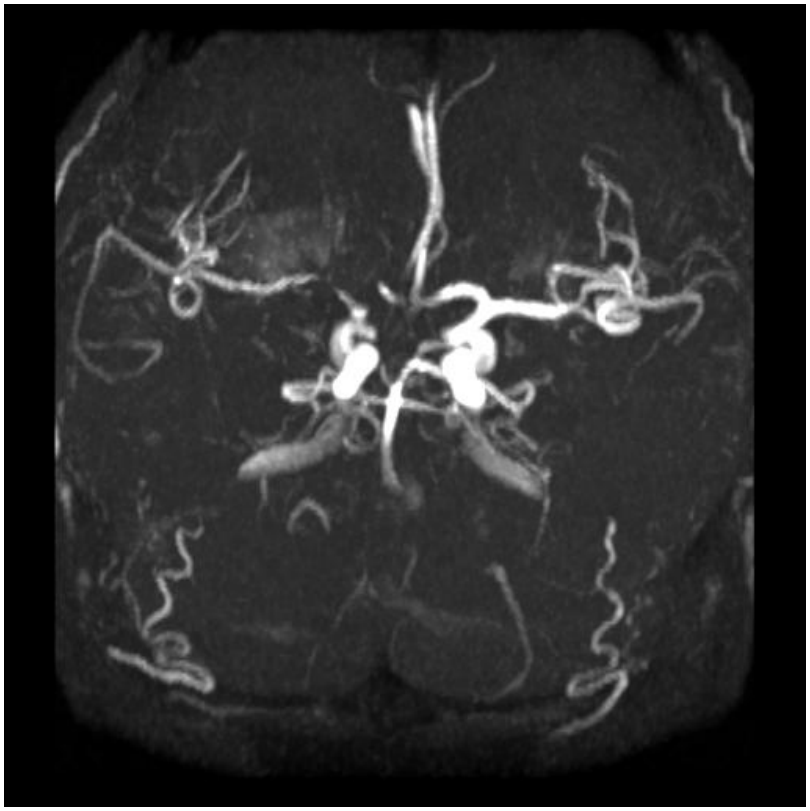
Restenosis 22mo

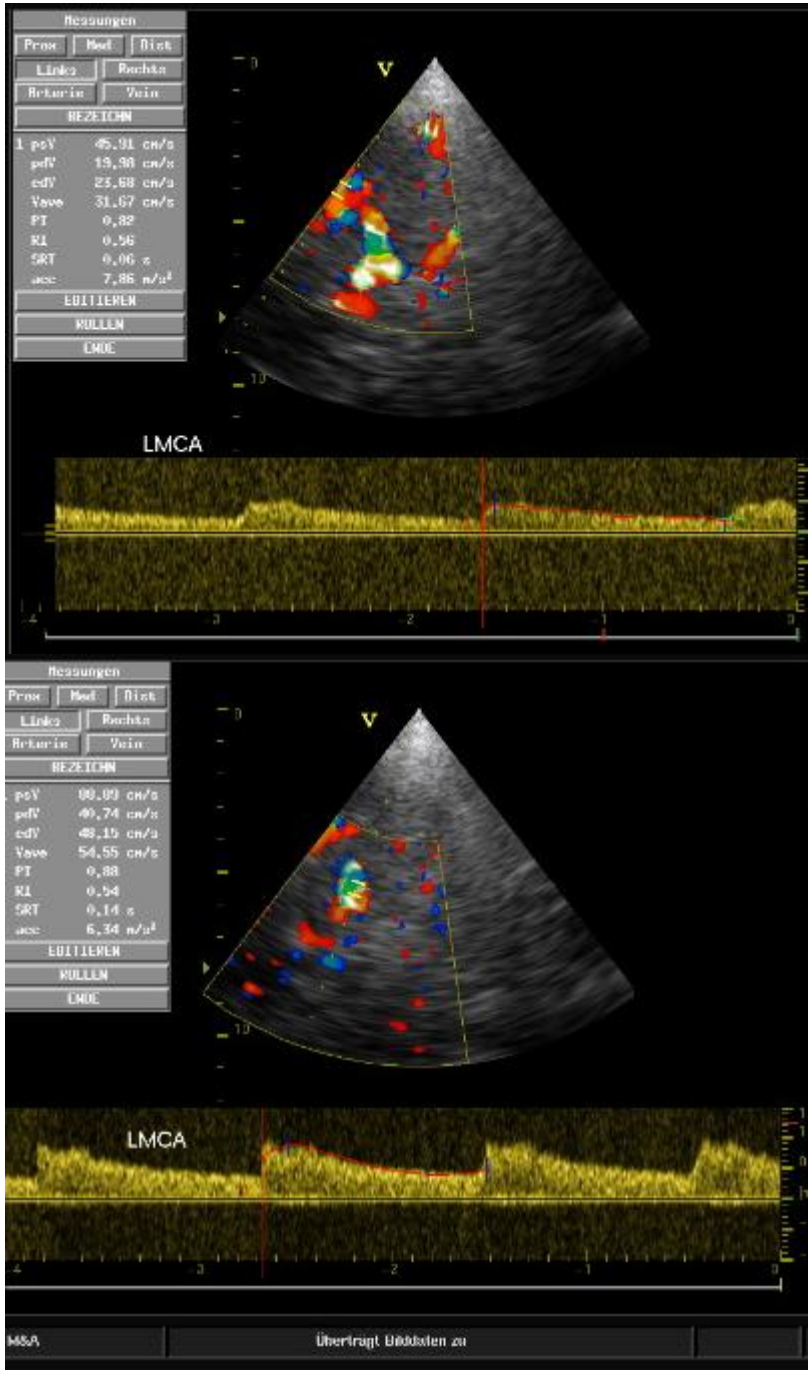


2.5 Mo Cil + ASS








Messungen
Prox
Med
Dist
Links
Rechts
Arterie
Vein
BEZEICHN
1 psV 45.91 cm/s
pdV 19.98 cm/s
edV 25.68 cm/s
Vave 31.67 cm/s
PI 0.82
RI 0.56
SRT 0.06 s
acc 7.86 m/s²
EDITIEREN
NULLEN
LMDC
LMCA
Messungen
Prox
Med
Dist
Links
Rechts
Arterie
Vein
BEZEICHN
psV 80.09 cm/s
pdV 40.74 cm/s
edV 48.15 cm/s
Vave 54.55 cm/s
PI 0.88
RI 0.54
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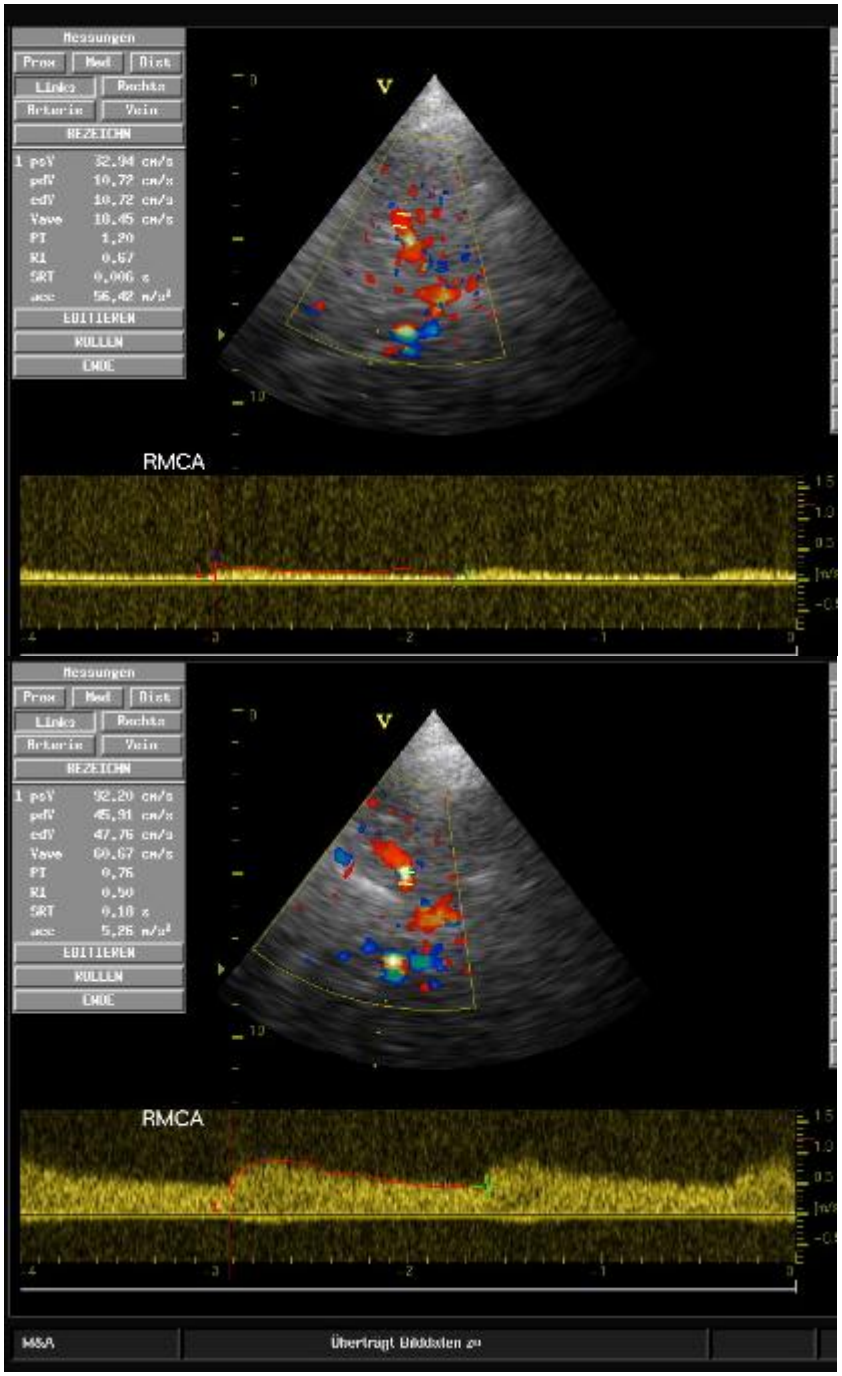
acc 6.34 m/s²
EDITIEREN
NULLEN
LMDC
LMCA
M&A
Übertragt Bilddaten zu


Messungen
Prox
Med
Dist
Links
Rechts
Arterie
Vein
BEZEICHN
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pdV 10.72 cm/s
edV 10.72 cm/s
Vave 10.45 cm/s
PI 1.20
RI 0.67
SRT 0.006 s
acc 56.42 m/s²
EDITIEREN
NULLEN
LMDC
RMCA
Messungen
Prox
Med
Dist
Links
Rechts
Arterie
Vein
BEZEICHN
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pdV 45.91 cm/s
edV 47.76 cm/s
Vave 69.67 cm/s
PI 0.76
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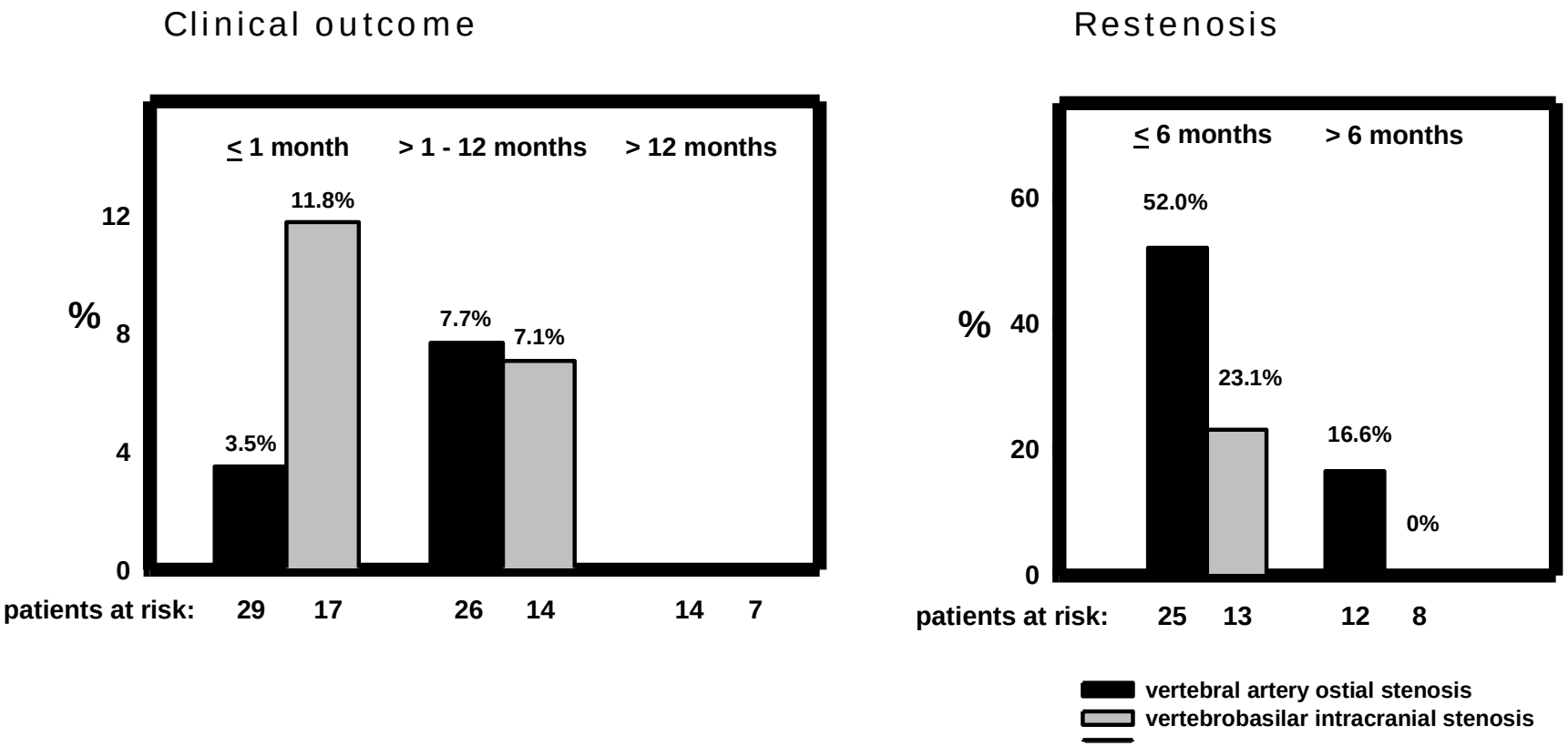
Übertragt Bilddaten zu



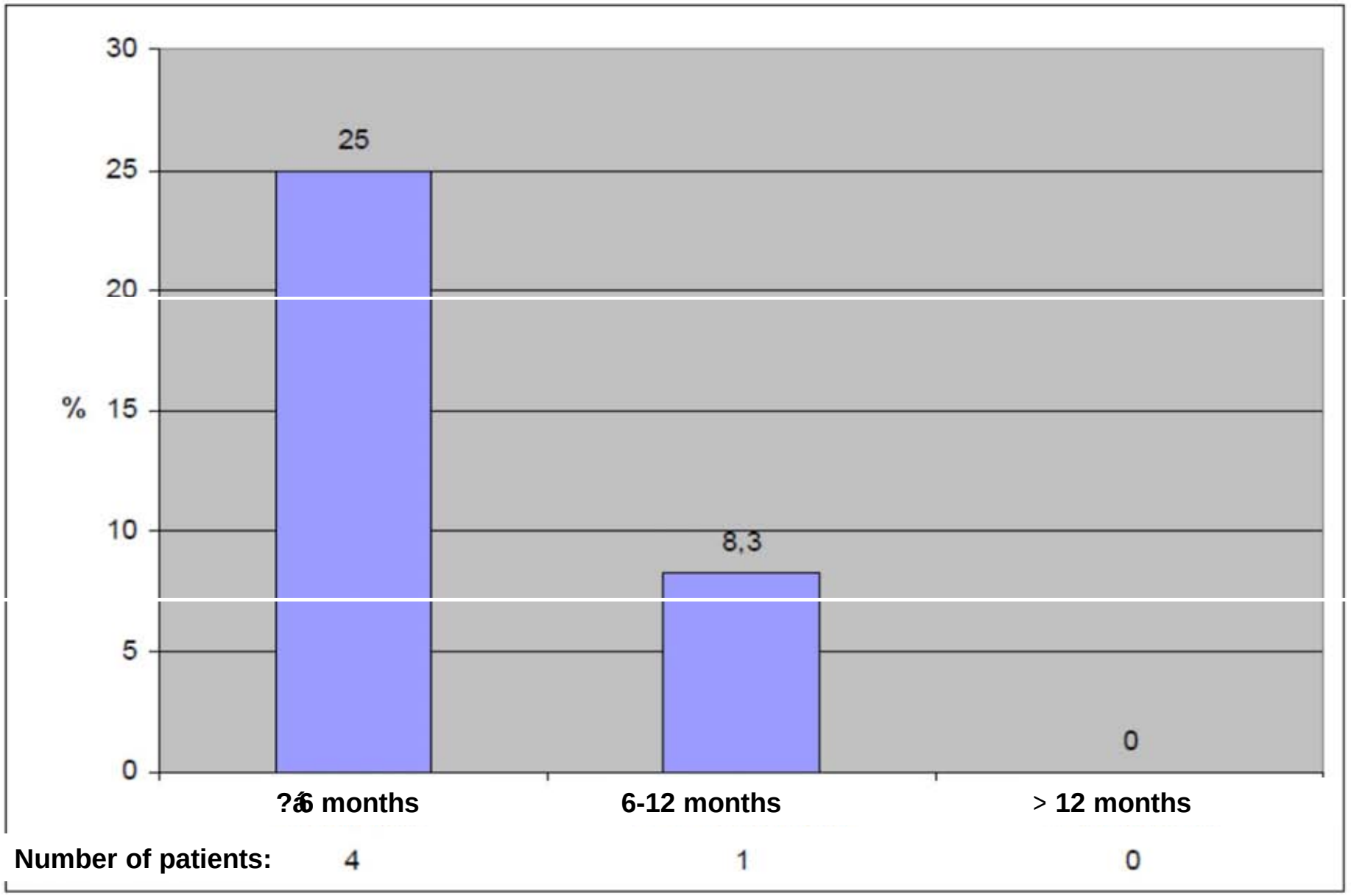
FU Intervals: +/-1d, 30d, 3/6/12/18/24 mo, yearly

Seifert-Held T. et al ; European Journal of Neurology 16 (2009), p. 31-36

Intracranial ICA Stenosis

Patient number	21
Tandem stenosis (extra- +intracranial) n (%)	11 (52,4%)
Mean age (years)	68,5 (39-86)
Male/Female n	17 / 4
Qualifying event:	
TIA, n (%)	7 (33,3%)
completed stroke, n (%)	14 (66,7%)
Mean follow up in months (range)	16,1 (3-61)

Restenosis rate



Stenting in symptomatic intracranial stenosis

- **Outcome:**
  - Ø **Endovascular treatment**:
    - Stenting: **90** vessels, Ballon dilatation: **3vessels**
    - Technical success rate **98,9**%
    - Mean Follow–up **2,6 years**
- **Complications:**

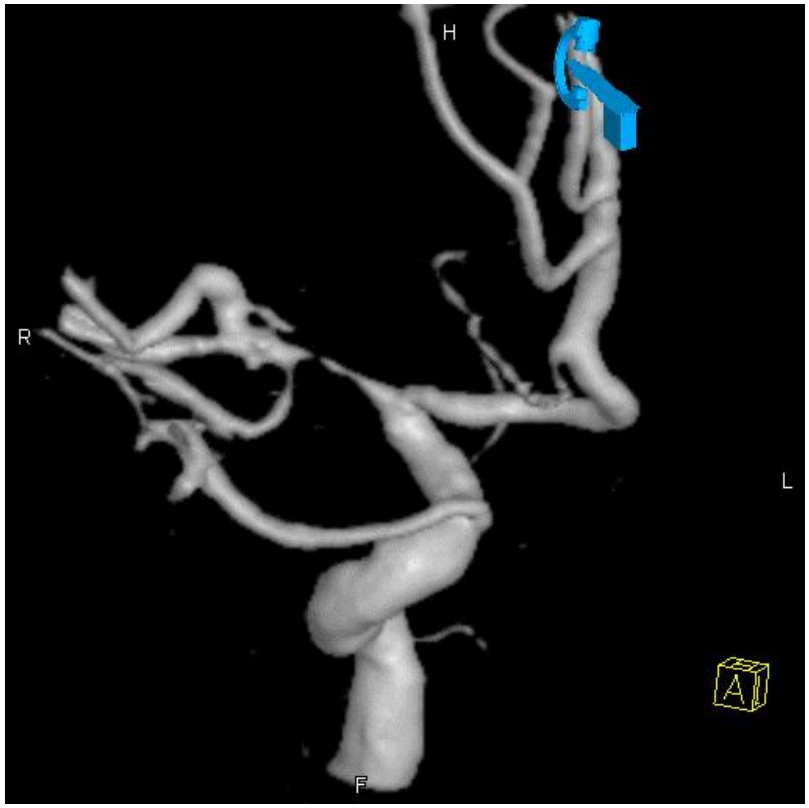
	24h (N=93)	**6-Mo (N=85)**	**Last Follow-up (N=93)**
Restenosis/occlusion	**7** (7,5%)	**14** (16,5%)	**12** (12,9%)
Re-Events: **- Ipsilateral Stroke** **/death**	**4** (4,3%) -	**9** (10,6%) **2** (2,4%)	**21** (22,6%) **5** (5,4%)
Re-interventions	-	**6** (7,1%)	**17** (18,3%) Erst-Reeingriff: 11 Monate

C.Vetta et al, Graz, 2013

09032007

16032007

11072007



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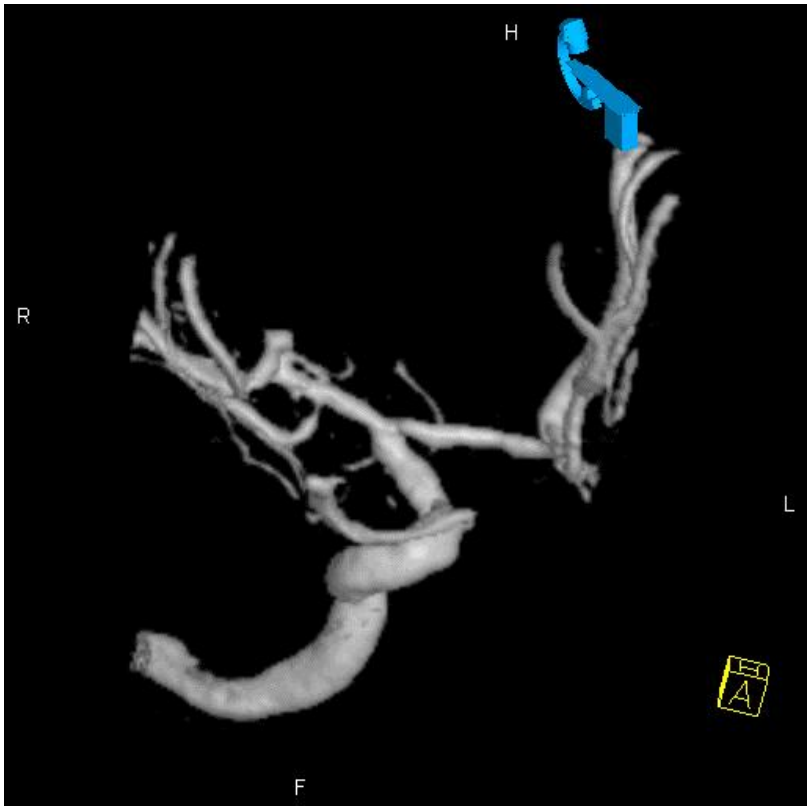
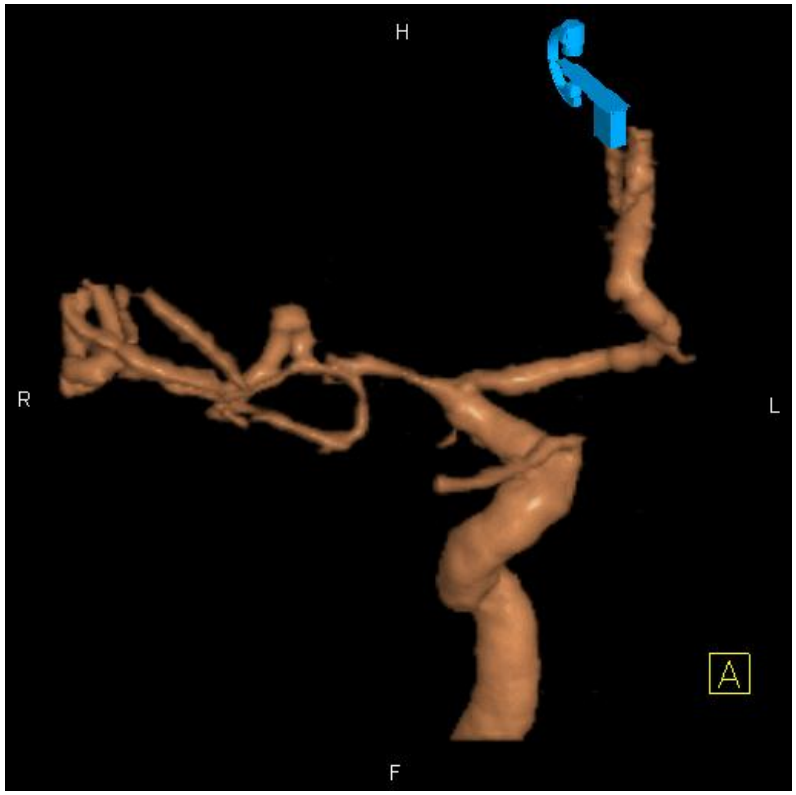


MCA RESTENOSIS- RE PTA

29102007



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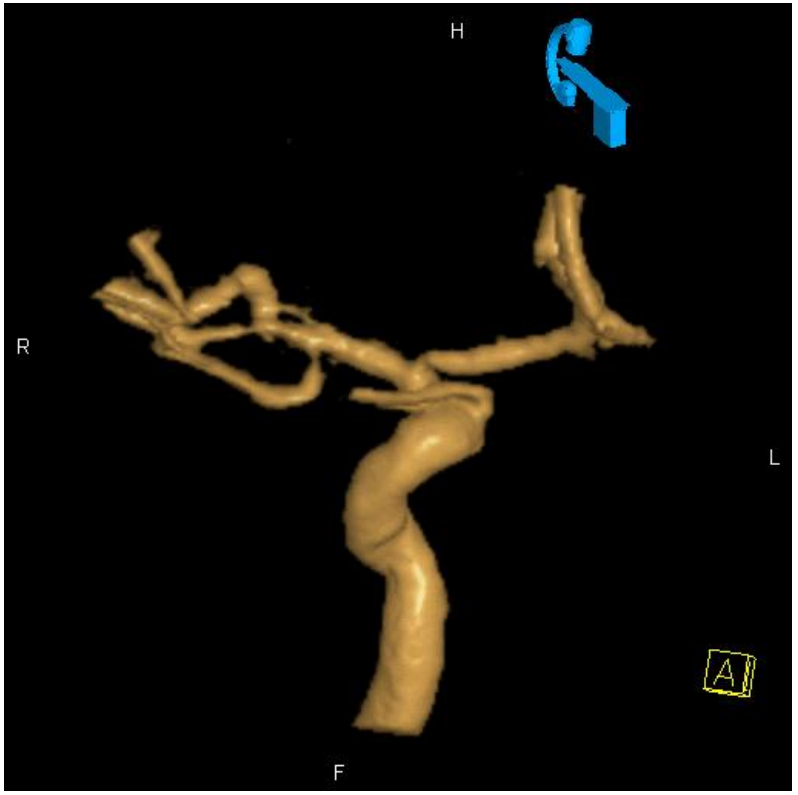
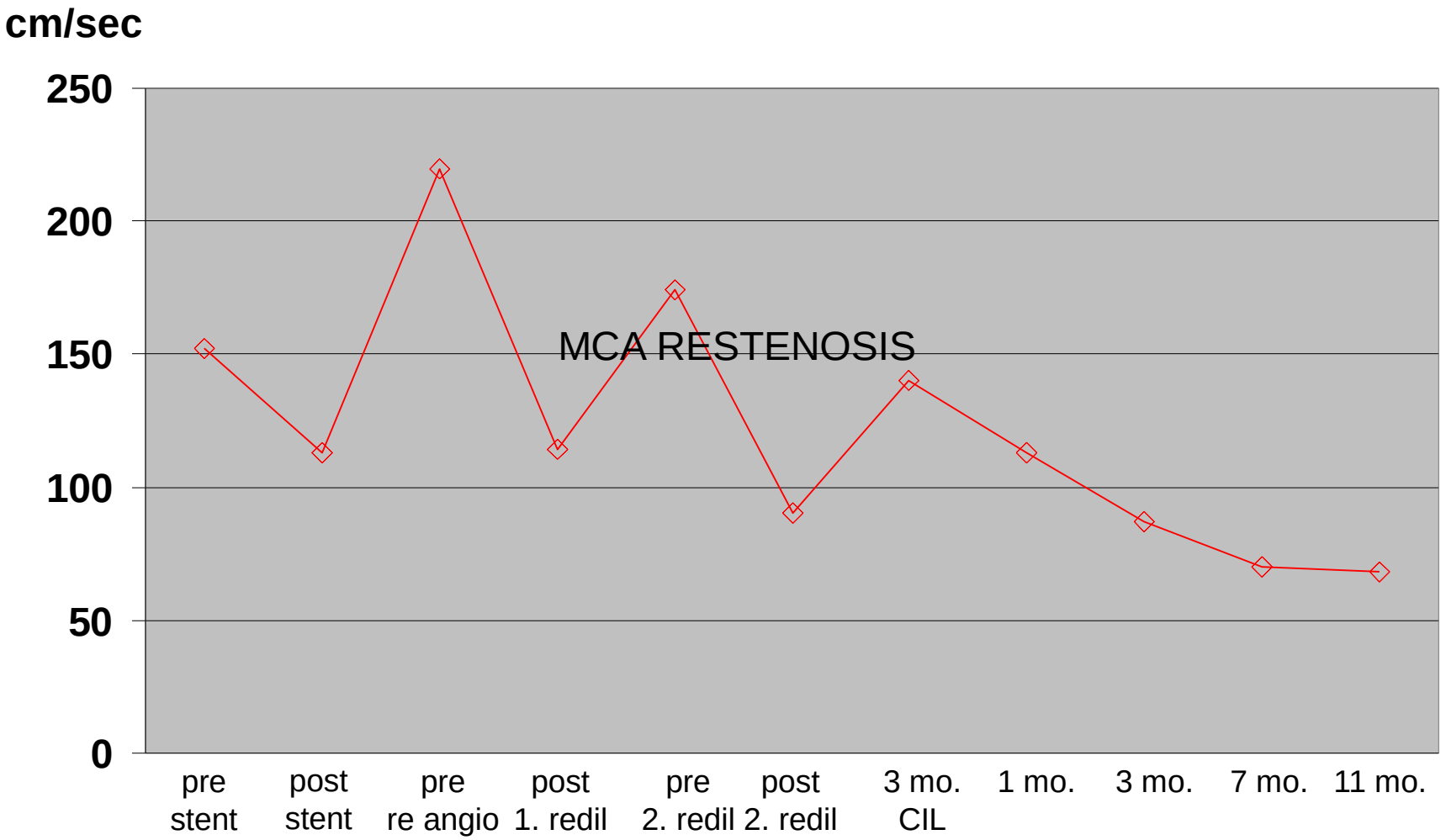
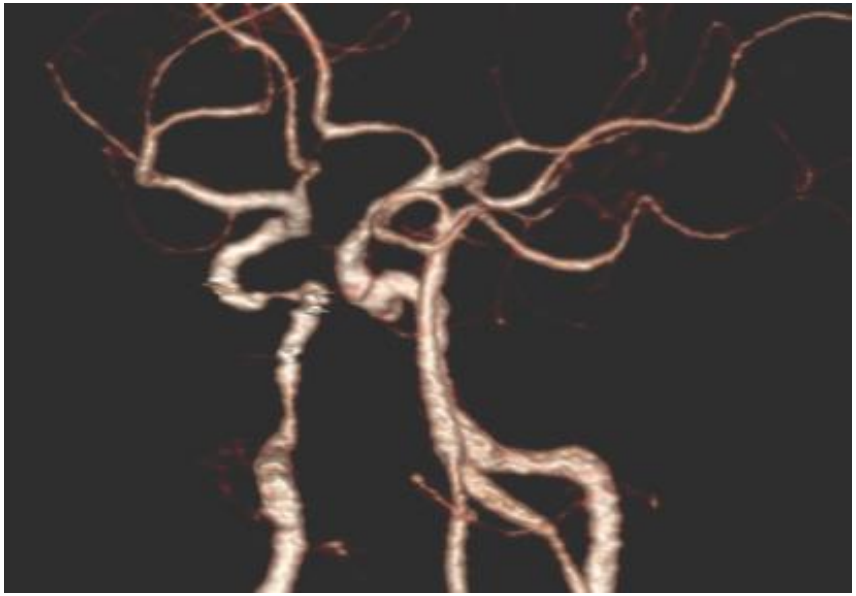


MCA mean velocities

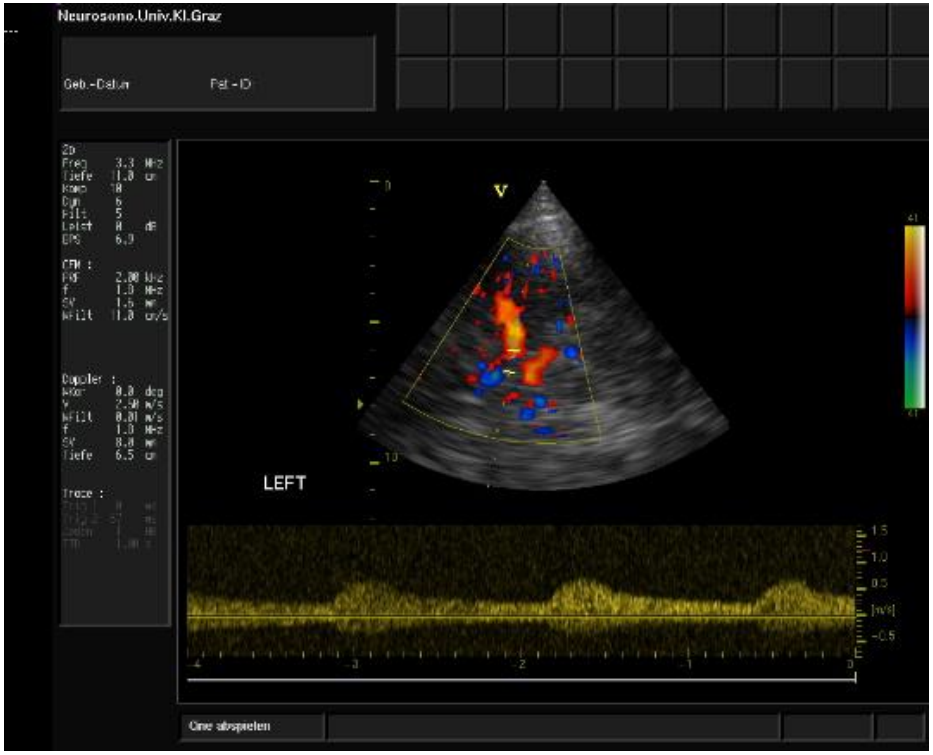


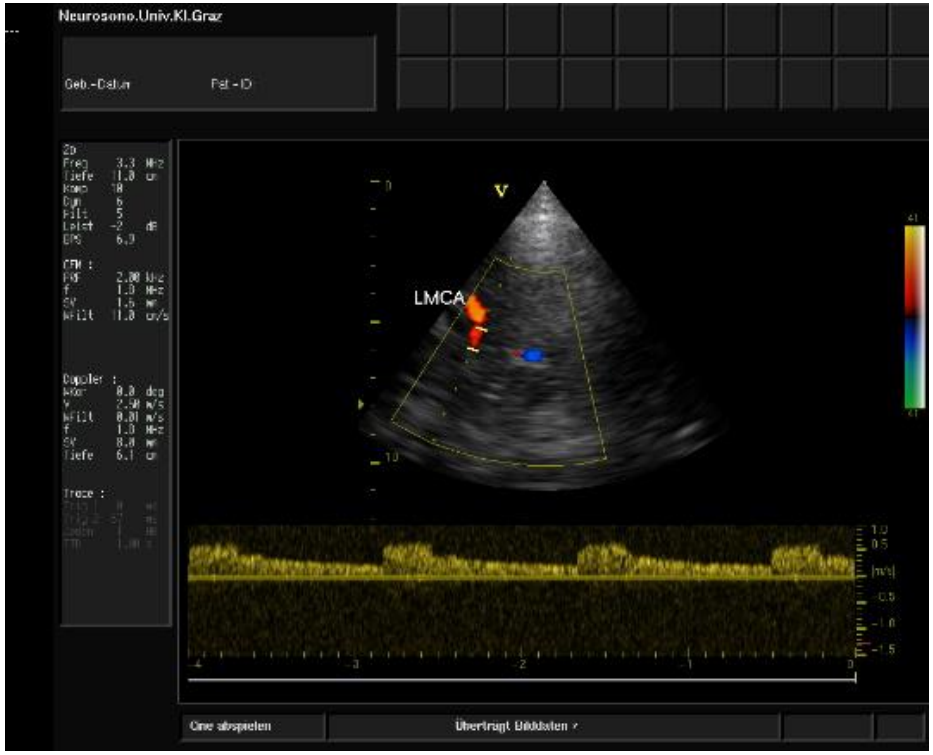
TCD FOLLOW UP OF MCA RESTENOSIS-RE PTA´S AND CILOSTAZOL TREATMENT

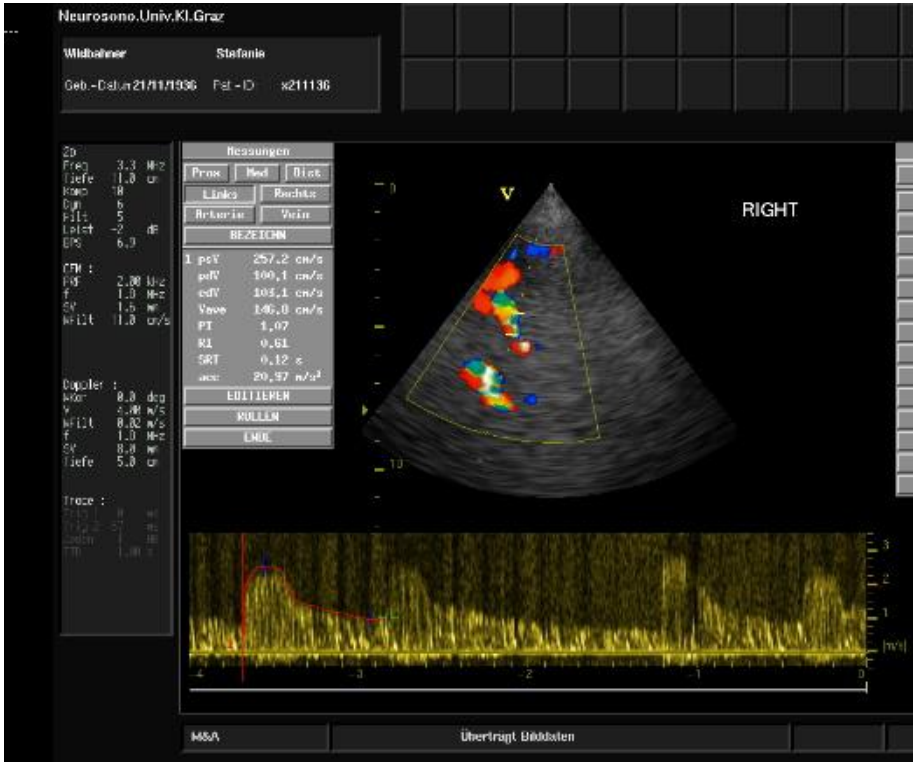
05112008



68 y/o male,ICA Restenosis, , MCA improved after Cil and ASS for 8 months







75 y/o female, MCA resten.(mean vel 148), right after 12 mo Cil +ASS (mean vel 90)

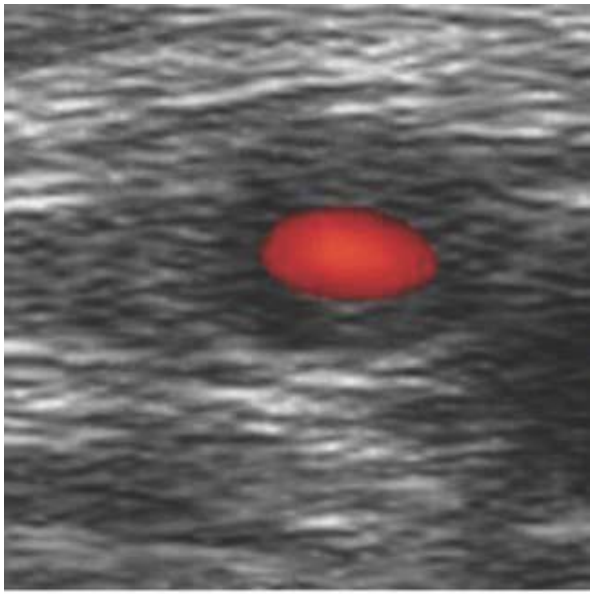
- *INTRACRANIAL STENOSES (+V1/2):*

- US and MRA SCREENING

- therapeutic decision
- only after i.a. DAS/CTA(?)

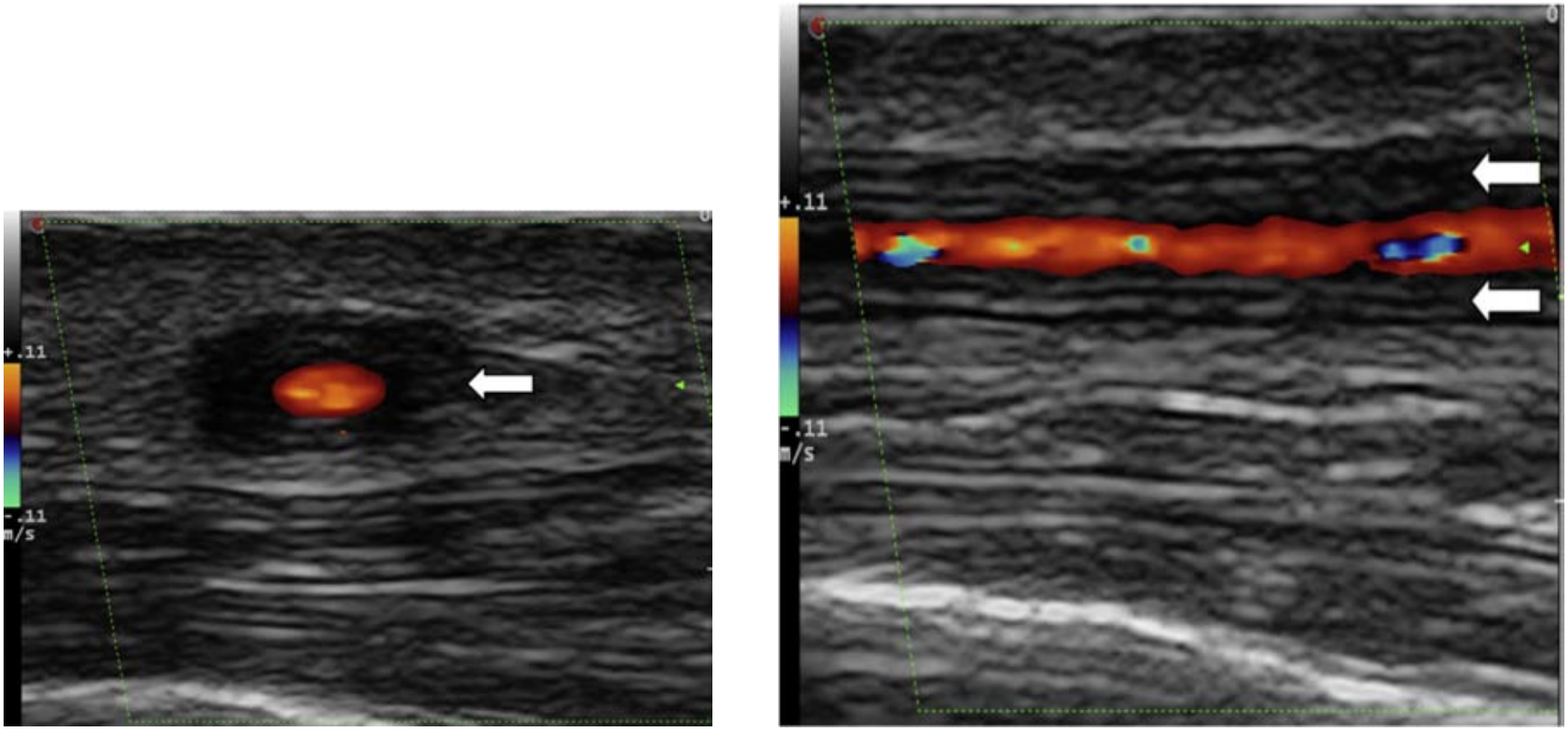
- US ok for FU

Role of ultrasonography in the diagnosis of temporal arteritis



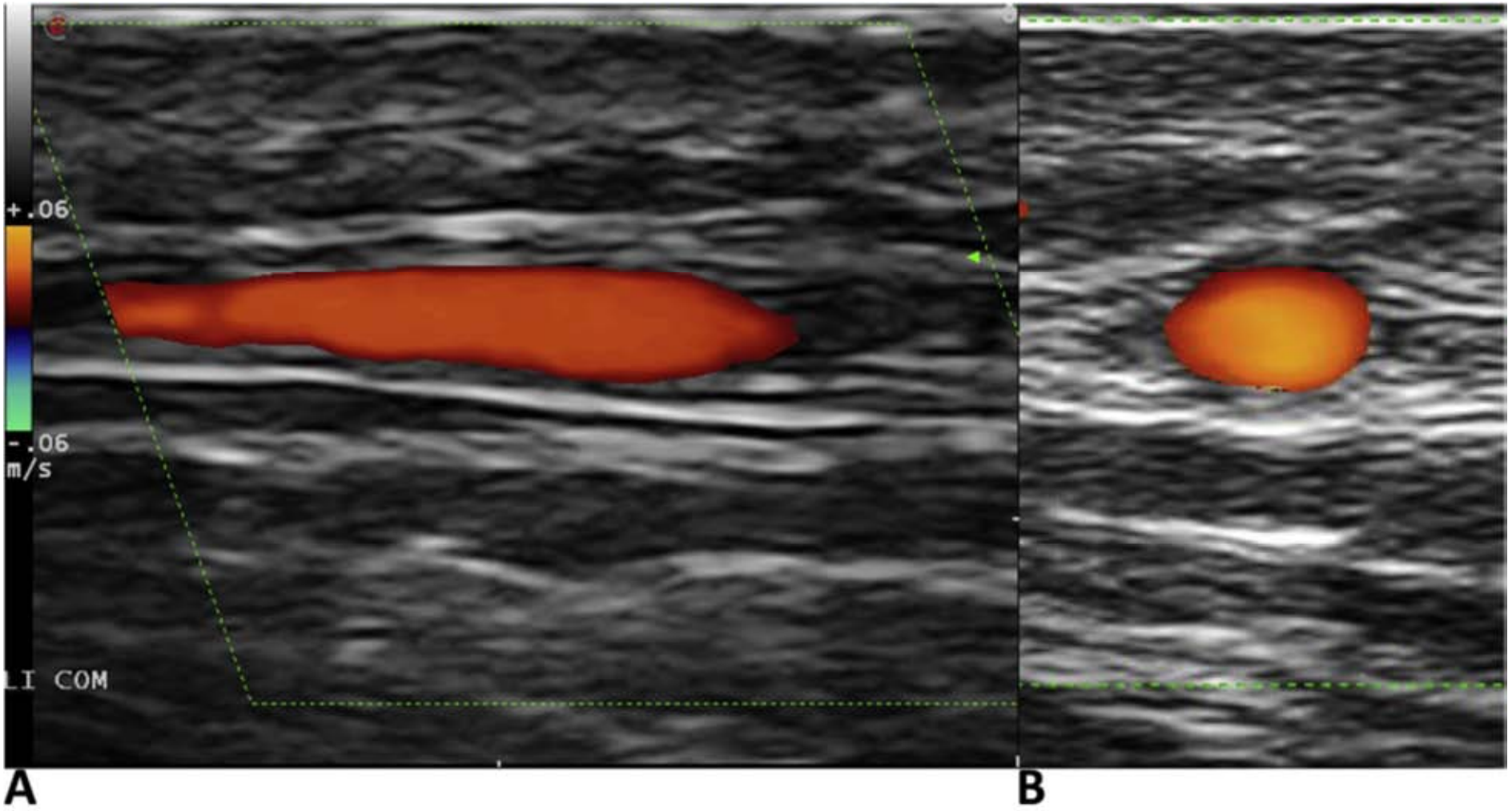
Temporal artery with halo sign

British Journal of Surgery , Ball EL et al
Volume 97, Issue 12, pages 1765-1771, 26 AUG 2010 DOI: 10.1002/bjs.7252
http://onlinelibrary.wiley.com/doi/10.1002/bjs.7252/full#fig1



US IN TEMPORAL ARTERIITIS

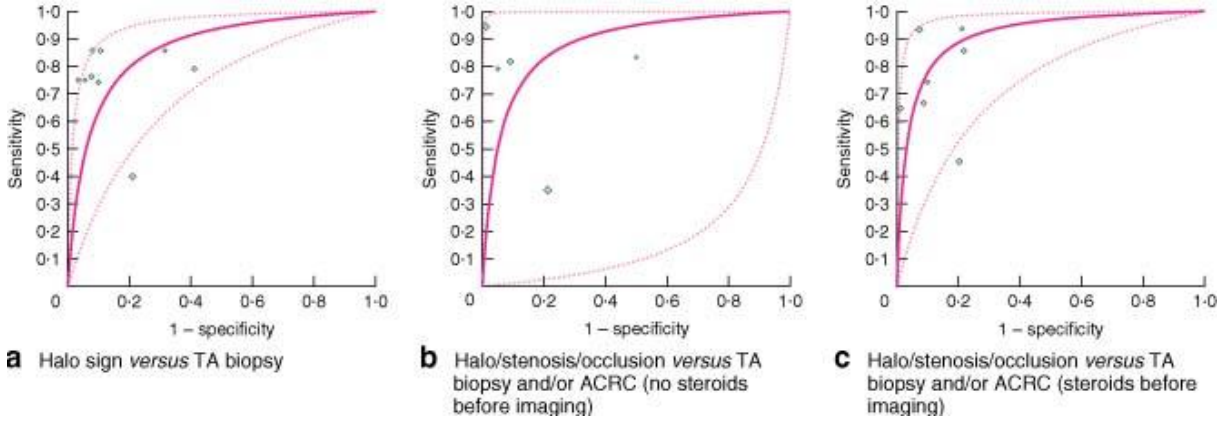
From: Schmidt WA.
Best Pract Res Clin Rheumatol. 2013 Feb;27(1):107-18



From: Schmidt WA.
Best Pract Res Clin Rheumatol. 2013 Feb;27(1):107-18

NORMAL TEMPORAL ARTERY

Role of ultrasonography in the diagnosis of temporal arteritis



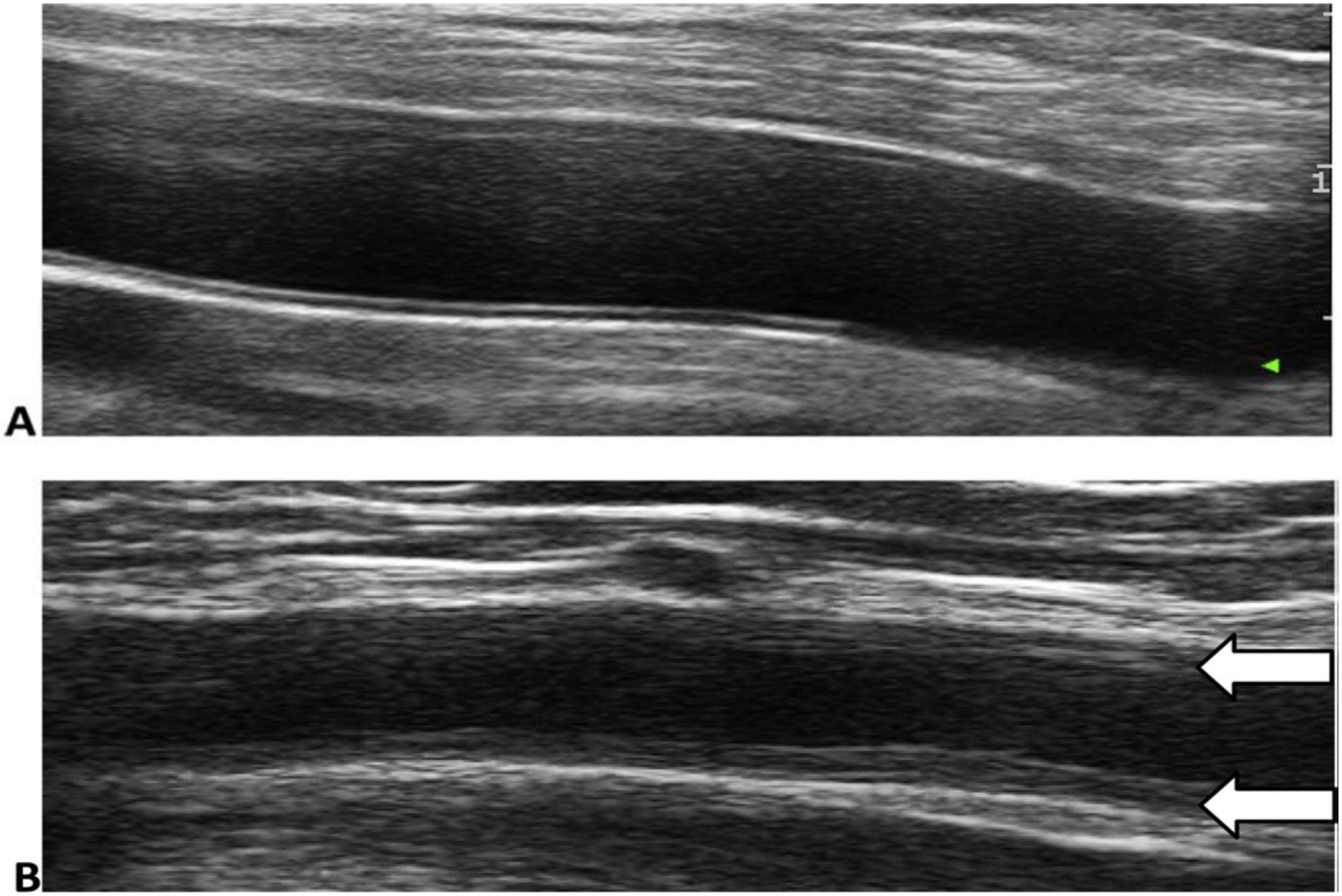
a Halo sign *versus* TA biopsy

b Halo/stenosis/occlusion *versus* TA biopsy and/or ACRC (no steroids before imaging)

c Halo/stenosis/occlusion *versus* TA biopsy and/or ACRC (steroids before imaging)

RESULTS:
There were 17 eligible studies containing 998 patients. When the halo sign on duplex imaging was compared with TA biopsy, the sensitivity was 75 (95 per cent confidence interval 67 to 82) per cent and the specificity was 83 (78 to 88) per cent. There was no heterogeneity across the eligible studies.
CONCLUSION:
Duplex ultrasonography was relatively accurate for diagnosing temporal arteritis. It should become the first-line investigation, with biopsy reserved for patients with a negative scan.

British Journal of Surgery; Ball EL et al;
Volume 97, Issue 12, pages 1765-1771, 26 AUG 2010 DOI: 10.1002/bjs.7252
http://onlinelibrary.wiley.com/doi/10.1002/bjs.7252/full#fig3



From: Schmidt WA.,GCA ; Axillary Artery
Best Pract Res Clin Rheumatol. 2013 Feb;27(1):107-18

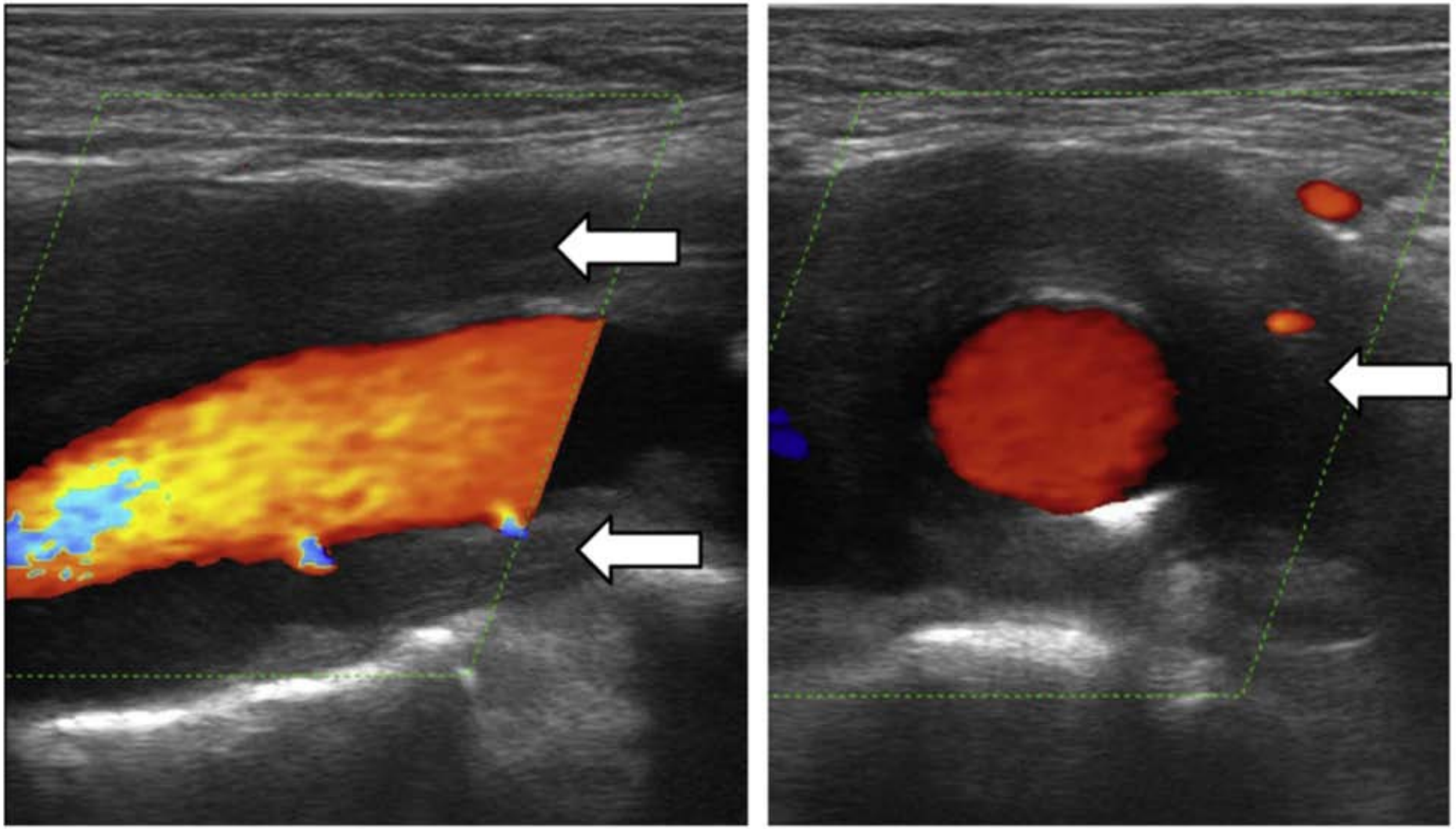


Fig. 8. Longitudinal (A) and transverse colour Doppler ultrasound images of abdominal aortitis. The arrows indicate the vasculitic wall swelling. The patient presented with pyrexia of unknown origin.

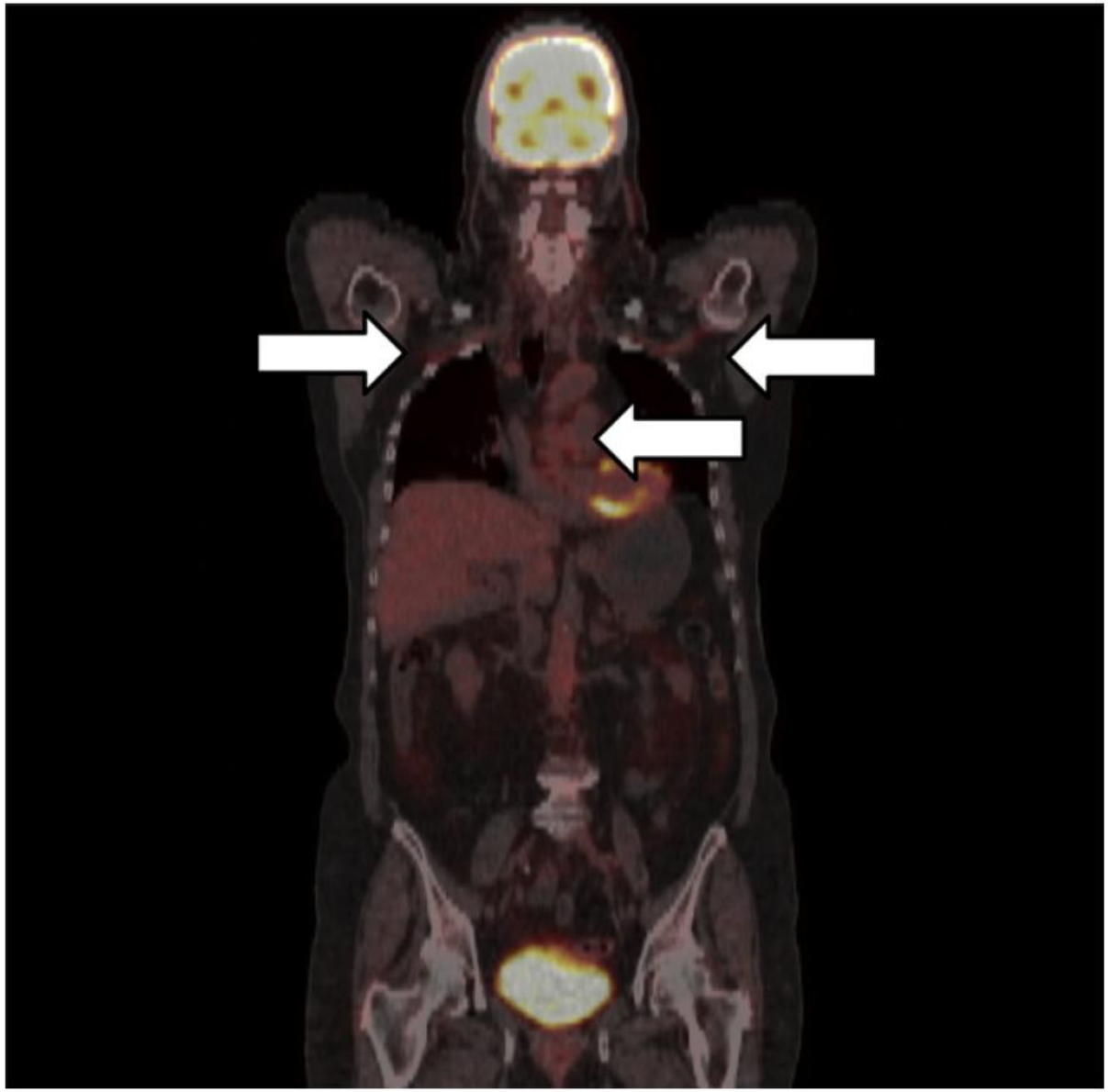


Fig. 7. Fusion image of PET-CT showing vasculitis of the ascending aorta, the subclavian and axillary arteries in large-vessel GCA. Courtesy Prof. Dr. Stefan Dresel, Dept. of Nuclear Medicine, Helios Klinikum Berlin-Buch, Germany.

Table 1
Comparison of imaging techniques in the diagnosis of large-vessel vasculitides.

Diagnostic test	Economical	Non-invasive	Depicting artery wall	Depicting aorta	Intervention	Temporal arteries
Angiography	+	–	–	++	++	–
Ultrasound	++	++	++	(+)	–	++
CT	+	+	++	++	–	–
CT-angio	+	+	–	++	–	–
MRI	+	+	++	++	–	++
MR-angio	+	+	–	++	–	+
PET	–	+	–	++	–	–

Practice points

Imaging for small-vessel vasculitides:

- Imaging studies are important for determining disease extension and disease activity.
- However, the diagnosis should be confirmed histologically.
- Imaging is important for follow-up and for deciding if the disease is in remission.

Imaging for medium-vessel vasculitides:

- Echocardiography is an essential part of the initial diagnosis in Kawasaki disease for the detection of coronary artery aneurysms.
- Angiography or MRA may show aneurysms of intestinal arteries in polyarteritis nodosa; however, findings are not specific for the disease.

Imaging for large-vessel vasculitis:

- Several imaging techniques show pathognomonic findings in case of active GCA, Takayasu arteritis or aortitis: ultrasound, MRI, MRA, CT, CTA and PET.
- Imaging studies show homogeneous, circumferential wall swelling and smoothly tapered luminal narrowing.
- Angiography is to date mainly used for interventions in complicated large-vessel vasculitis.

Imaging for temporal arteritis:

- Ultrasound and MRI show characteristic homogenous wall swelling of temporal arteries in active disease.
- The findings disappear after days or weeks with treatment.
- In experienced centres ultrasound or MRI replace temporal artery histology in patients with typical clinical and imaging findings.
- Extracranial arteries such as the proximal arm and leg arteries and the aorta are commonly involved.

Fig. 5. MR-angiography with suspected vasculitis of the left brachial artery. The arrow indicates a smoothly tapered luminal narrowing in large-vessel GCA. Courtesy Dr. Petra Bock, Dept. of Radiology, Evangelische Lungenklinik Berlin-Buch, Germany.