

1ST RESIDENTIAL TRAINING COURSE

ESNCH

Bertinoro, september 7-12, 2008

EXTRACRANIAL INSONATION: TRICKS AND PITFALLS

Luigi Lusiani, MD

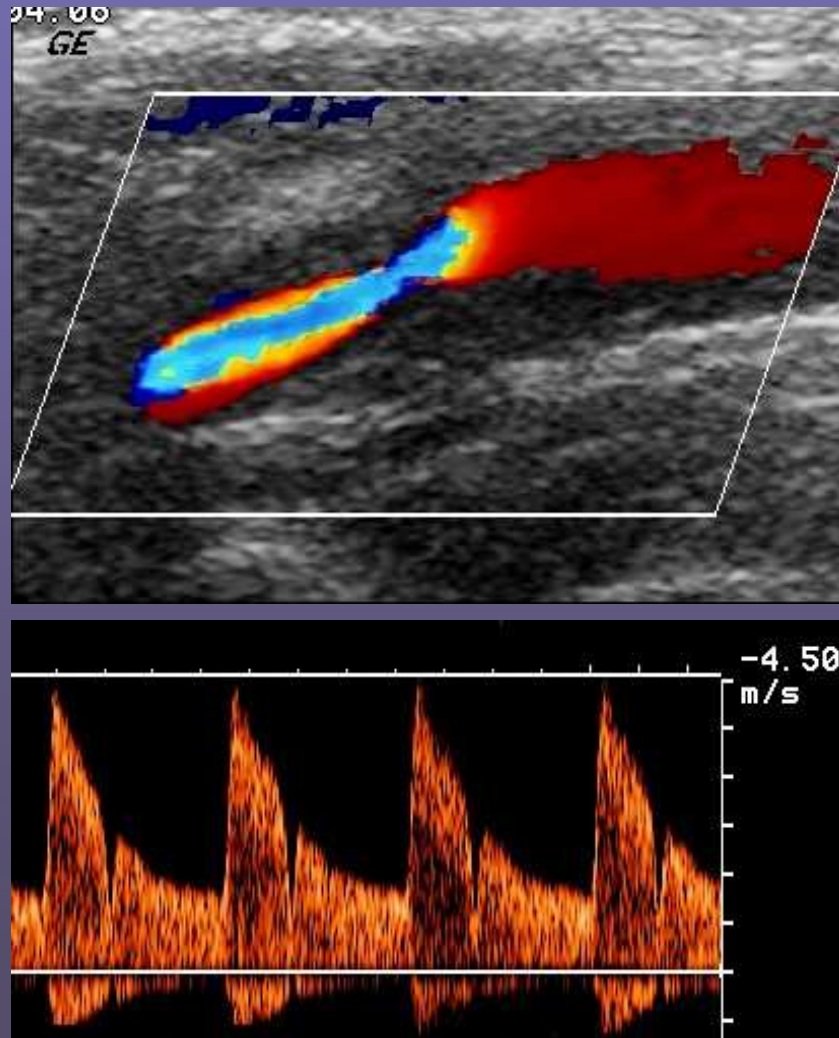
INTERNAL MEDICINE

Castelfranco Veneto (Italy)

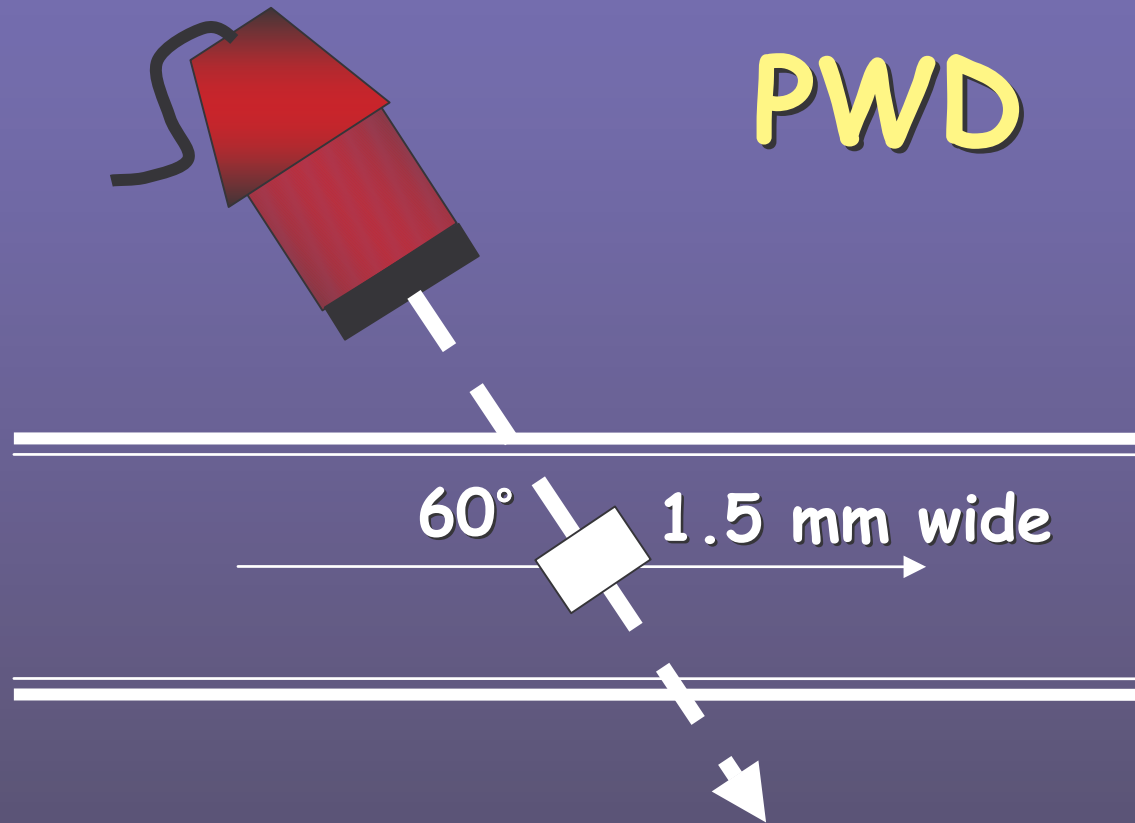
*“Il fondamento dell’arte medica
resta, secondo la mia opinione,
l’essere padrone del metodo di
indagine..”*

Ippocrate

Carotid Artery Duplex Ultrasound

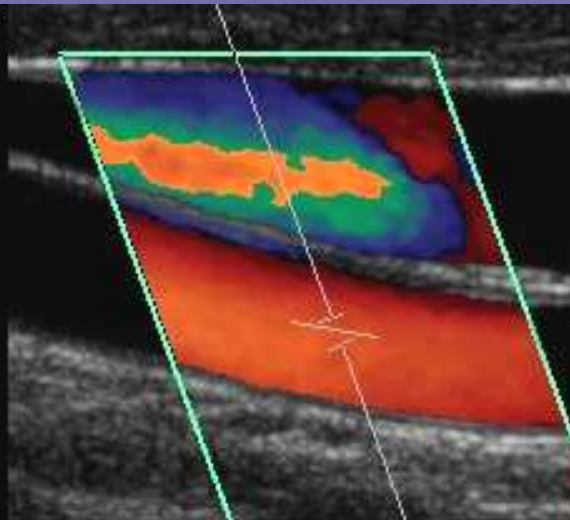


PWD

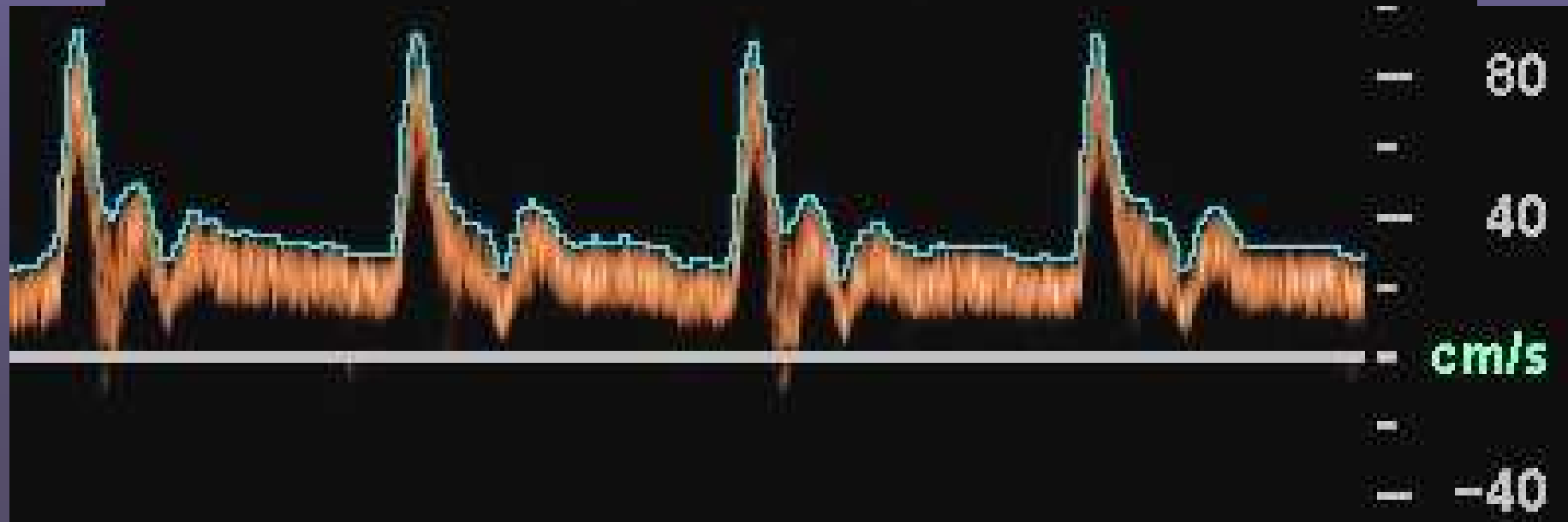


Internal / Common Carotid

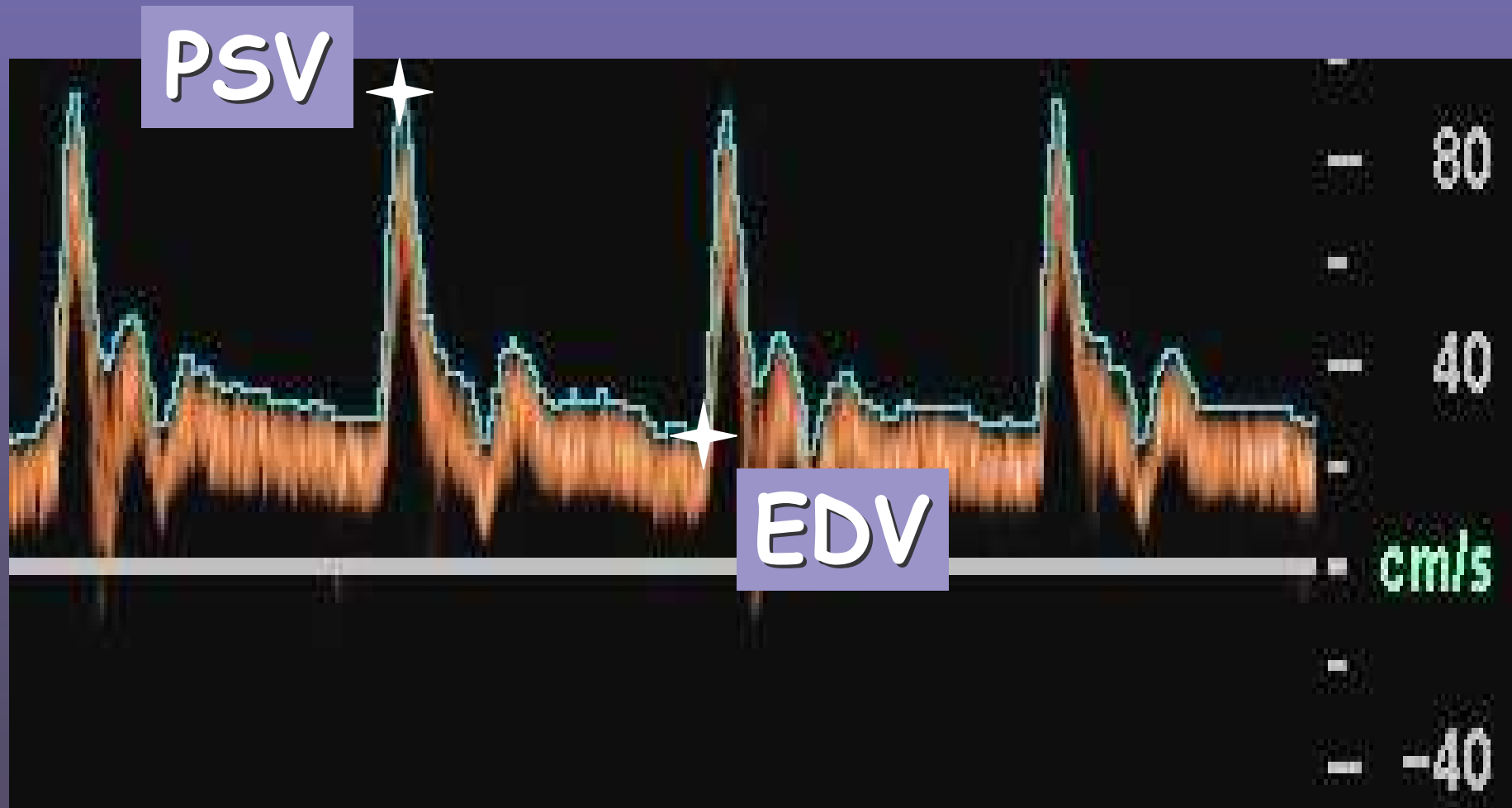
Col 68% Map 5
WF Low
PRF 3000 Hz
Flow Opt: Med V



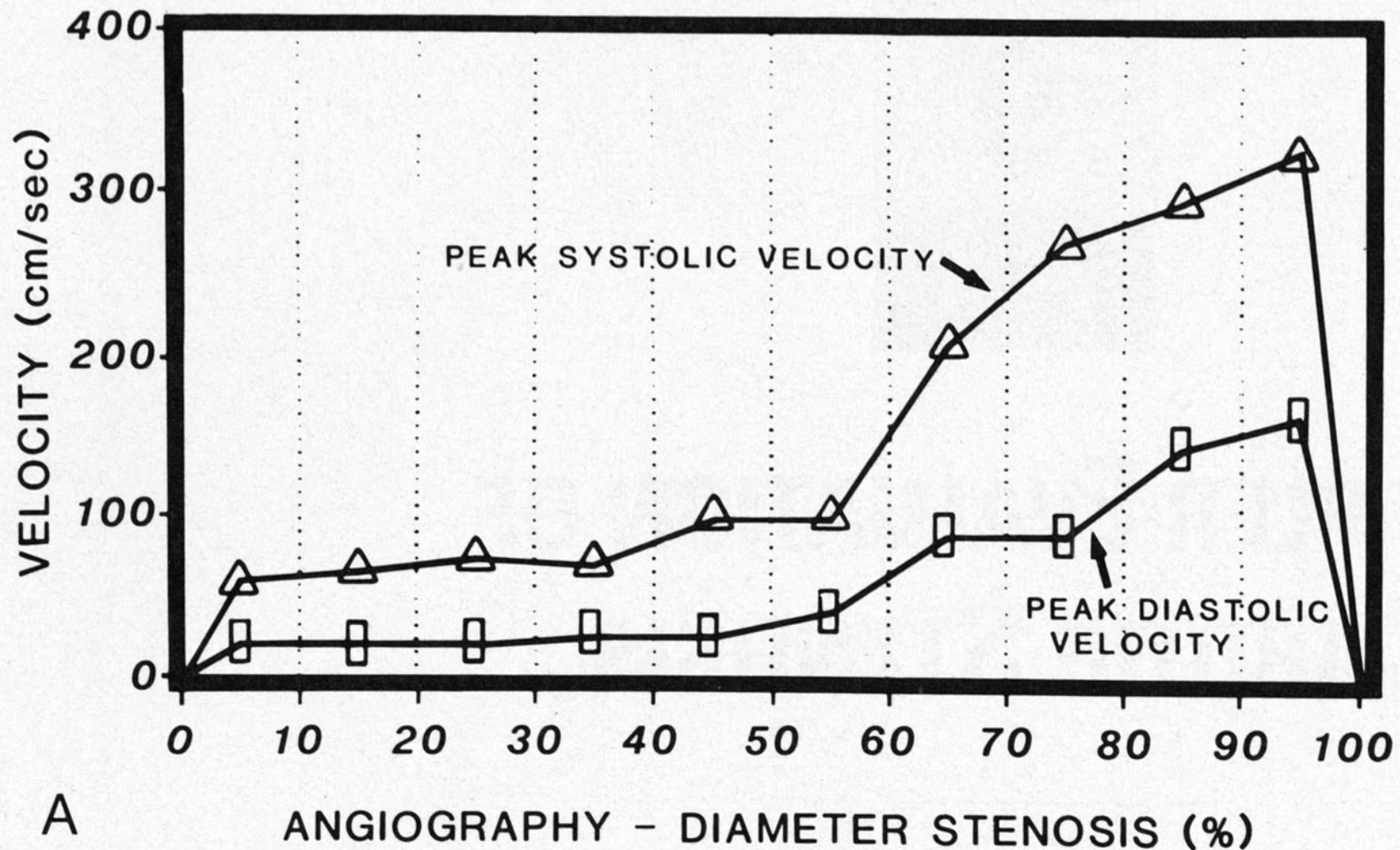
SV Angle -60°
Dep 2.5 cm
Size 1.5 mm
Freq 6.0 MHz
WF Low
Dop 58% C 4
PRF 8333 Hz



Internal / Common Carotid



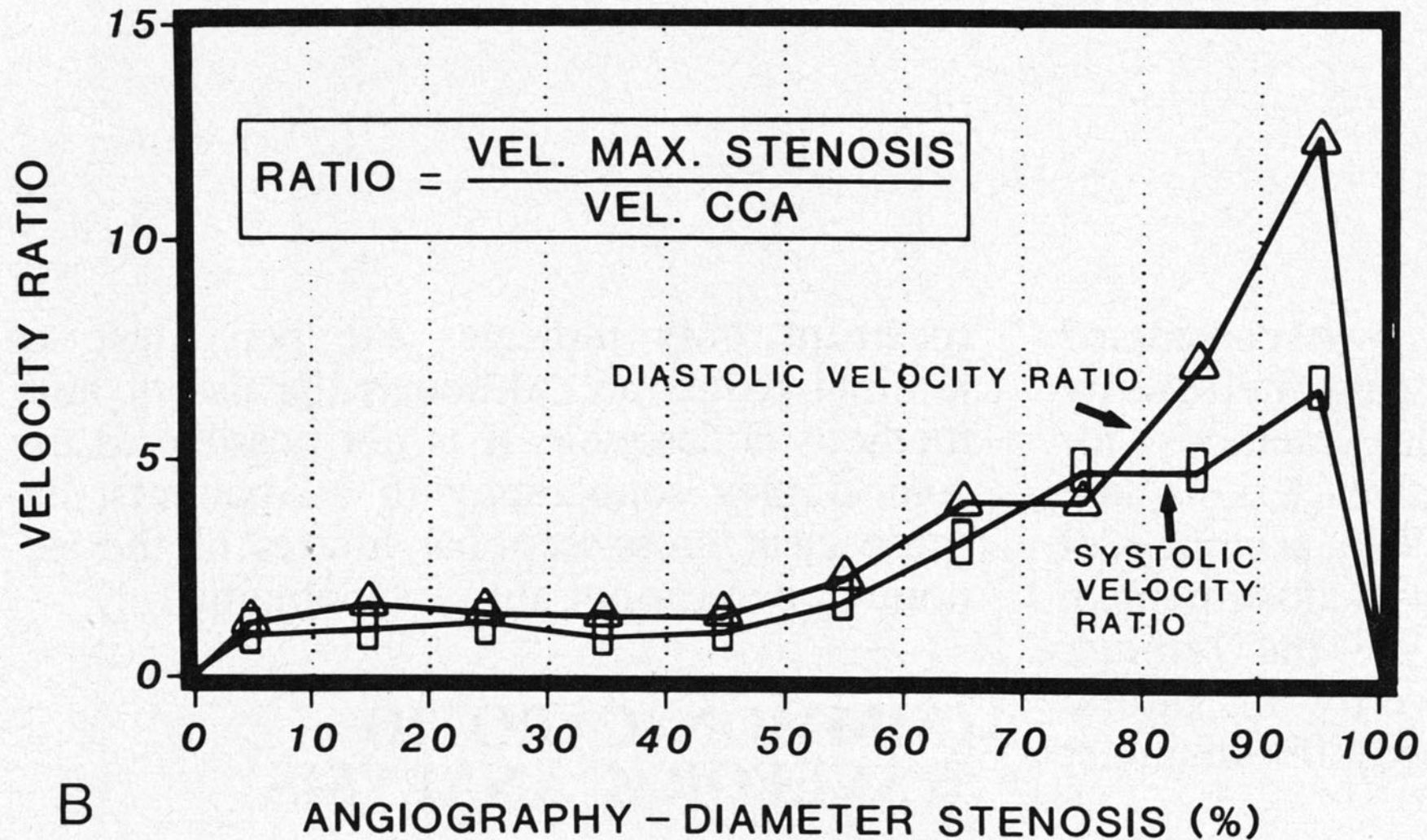
Peak Systolic Velocity vs. Stenosis



- CONTRALATERAL OCCLUSION
- LOW OR HIGH CARDIAC OUTPUT STATES
- ARRHYTHMIAS
- ANEMIA/HEMODILUTION
- TIGHT STENOSIS AT THE CAROTID SIPHON SITE
- AORTIC VALVE STENOSIS OR INSUFFICIENCY

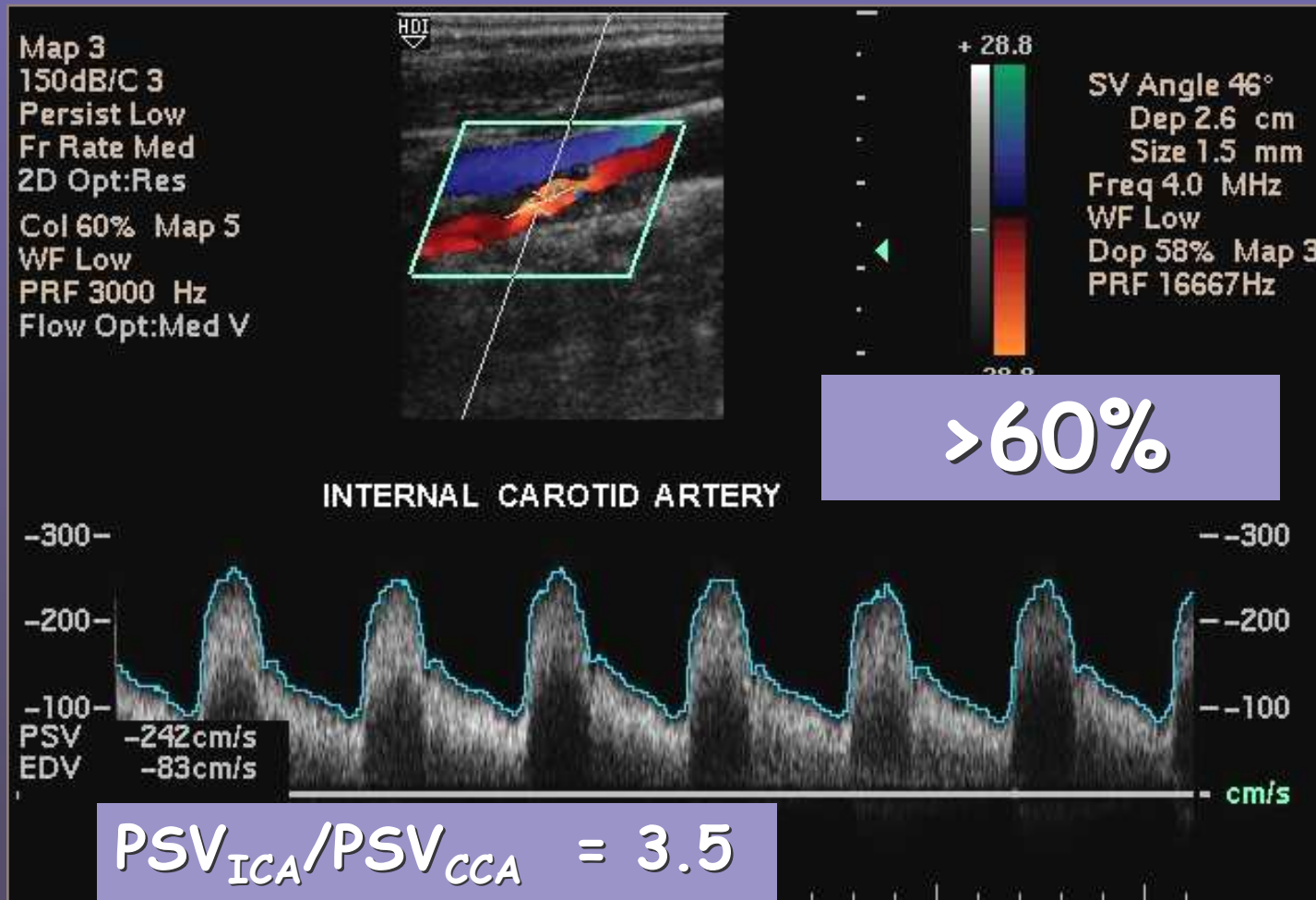
PSV_{ICA} / PSV_{CCA} is convenient

PSV_{ICA}/PSV_{CCA} vs. Stenosis



	PSV_{ICA} (cm/s)	EDV_{ICA} (cm/s)	PSV_{ICA}/PSV_{CCA} (cm/s)	SENS %	SPEC %	ACC %
50%	125			83	93	92
60%	260	70	3.2	84	94	97
70%	270	110		96	91	93
			4	91	87	88
80%		140		84	87	87
NEAR OCCL.	<50					
OCCLUS	NO	SIGNAL				

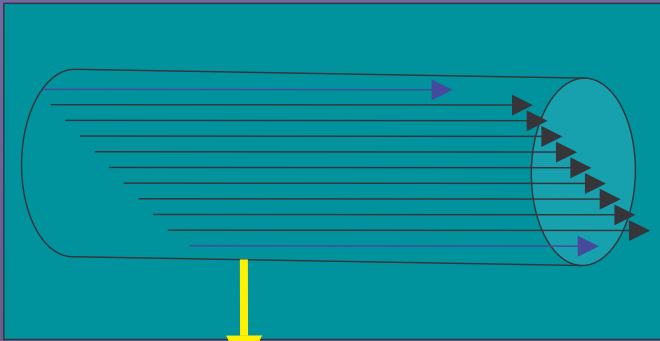
Internal Carotid Stenosis



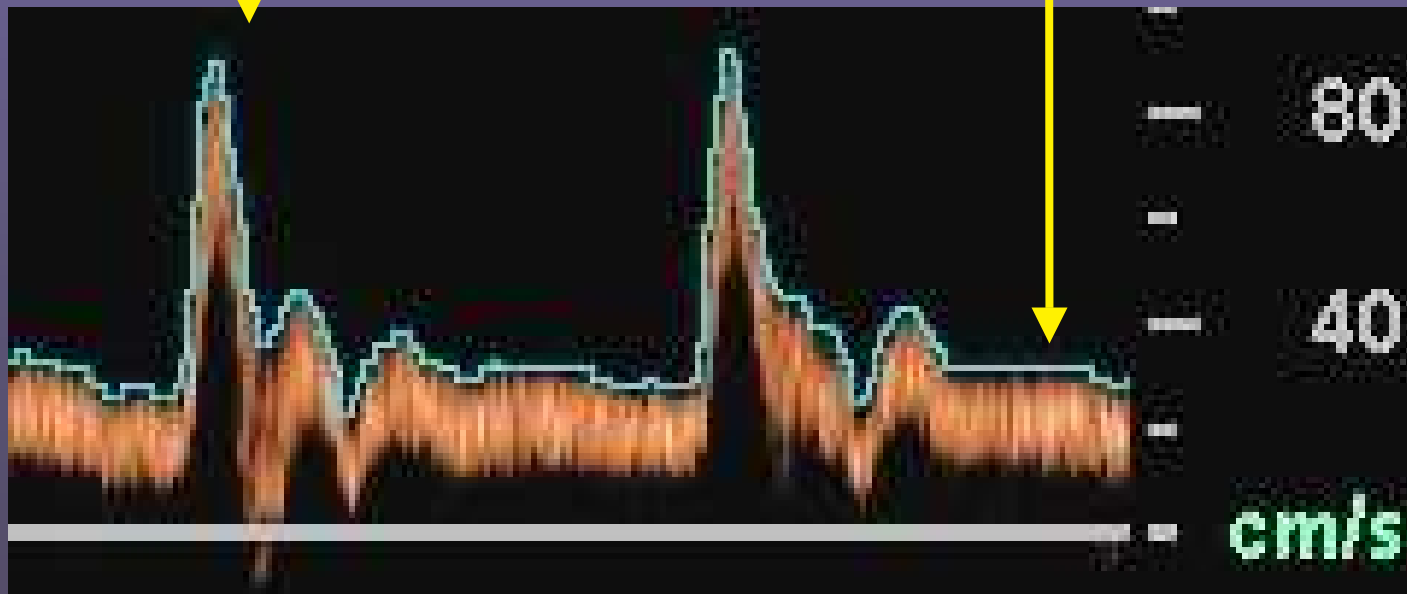
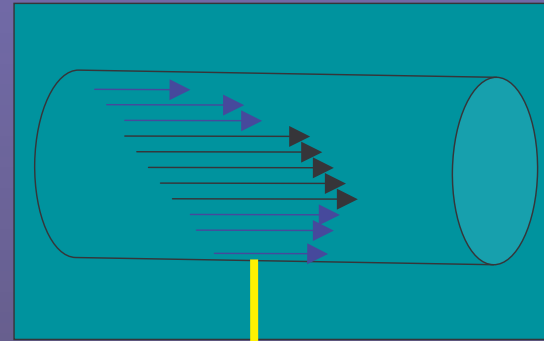
ANGLE CORRECTION is

- VERY UNCERTAIN
- The measurement of blood velocity is very inaccurate, and stenosis can only be estimated through wide steps of severity

Systole

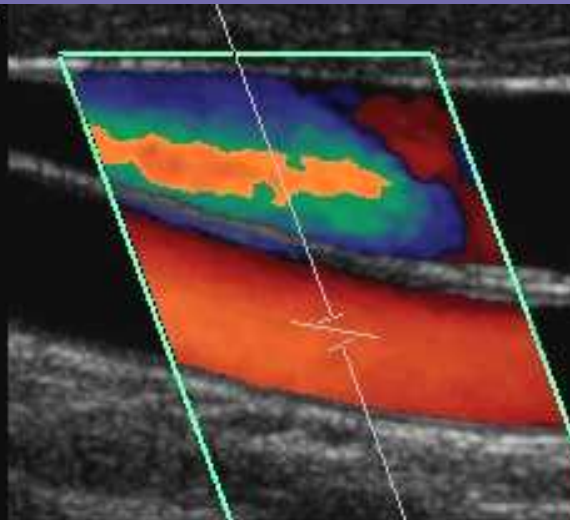


Diastole

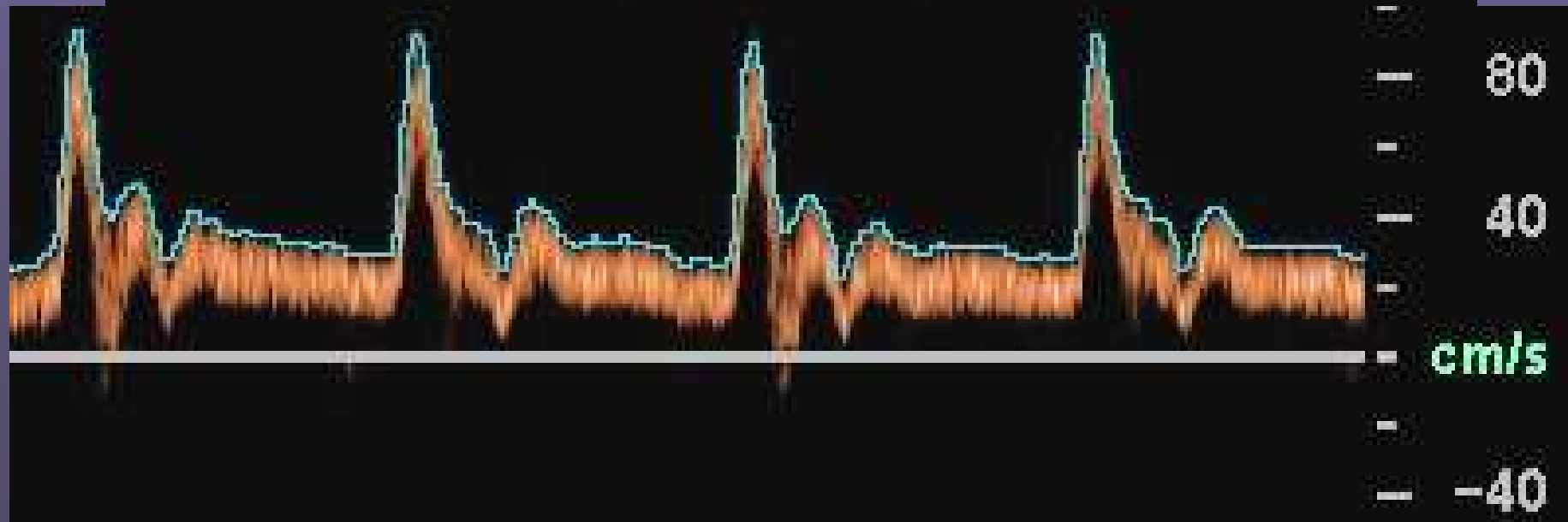


Internal / Common Carotid

Col 68% Map 5
WF Low
PRF 3000 Hz
Flow Opt: Med V

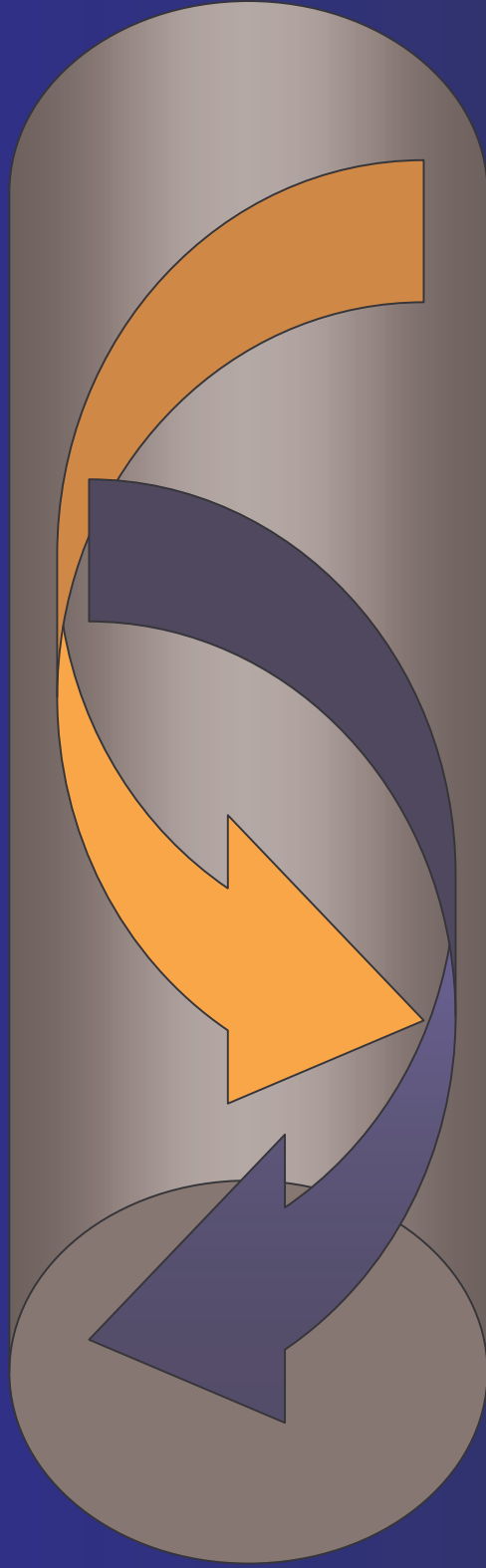


SV Angle -60°
Dep 2.5 cm
Size 1.5 mm
Freq 6.0 MHz
WF Low
Dop 58% C 4
PRF 8333 Hz



FLOW PROFILE is

- HELICAL IN STRAIGHT VESSELS
- SQUEWED IN CURVED VESSELS
- CONVERGENT INTO STENOSIS
- TURBULENT IN MANY
PHYSIOLOGIC CONDITIONS



RDI
5000

ART CAR COMUNE, ORI
UO ANGIOLOGIA - ULSS 8

03/04/09:102848
C8-5 CVas/rafts

09 Apr 03
10:30:12

ITo**0.3** IM**0.9**
Imm.36 4.0 cm

Map2

150 dB/C 3

Persistenza Basso

Ott. 2D:Ris

Col 72% Map4

FP Basso

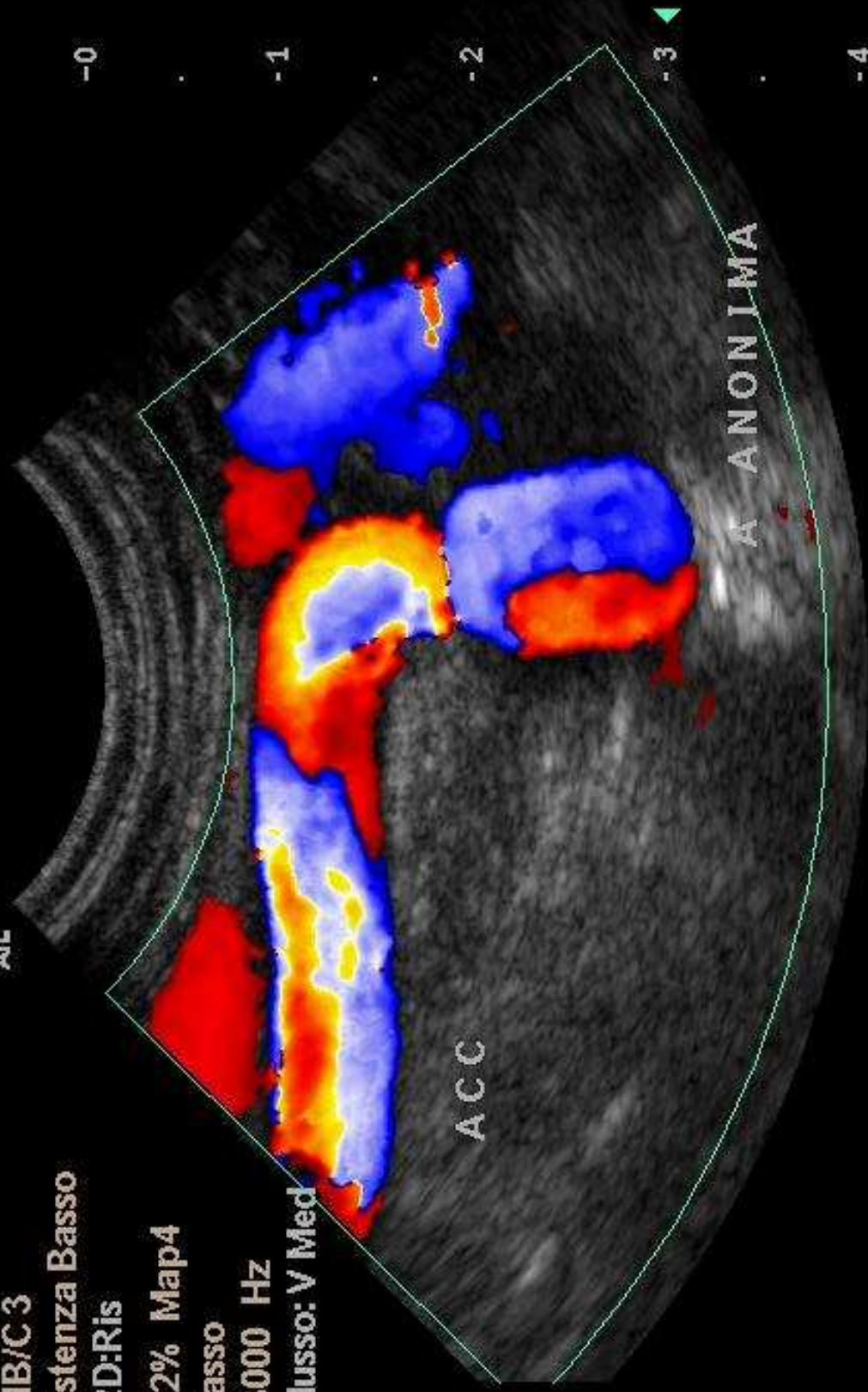
FRI 3000 Hz

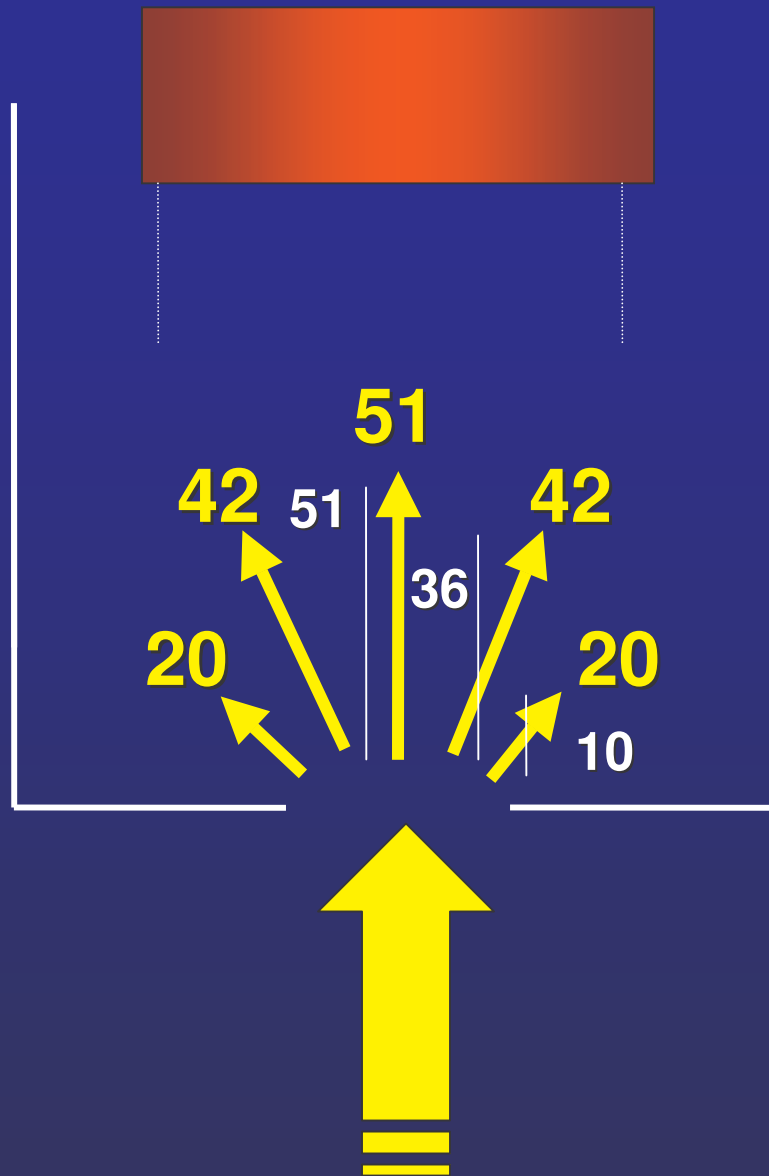
Ott. flusso: V Med

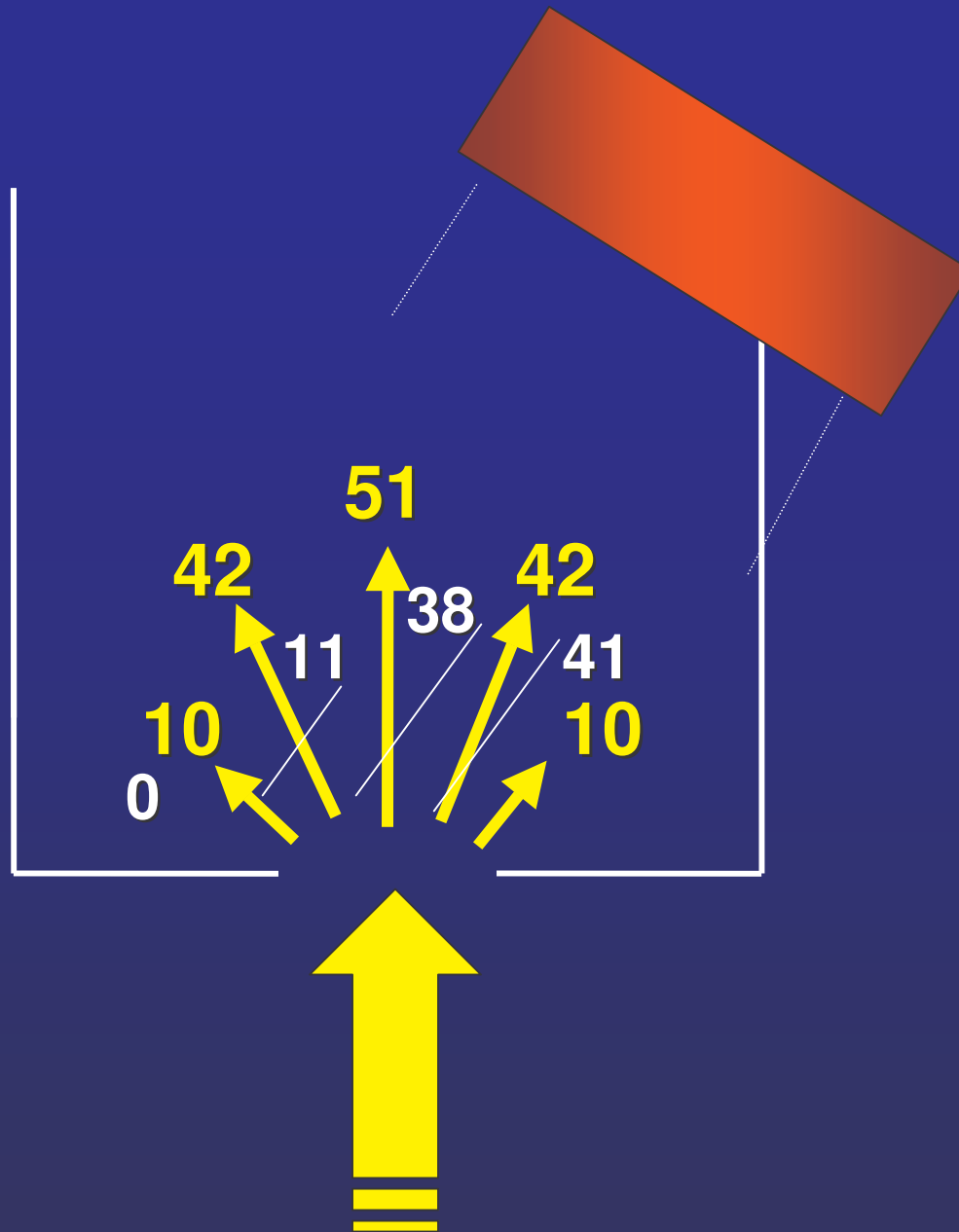
ATL

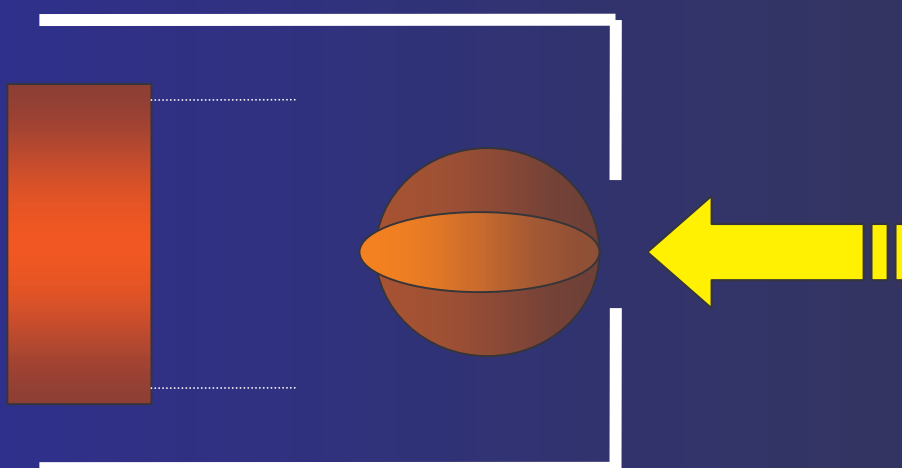
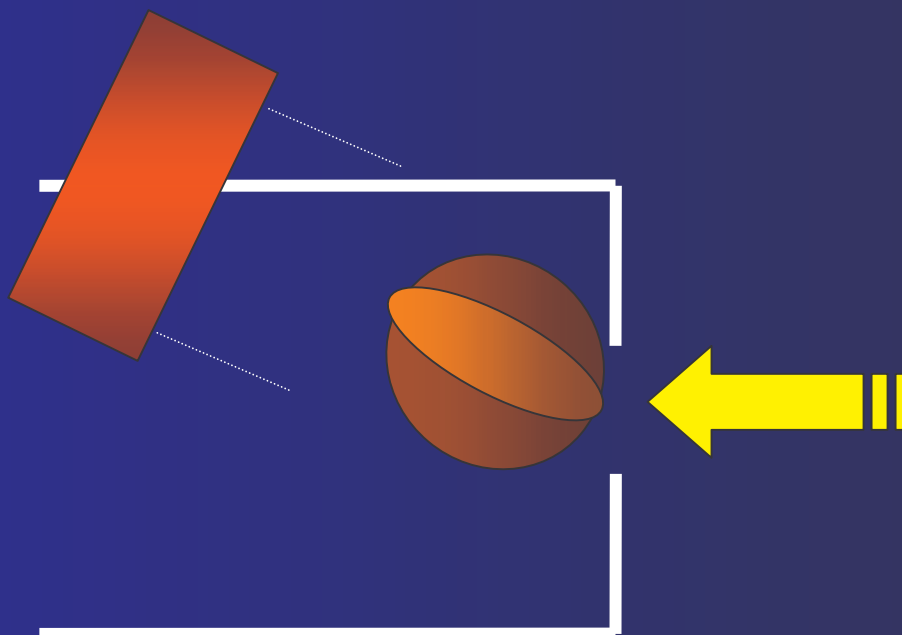
A C C

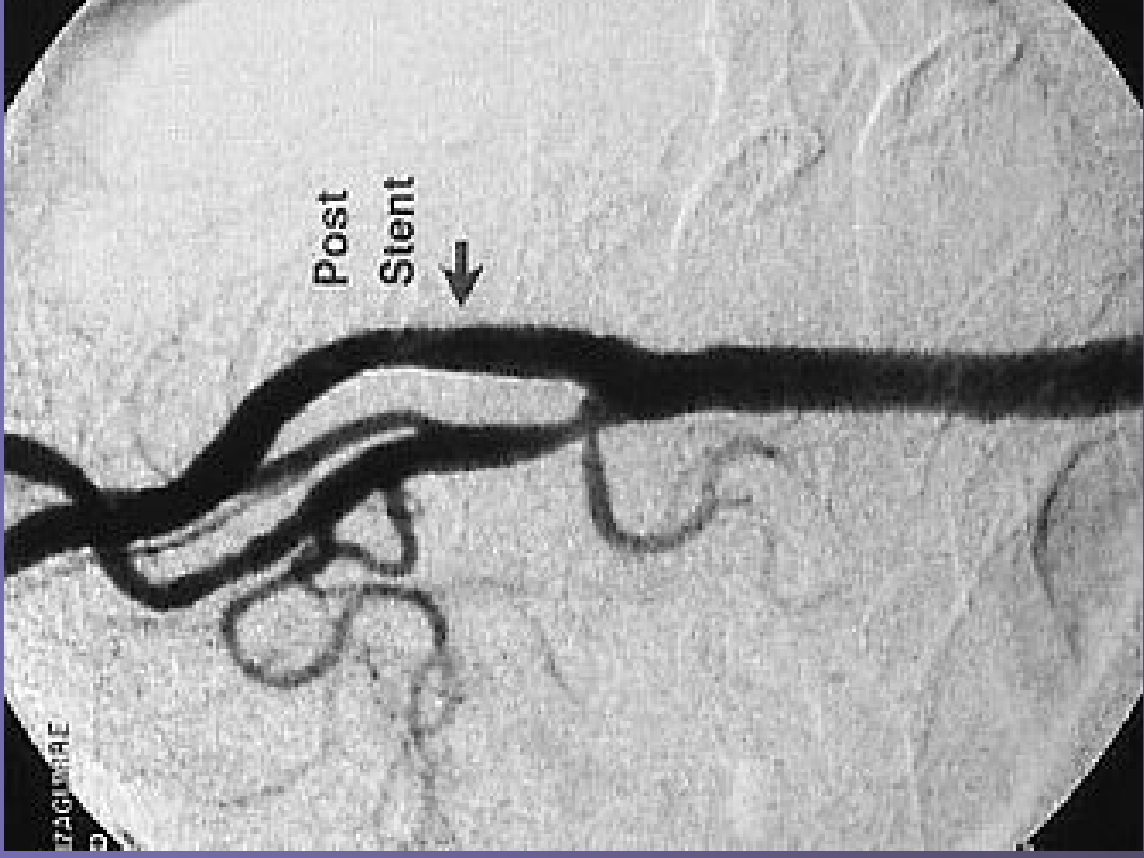
A A N O N I M A







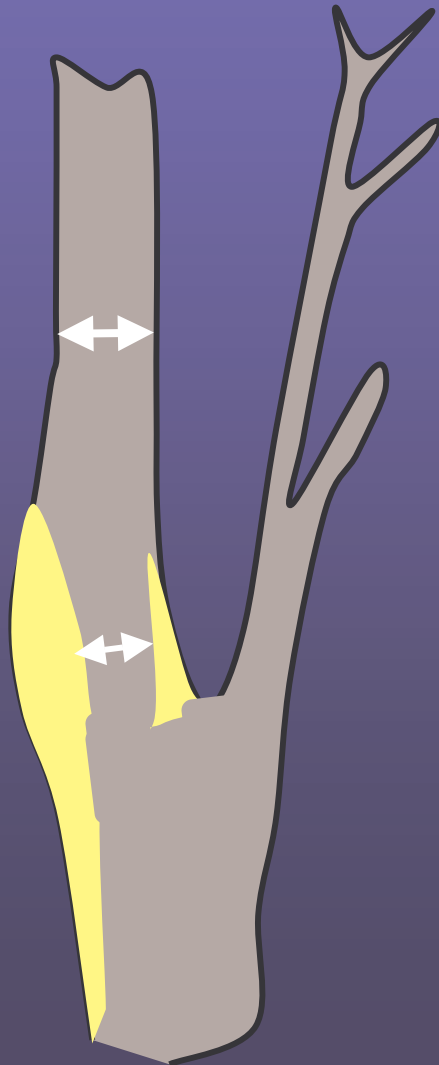




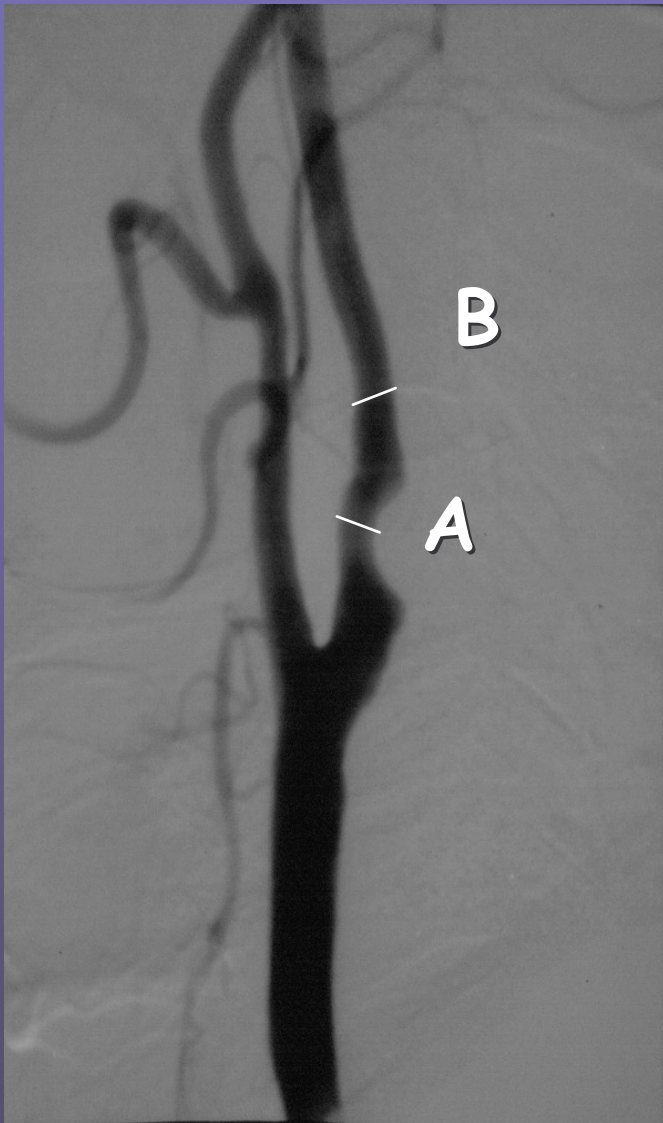
LIMITATIONS OF ANGIOGRAPHY AS "GOLD STANDARD"

- INTER-OBSERVER AND INTRA-OBSERVER VARIABILITY (agreement 78% and 83%, for a 70% stenosis)
- USED ONLY IN SELECTED PATIENTS
- IT SHOWS DIAMETER REDUCTION

NASCET

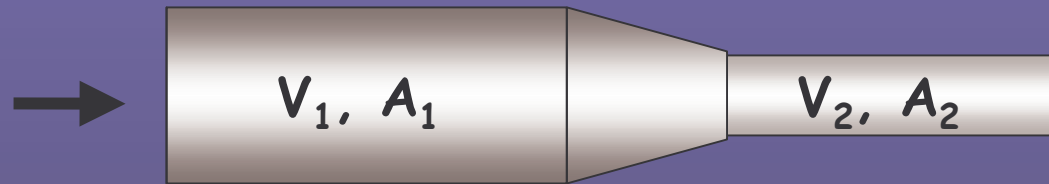


North American
Symptomatic
Carotid
Endarterectomy
Trial



NASCET Measurement Method = $(1 - A/B) * 100$

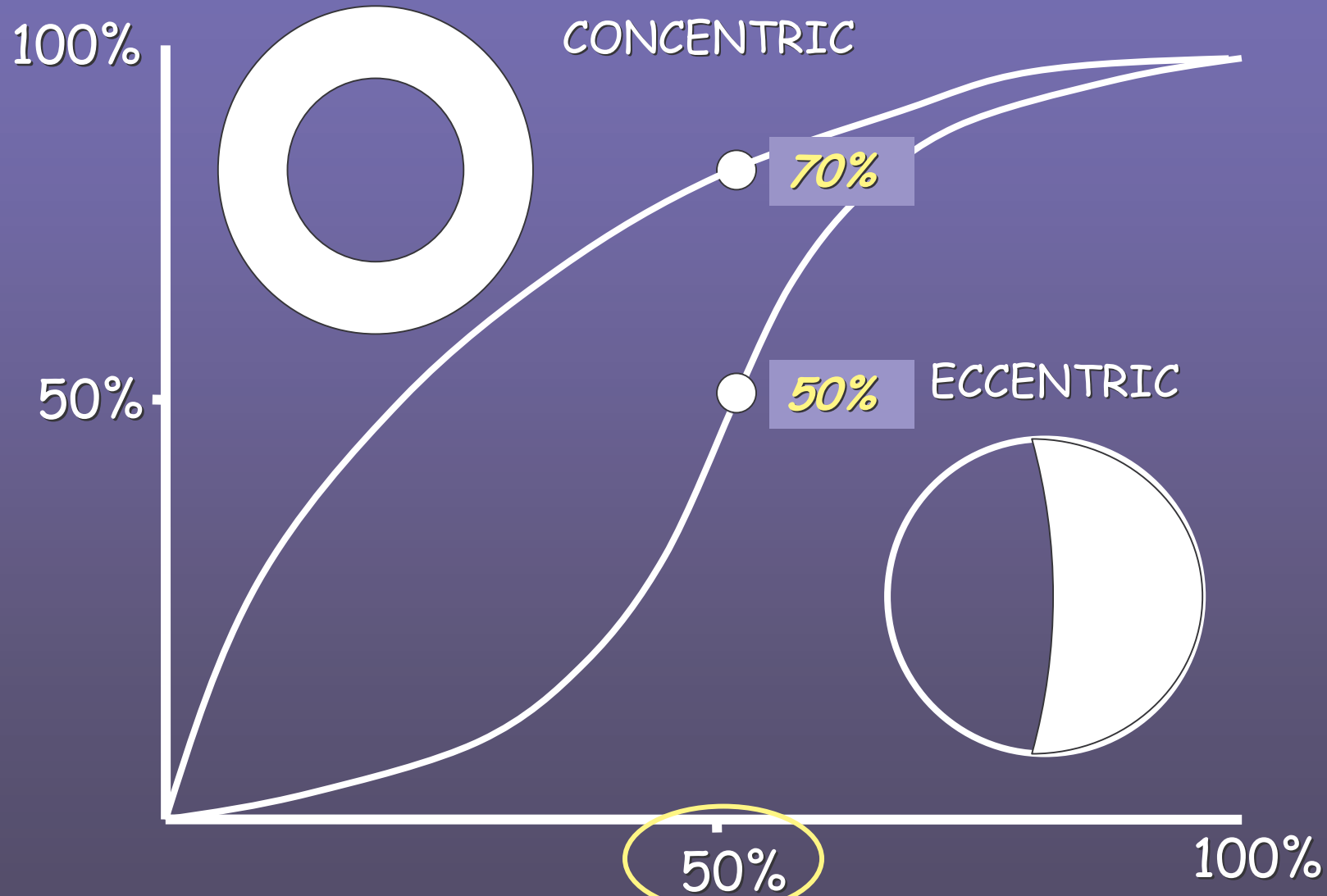
$$Q = V \times A$$



$$V_1 \times A_1 = V_2 \times A_2$$

$$V_2/V_1 = A_1/A_2$$

AREA REDUCTION



DIAMETER REDUCTION

Map 3
150dB/C 3

ATL

-8

+16.0

**MOST SYMPTOMATIC PATIENTS HAVE STENOSIS
SMALLER THAN 50%**

WF Low
PRF 2500 Hz
Flow Opt: Low V

-1

-2

-16.0

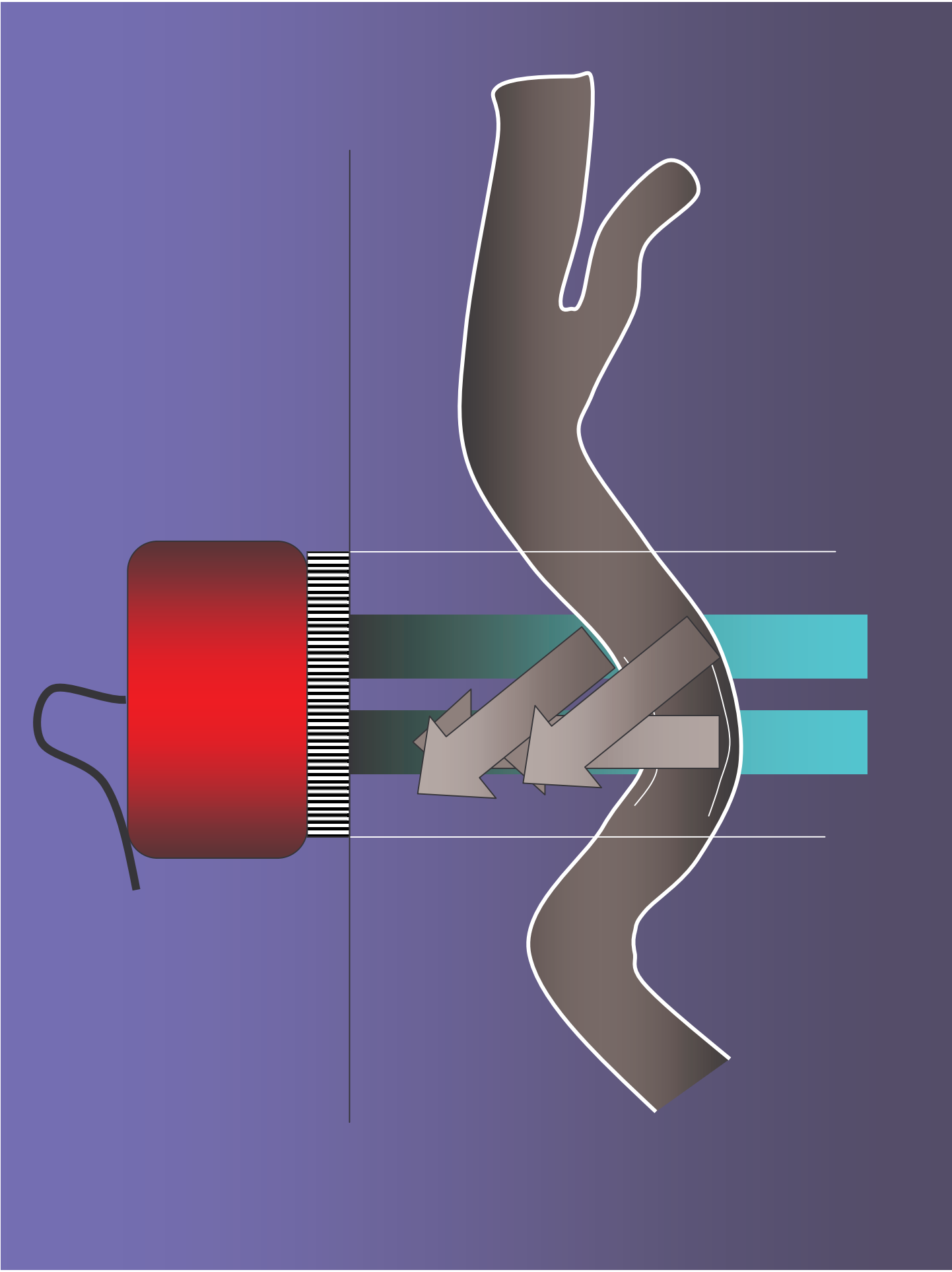
**THE MAJORITY OF PATIENTS WITH HIGHER
STENOTIC PLAQUES REMAIN SYMPTOM-FREE**

US CHARACTERIZATION OF CAROTID PLAQUES

- ECHOGENECITY
 - anechoic, isoechoic, hyperechoic
- TEXTURE
 - homogeneous, heterogeneous
- SURFACE CONTOUR
 - smooth, mildly irregular, ulcerated (>2 mm in depth and width)

US CHARACTERIZATION OF CAROTID PLAQUES

- TYPE 1: low echogenecity
- TYPE 2: intermediate low echog.
- TYPE 3: intermediate high echog.
- TYPE 4: high echogenecity
- TYPE 5: unclassified due to calcium





08 May 02



12:05:31 pm

8L5c

#31

50MHz

40mm

CIMT

General

60dB S1/ 0/0/3

Gain= -2dB Δ =1

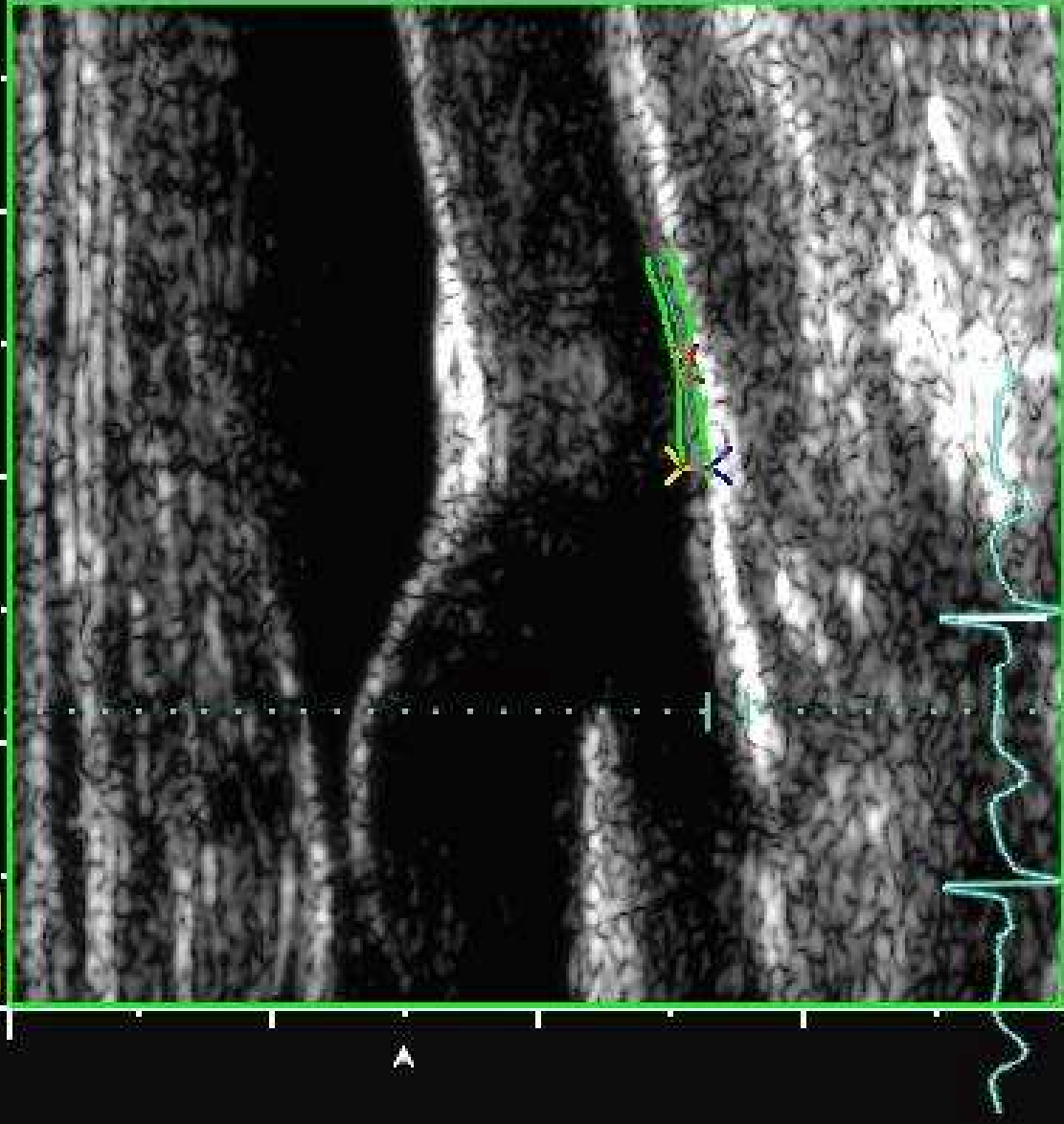
Store in progress



0:26:12

HR= 75bpm

LT CCA
POST 270



US CHARACTERIZATION OF CAROTID PLAQUES

PITFALLS

same plaque

- 7.5 MHz = hypo-echogenic (echo-lucent)
- 20 MHz = hyper-echogenic (echo-rich)

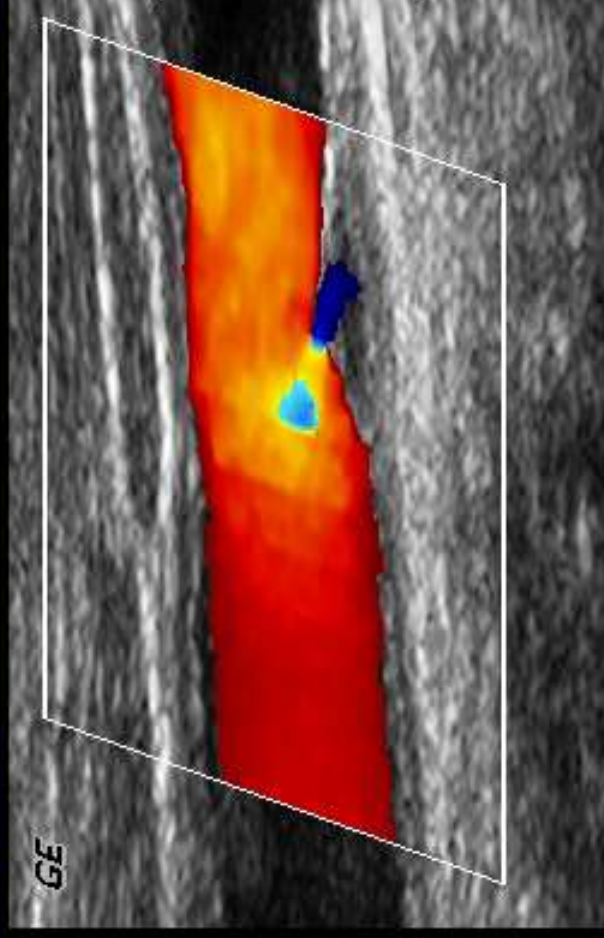
US CHARACTERIZATION OF CAROTID PLAQUES

PITFALLS

- **SUBJECTIVE**
(GSM concept)
- **DIFFICULT TO REPRODUCE**
(lack of pointing facilities)
- **CALCIUM**
(21-48% of plaques)

GE MEDICAL SYSTEMS
3790P
114F
34CG
IM#12

D0.4cm 5739L
CAROTID
CINE 0059
25G
72DR
R1 A5 P16



29
1
29
cm/s

COMMON CAROTID ULCERATION

TIS=1.9 MI=0.9 AO=69%

[HDI]
5000

COILING

UO ANGIOLOGIA - ULSS 8

02/09/23:104159

L12-5 38 CVas/RAFTS

23 Set 02

10:42:56

ITt 0.0 IM 0.8

Imm.85 3.9 cm



HDI
5000

OCCLUSIONR ICA

UO ANGIOLOGIA - ULSS 8

02/09/13:111811

L12-5 38 CVas/RAFTS

13 Set 02

11:20:28

ITt 0.1 IM 0.8

Imm.105 3.3 cm

Map4

150 dB/C 3

Persistenza Basso

Ott. 2D:Ris

Col 79% Map4

FP Basso

FRI 3000 Hz

Ott. flusso: V

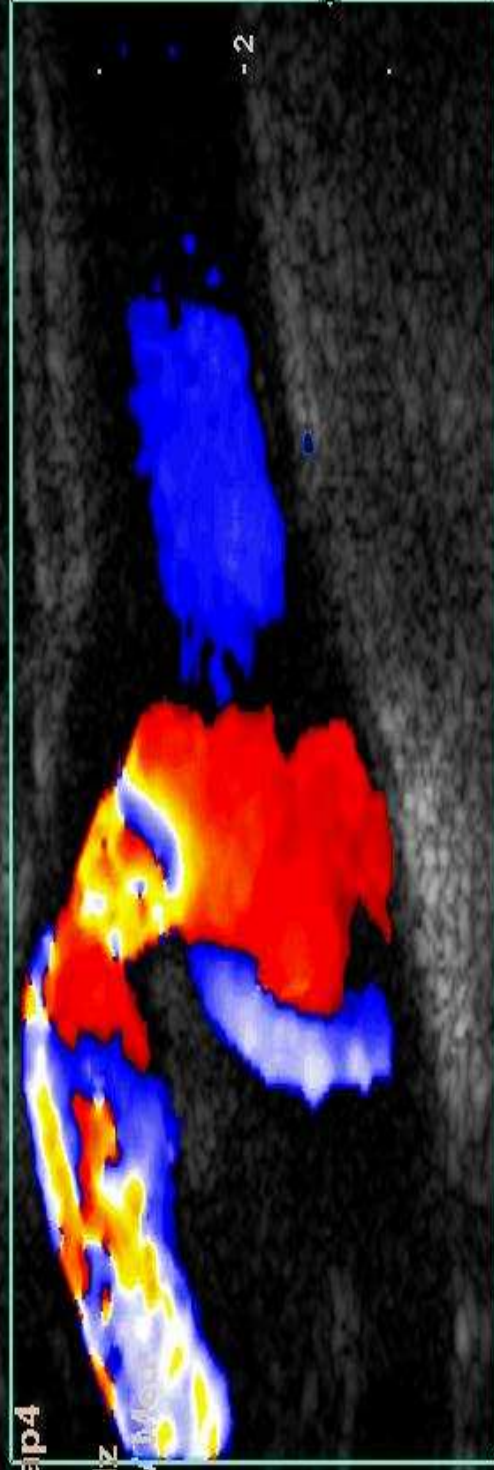
+ 19.2



- 1

- 2

- 3



40 -

20 -

cm/s

-20 -

-40 -

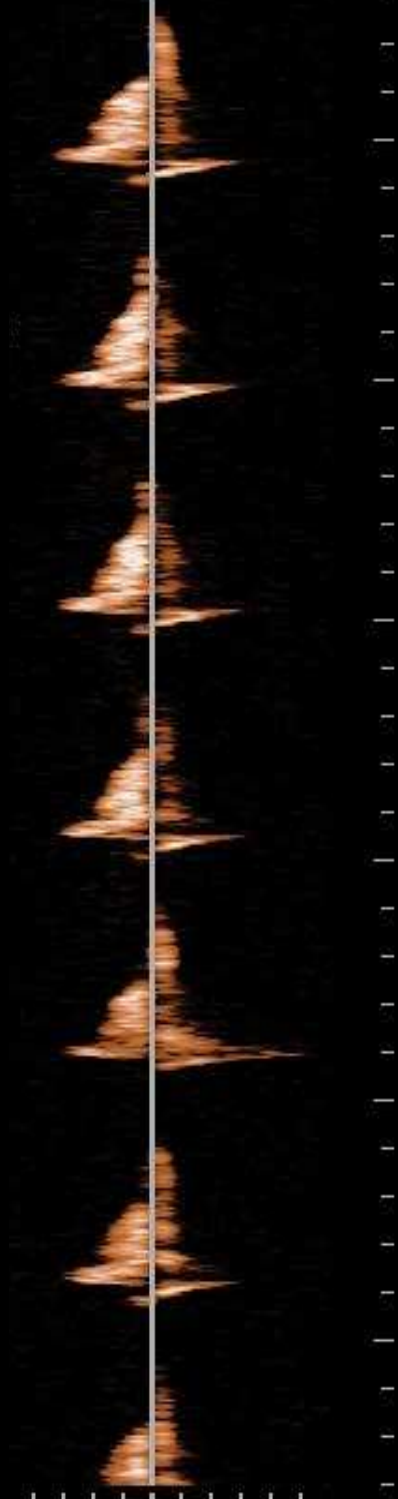
40 -

20 -

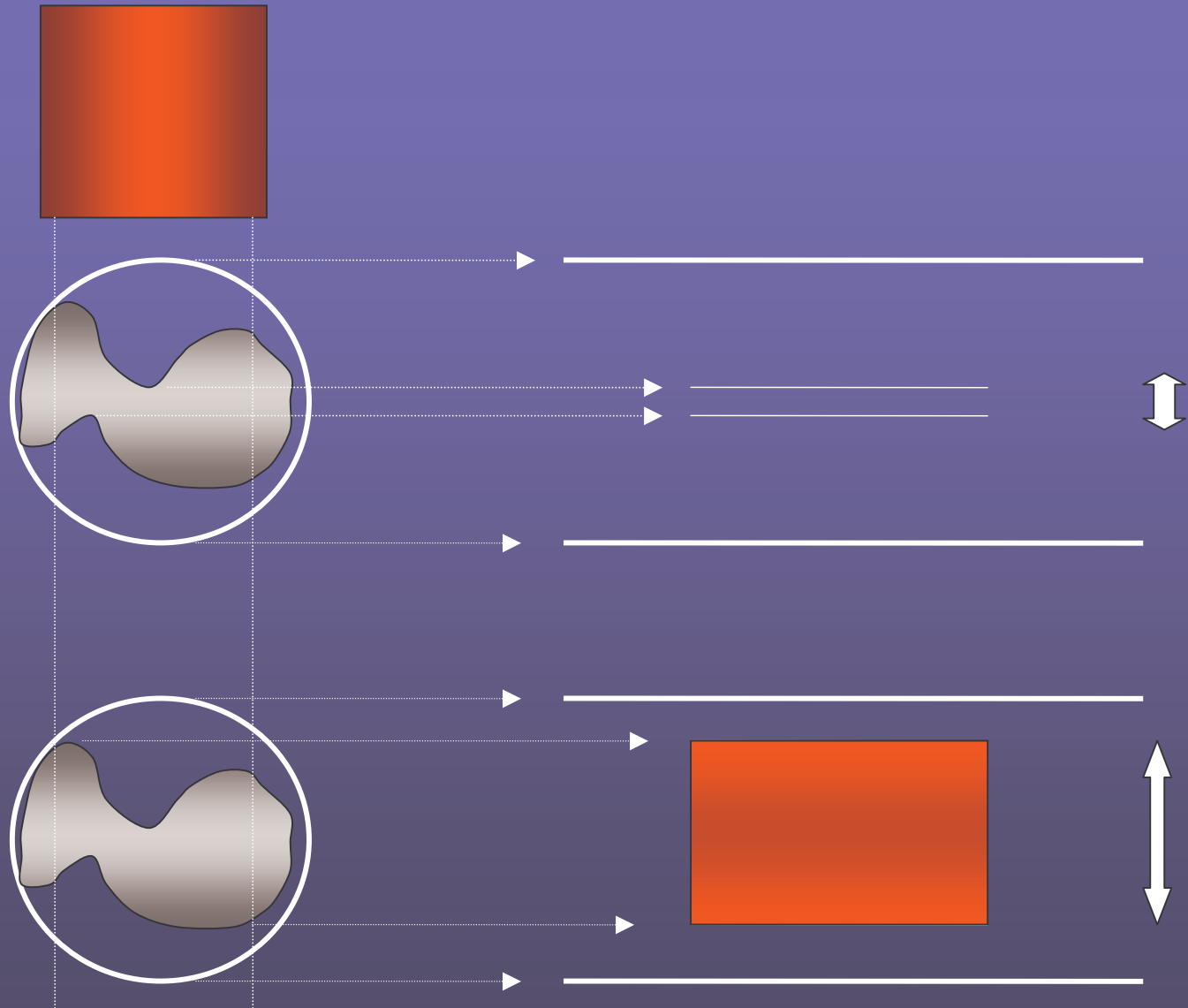
cm/s

-20 -

-40 -



B-mode



CFM

DUPLEX SCANNING is

- OPERATOR DEPENDENT
- MACHINE DEPENDENT
- LABORATORY-SPECIFIC CRITERIA
(even for multicenter trials)
- CONTINUING QUALITY CONTROL
PROCESS