Advanced Tutorial TCCS

Principles, instrumentation, technical requirements and

how to carry out a cerebrovascular examination

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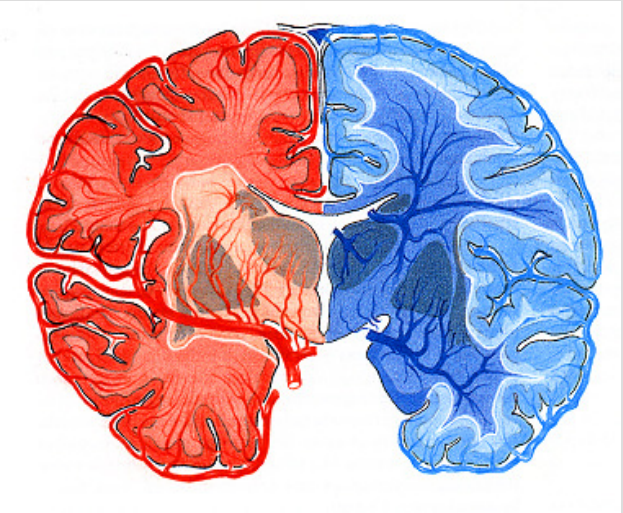


15th Meeting of the European Society of Neurosonology and Cerebral Hemodynamics

Madrid, Spain, May 22 – 25, 2010

What about machines ?

What about clinical knowledge ?

What about anatomical knowledge ?

What about examination techniques ?

What else ?

What about machines ?

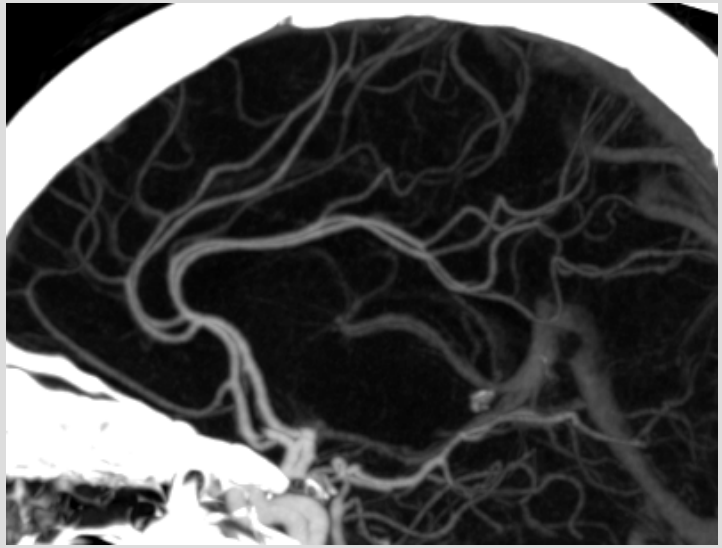
What about clinical knowledge ?

What about anatomical knowledge ?

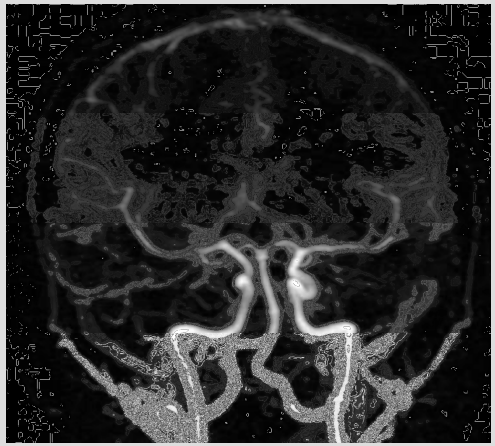
What about examination techniques ?

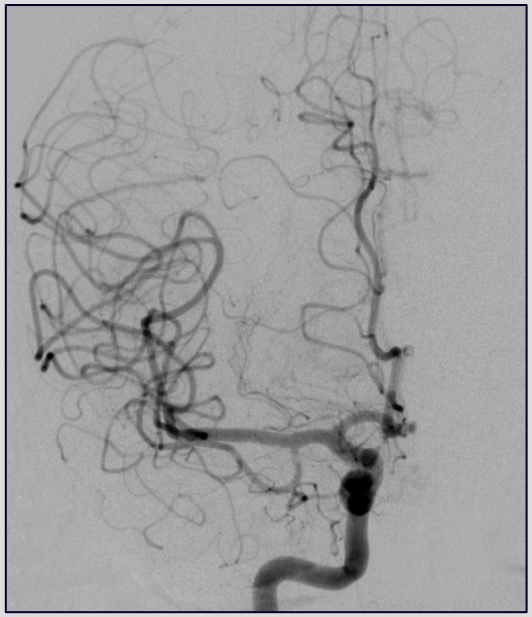
What else ?

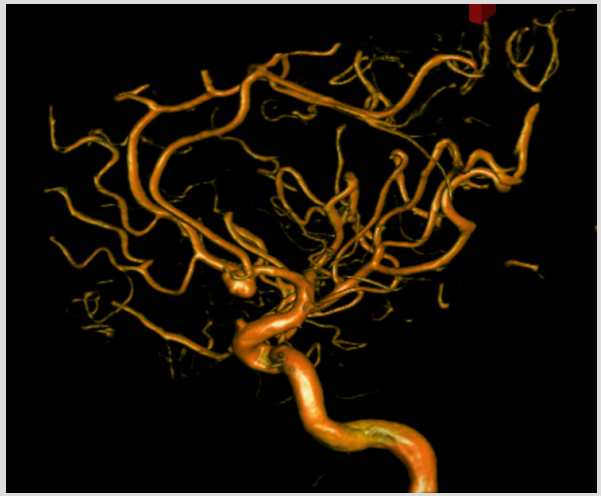
Ultrasound has to compete with

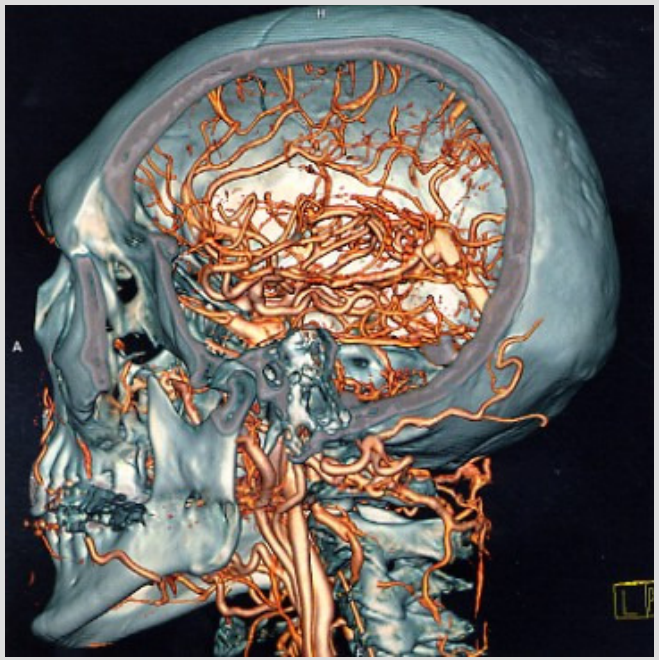


DSA
MRA
CTA









TCD or TCCS ?

MCA 98 %
ACA 87 %

bilateral absence of temporal bone window 6/89 patients = 7%

MCA 98 %
ACA 98 %

bilateral absence of temporal bone window 6/89 patients = 7%

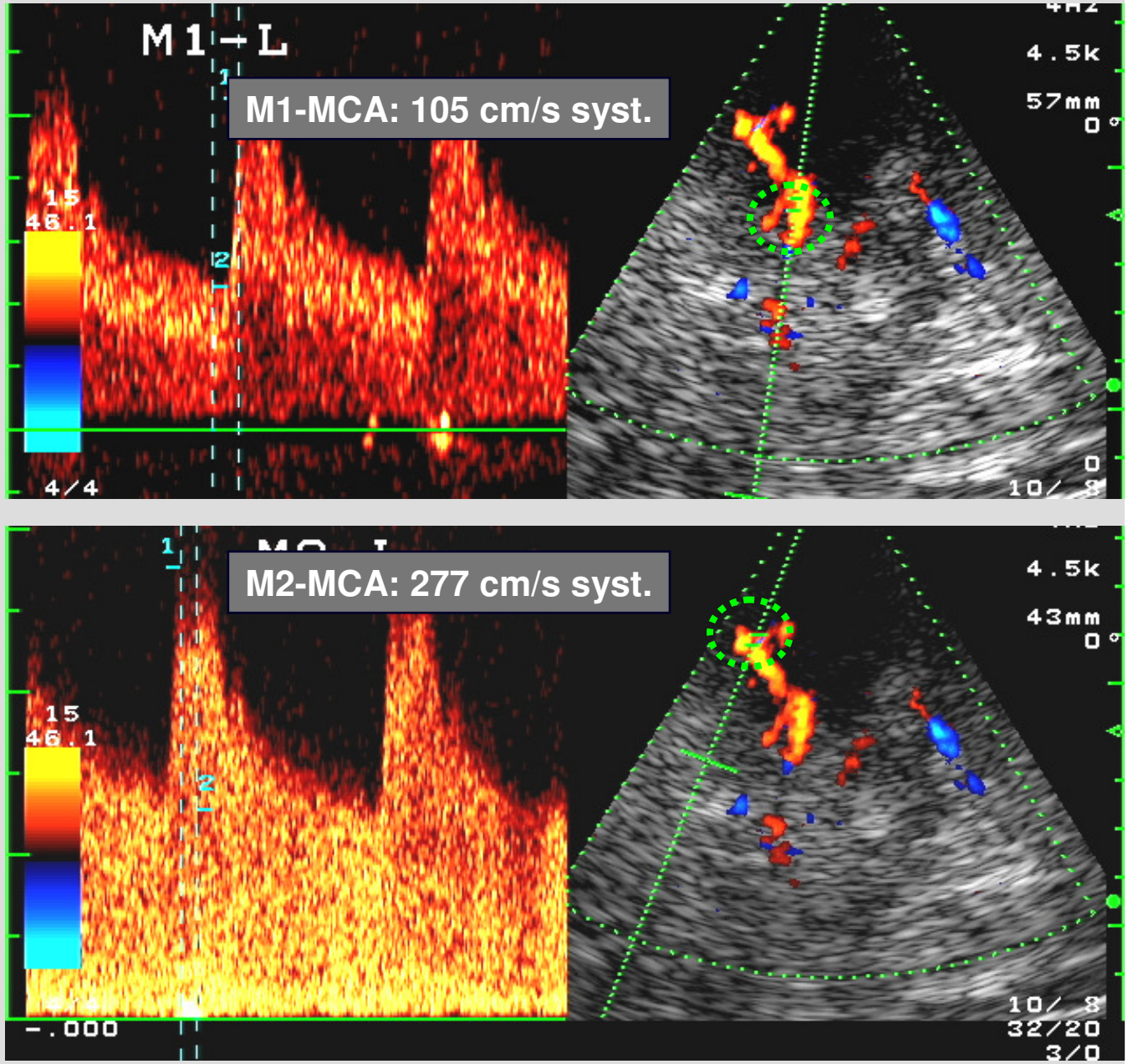
Schöning et al
J Neurosurg 1993

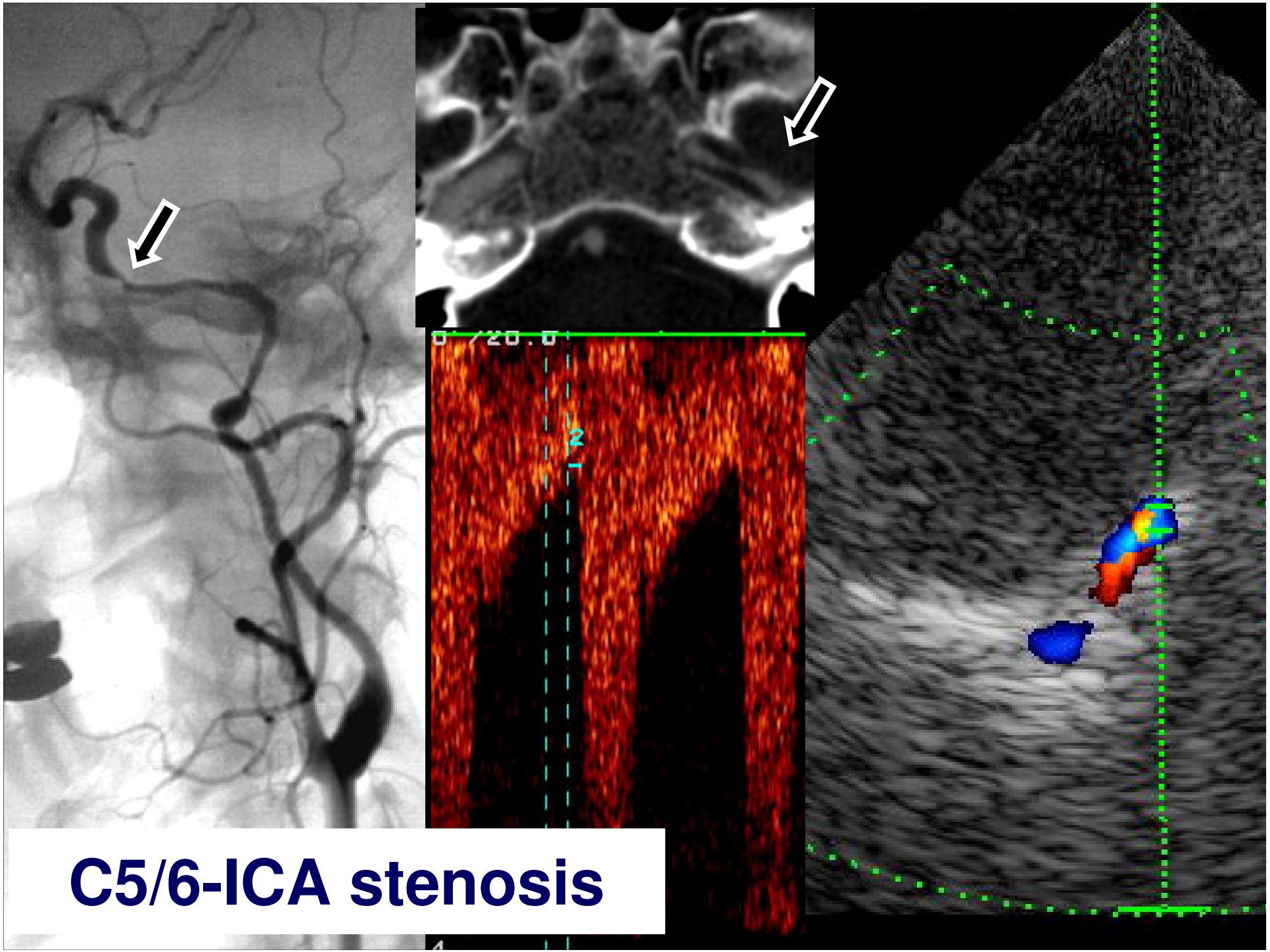
Krejza et al
J Neuroimag 2007

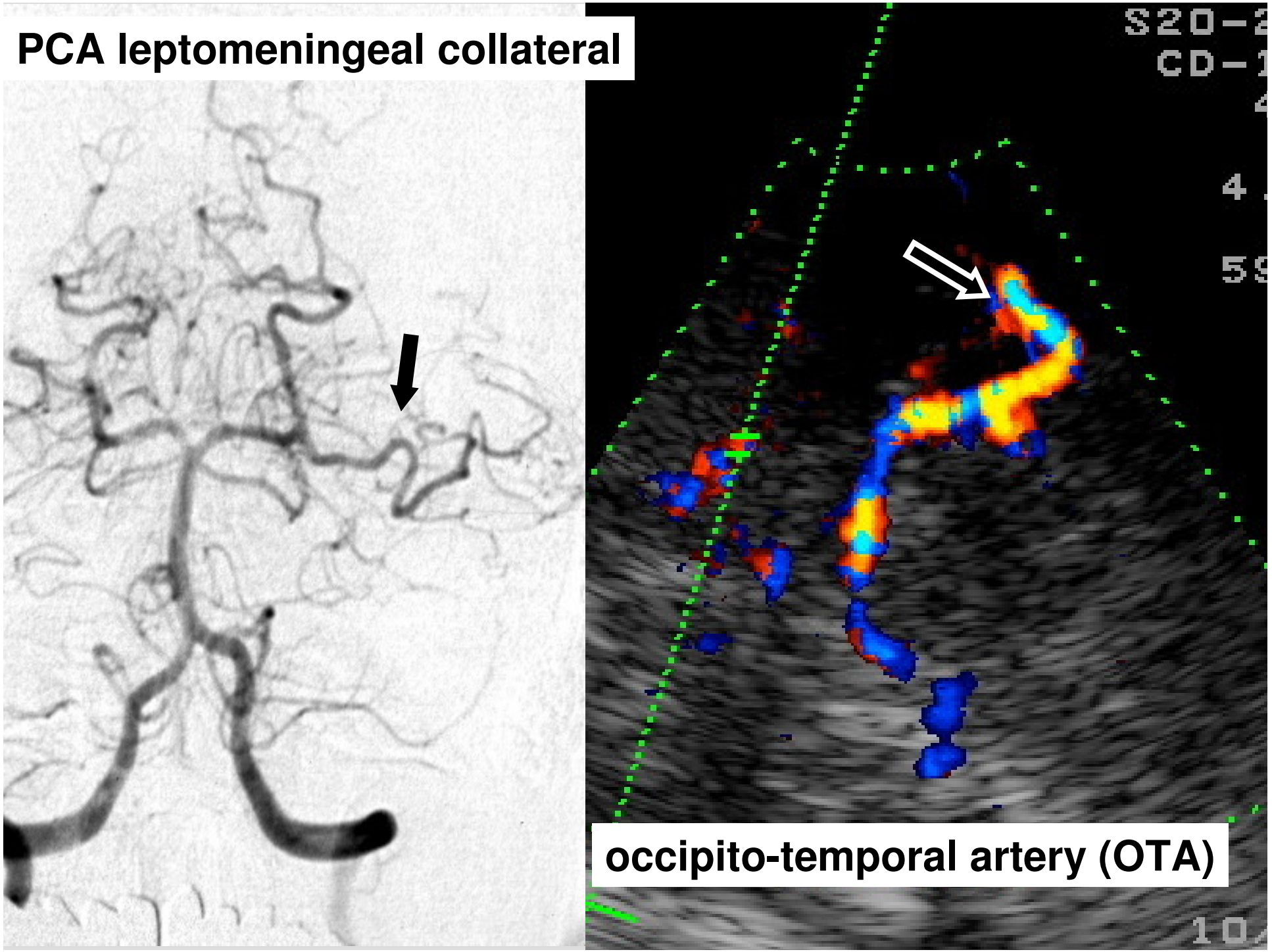
What favours TCCS ?

More precise, secure and detailed vessel diagnosis in chronic, subacute, acute and peracute stage of stroke

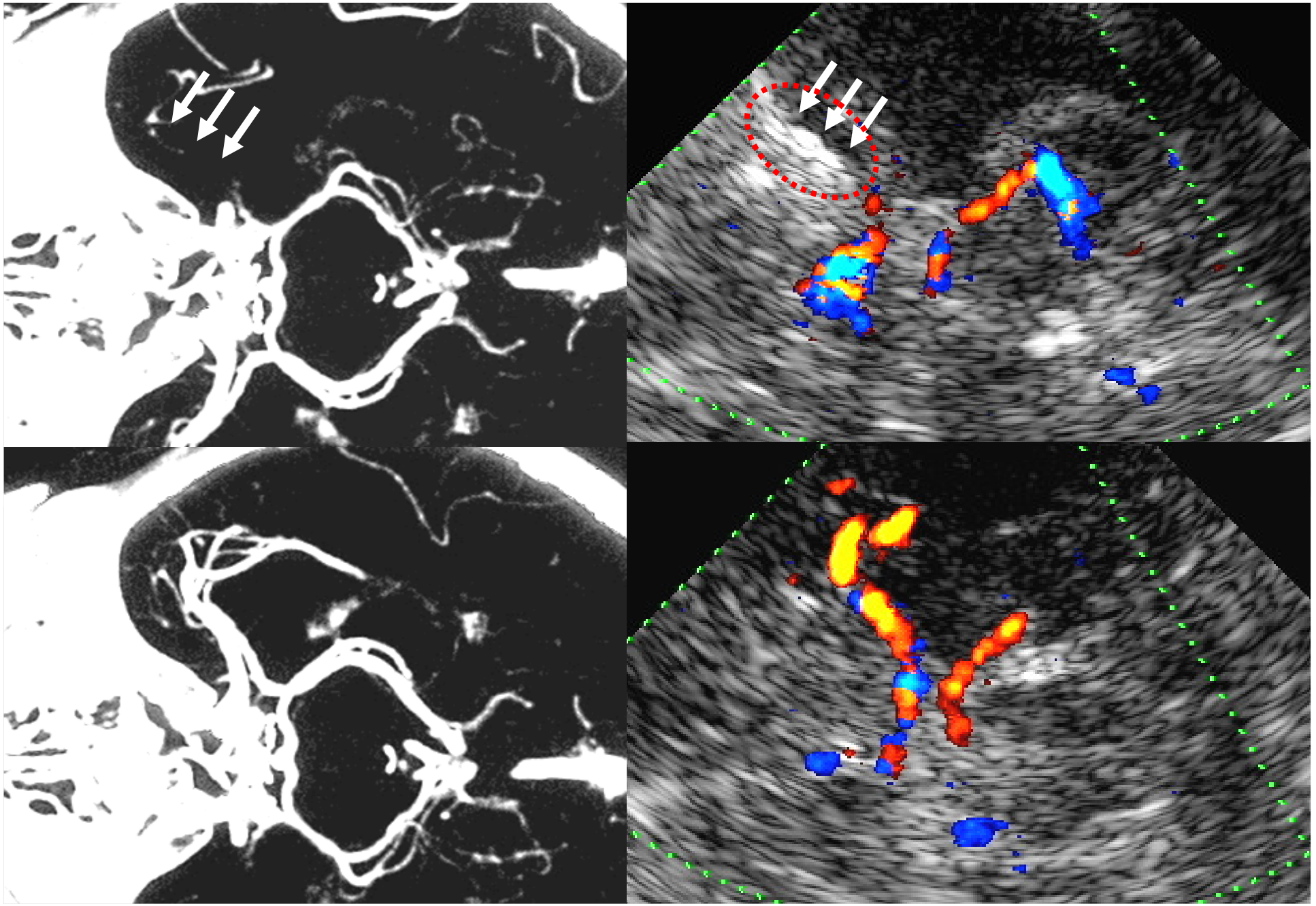
M2-MCA stenosis




C5/6-ICA stenosis

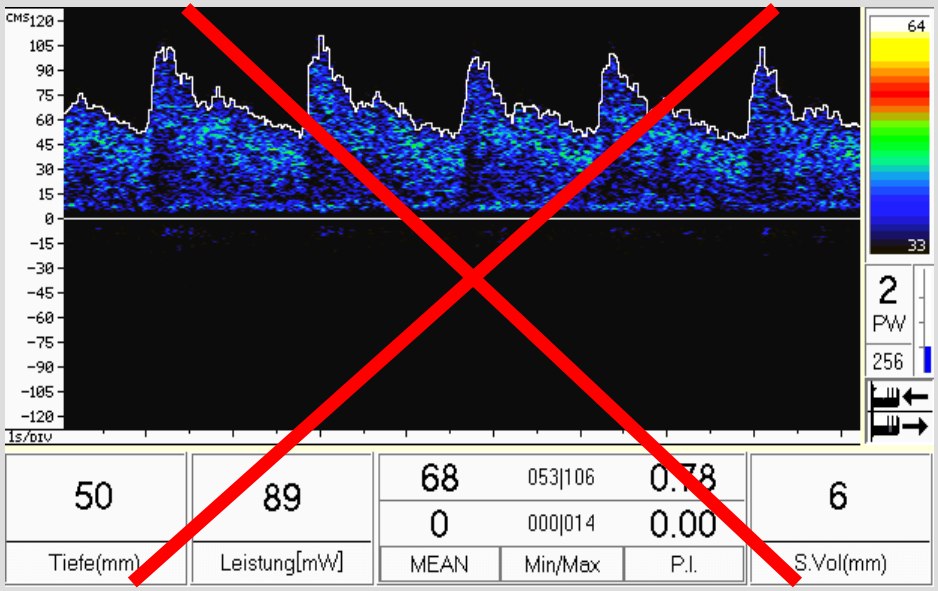

PCA leptomeningeal collateral
occipito-temporal artery (OTA)

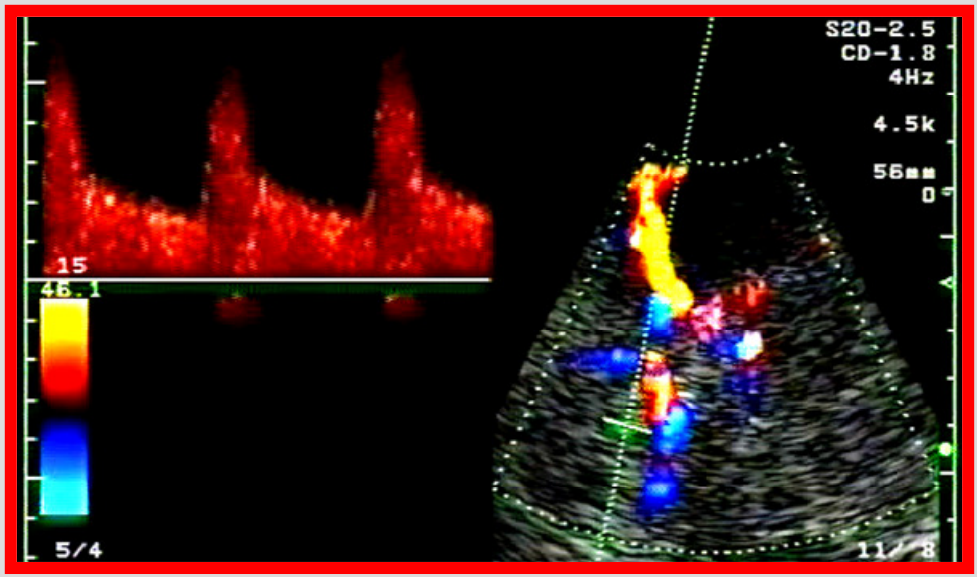
Proximal M1-MCA occlusion



TCCS…

is similar sensitive in vessel detection as TCD, but
is less operator-dependent than TCD
identifies more reliable specific vessel segments / collaterals
identifies more reliable vessel occlusions
allows to use angle correction
allows to examine diameter and position of the 3th ventricle
allows to detect cerebral hemorrhage

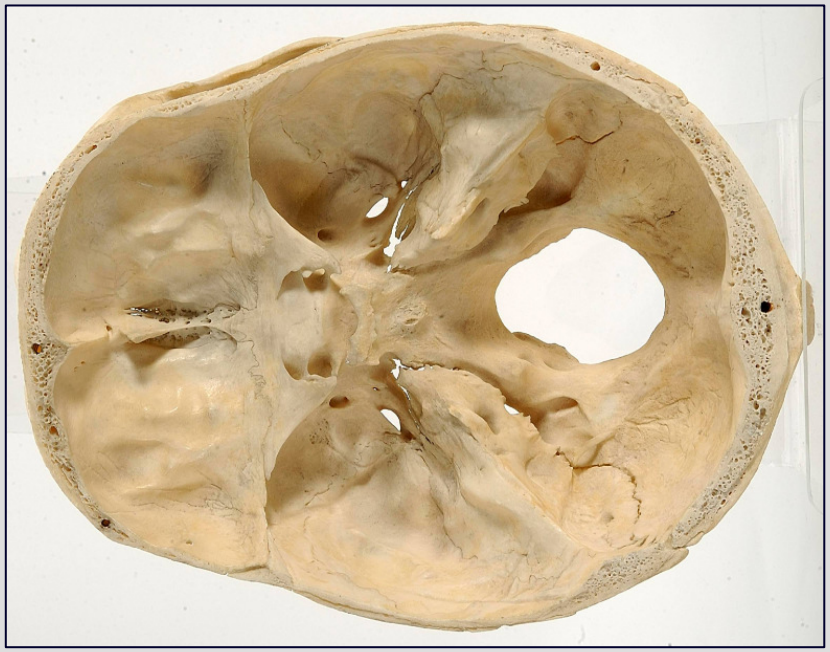


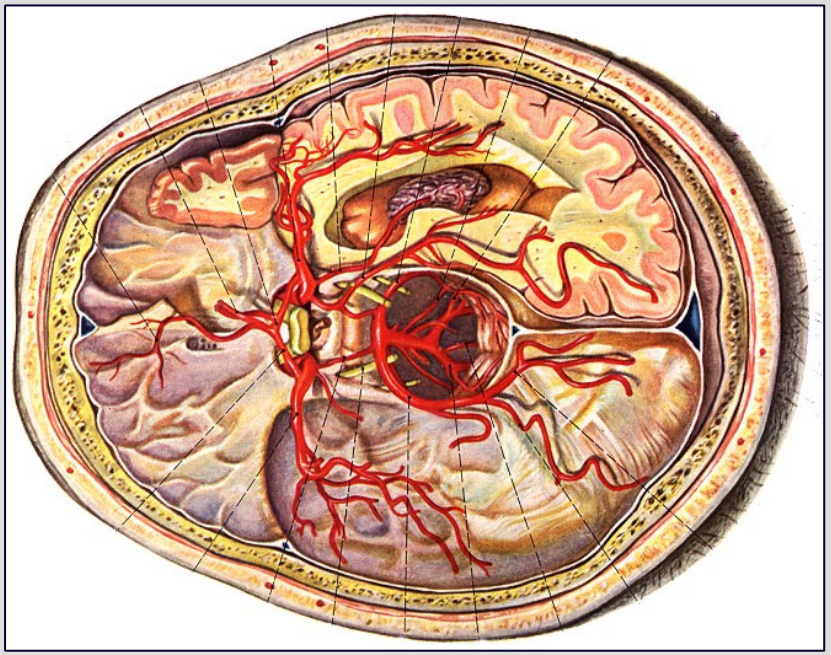


The acoustic power output of modern TCCS machines are limited according to FDA regulations for fetus protection

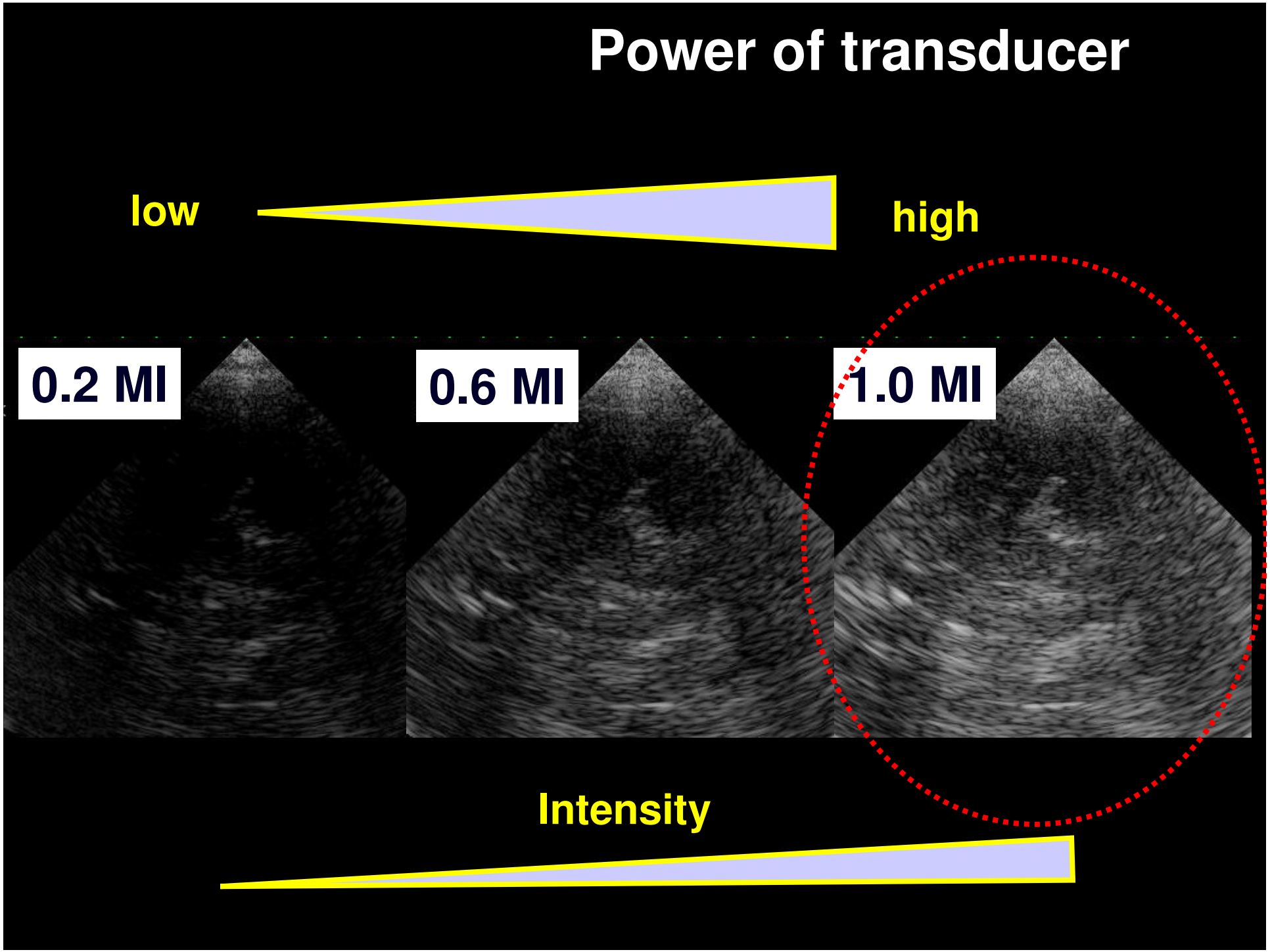
Note that skull acoustic reflection and absorption accounts for 94% of the energy loss in children and 98% for white middle-aged women

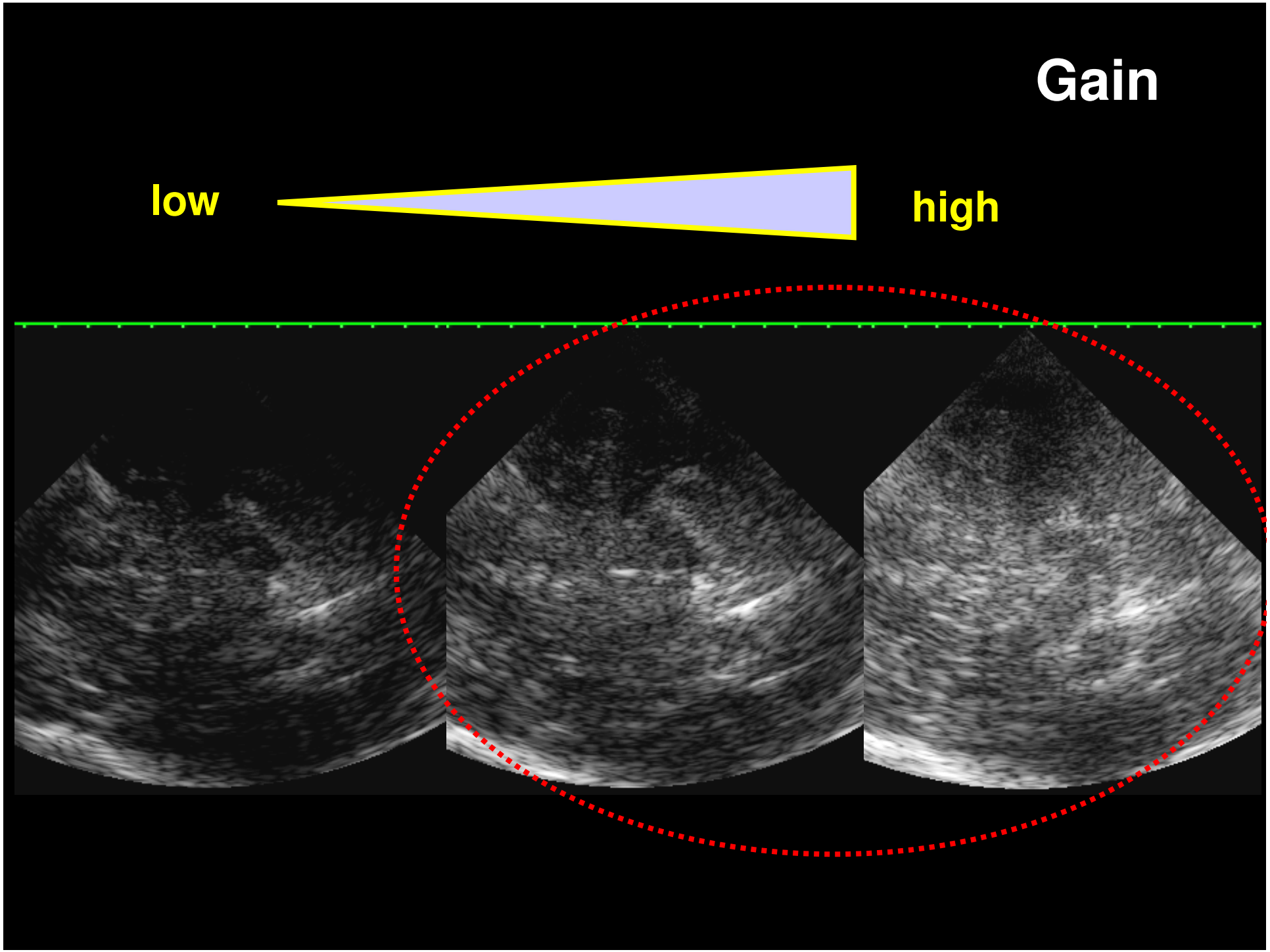
Eden *Stroke* 1991





Therefore, older TCCS machines can be more sensitive for intracranial flow detection despite improved transducer and software efficiency

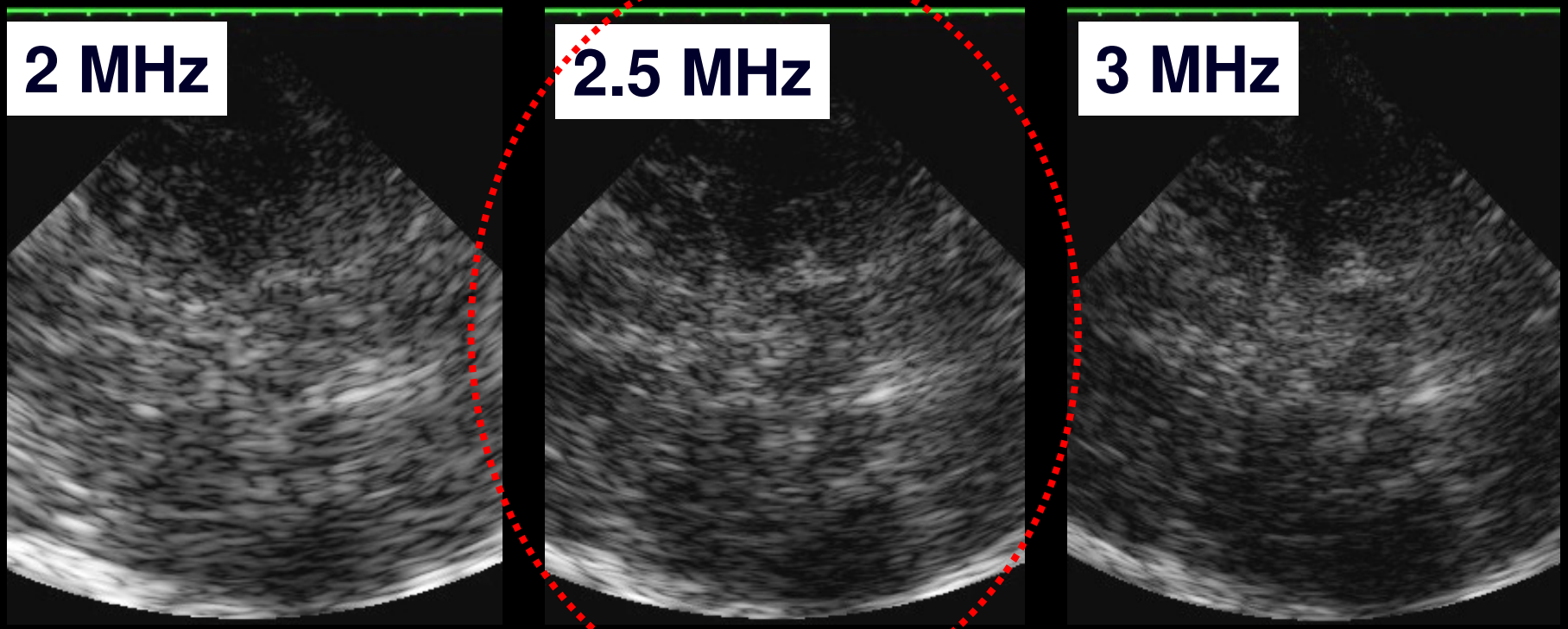

Power of transducer
low
high
0.2 MI
0.6 MI
1.0 MI
Intensity


Gain
low
high

Frequency of transducer

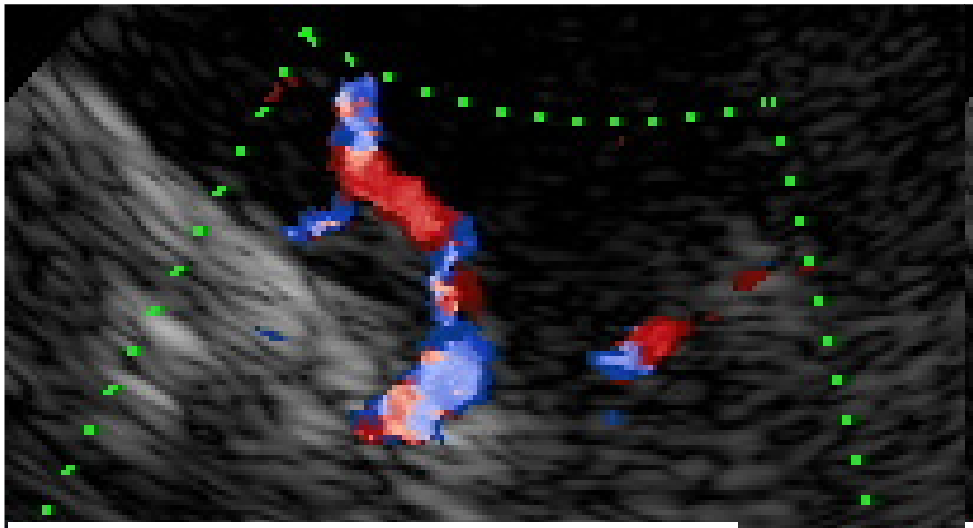
low

high



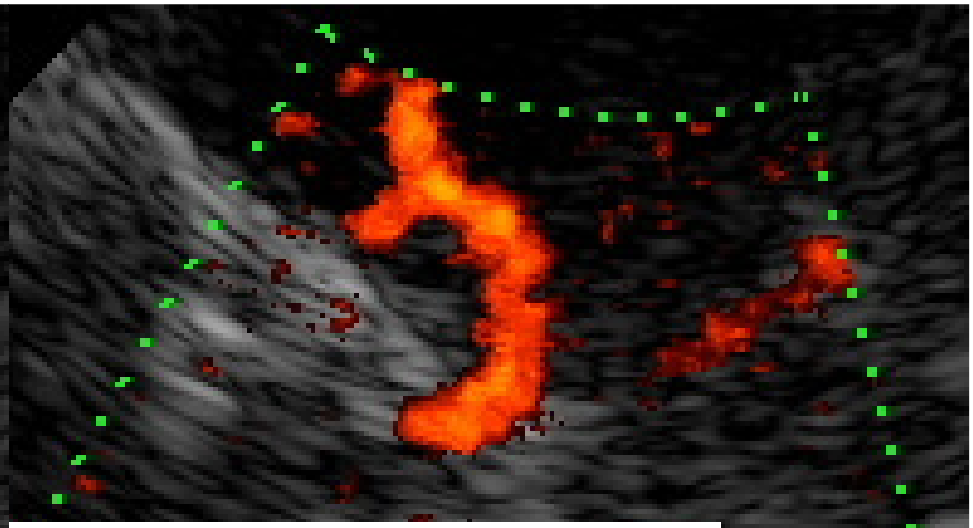
Intensity

Resolution



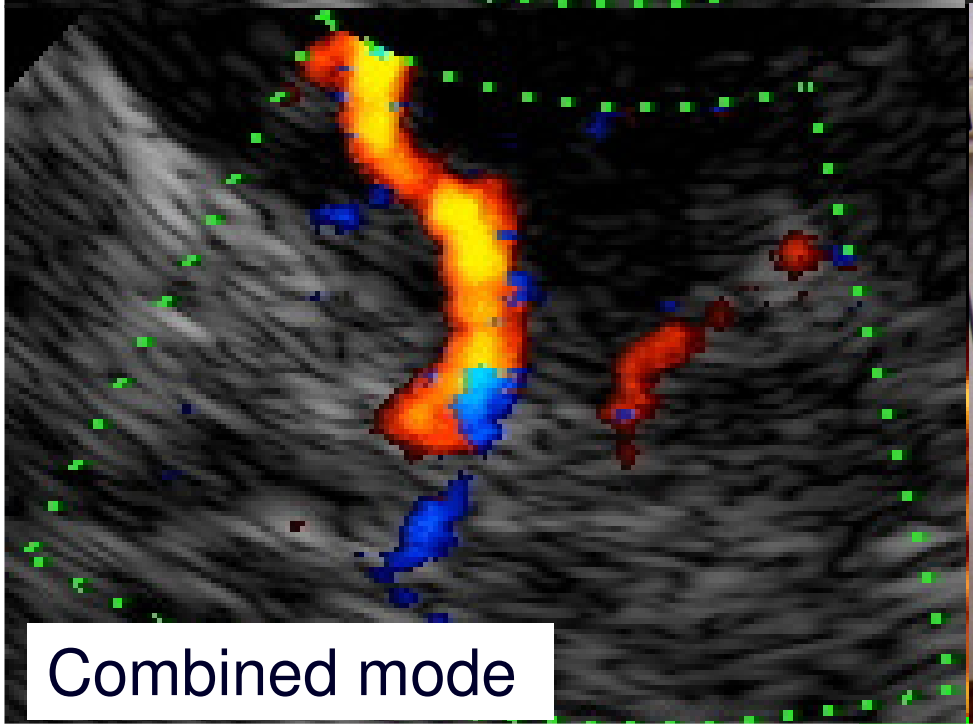
Color (frequency) mode

+ indicates flow direction



Power (intensity) mode

+ not depending from angle

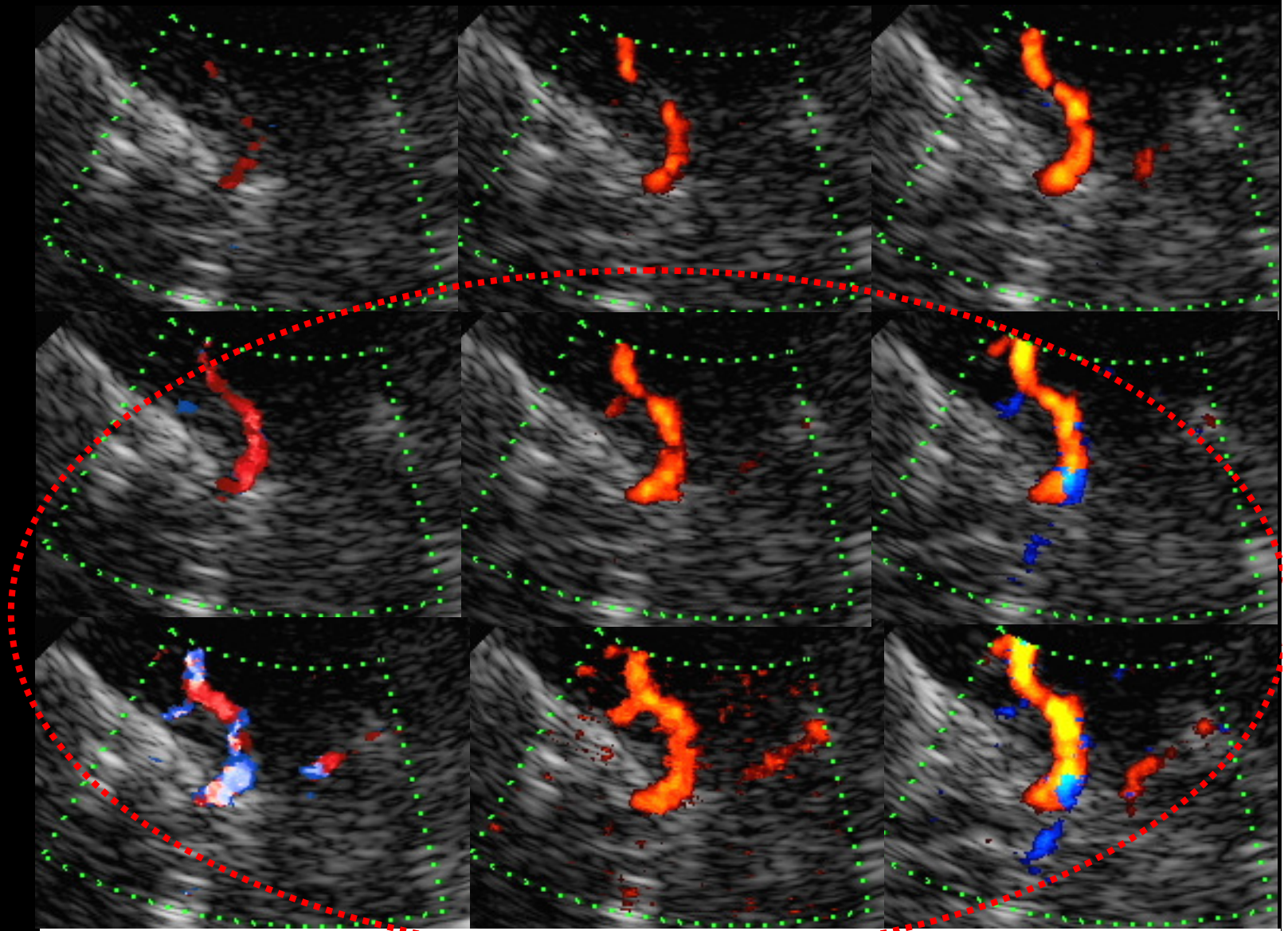


Combined mode

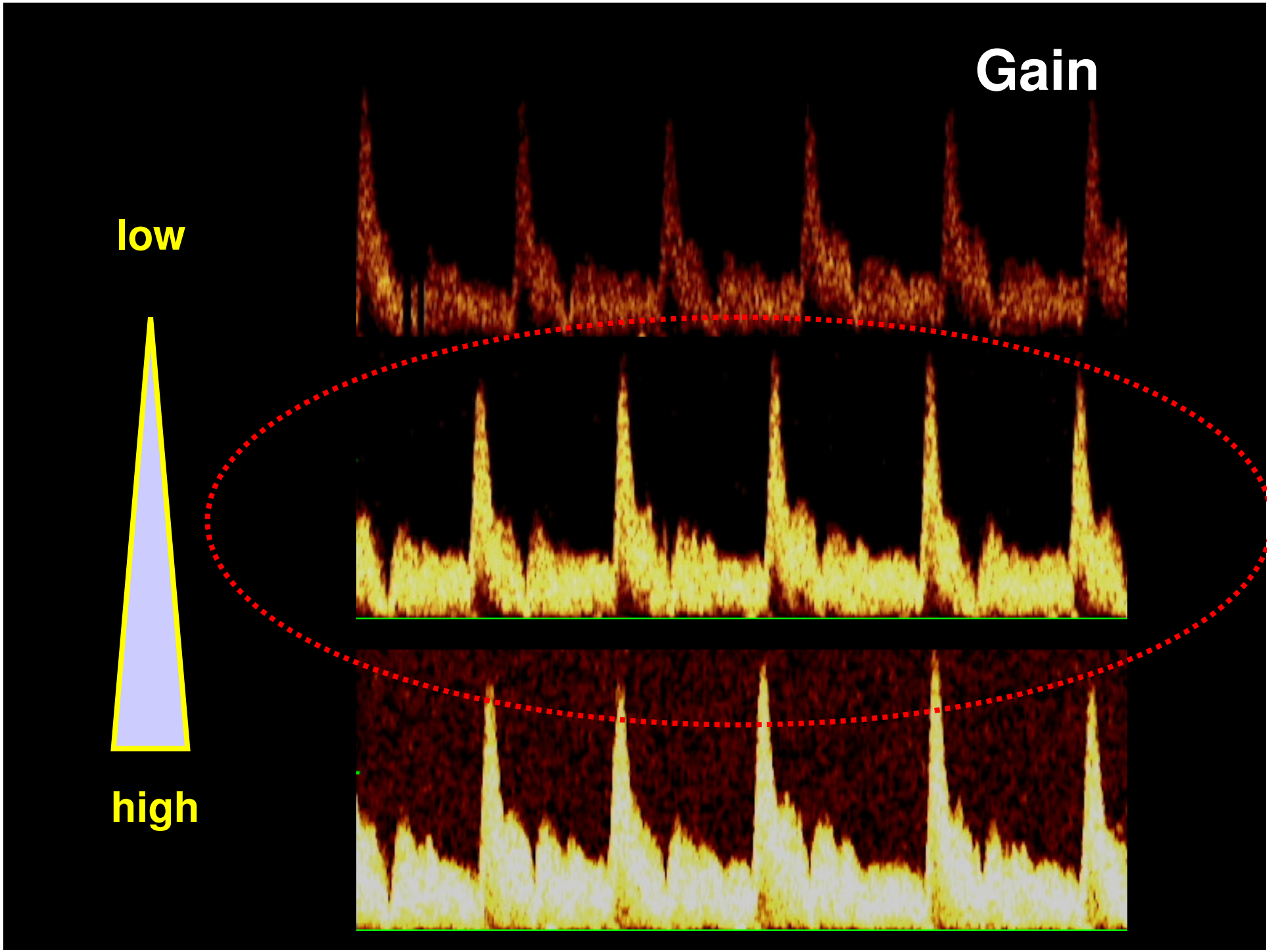
Pulse repetition frequency (PRF)

high

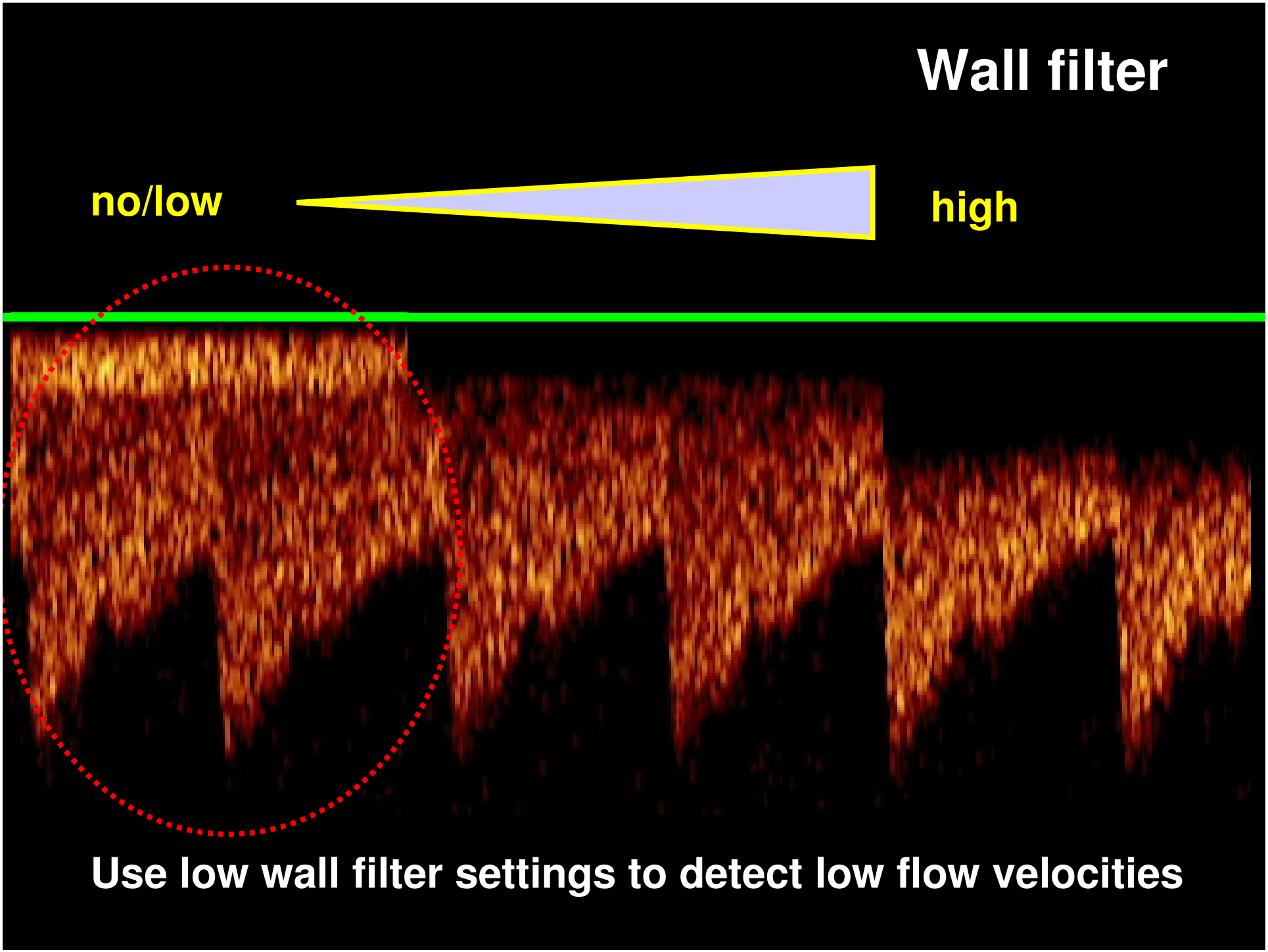
low

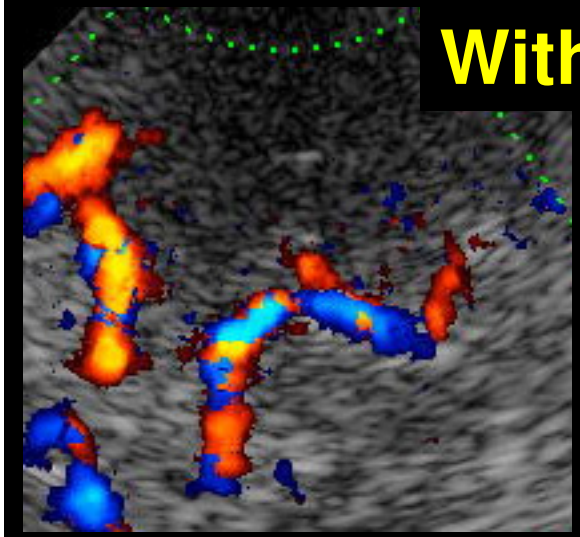


Color mode Power mode Combined mode


Gain
low
high

Wall filter


no/low
high
Use low wall filter settings to detect low flow velocities



With or without Angle correction (AC) ?

AC may reduce the inaccuracy in flow velocity measurement and may therefore allow better definition of intracranial stenosis

In a curved arterial segment however AC is difficult to apply. Elongated vessels are the rule in elderly patients

AC should be applied if a straight vessel segment of at least 1.5 cm is visible. If not, the insonation angle should be as small as possible and the highest measurable velocity should be registered without correction

In presumed stenoses velocities with and without AC and the depth of insonation should be noted

What about machines ?

What about clinical knowledge ?

What about anatomical knowledge ?

What about examination techniques ?

What else ?

one should know…

that brain infarctions may have different etiologies therefore expecting or excluding certain vessel pathologies accessible by ultrasound

one should know…

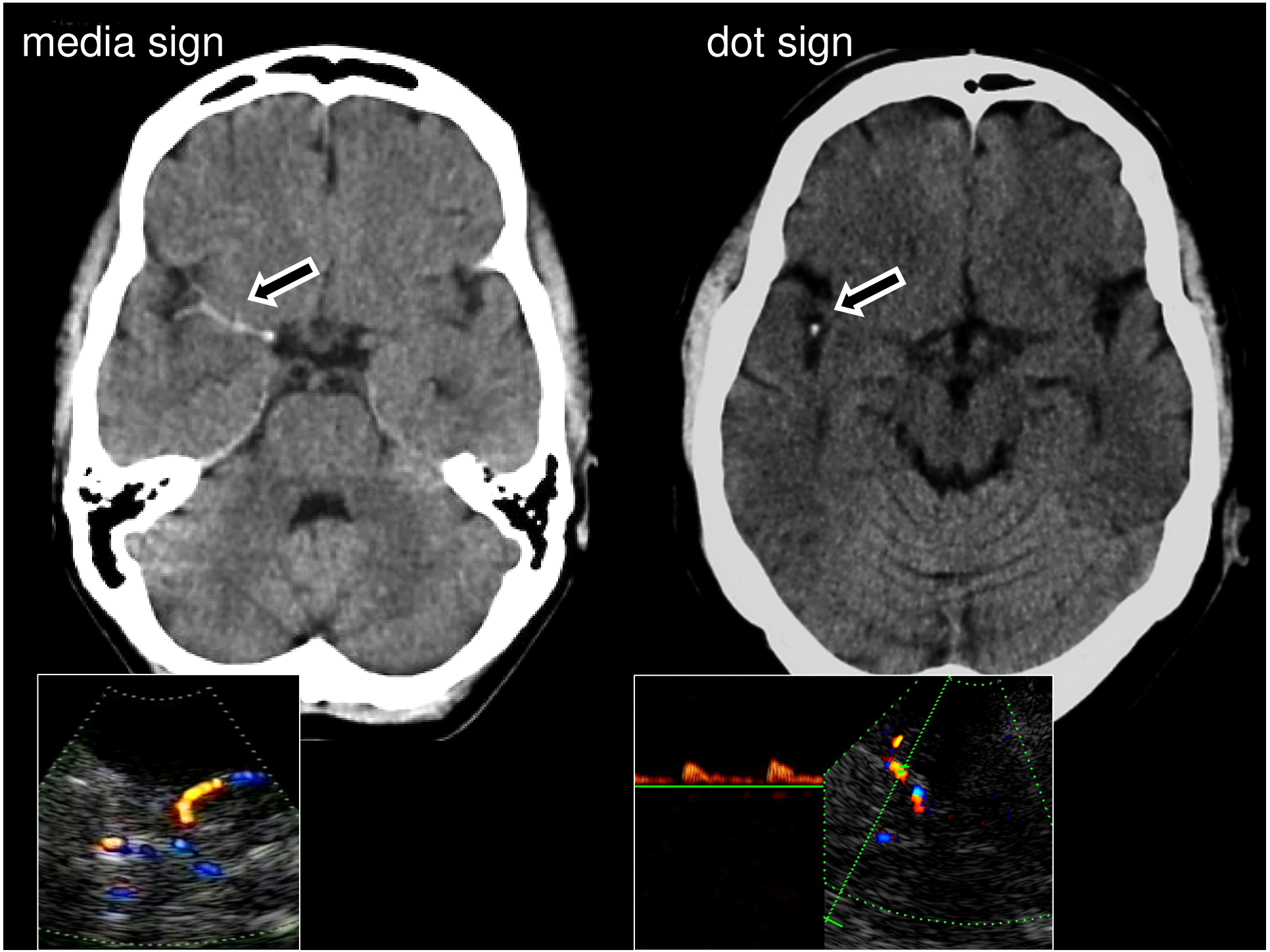
the distribution of macroangiopathic vessel lesions in the brain supplying arteries

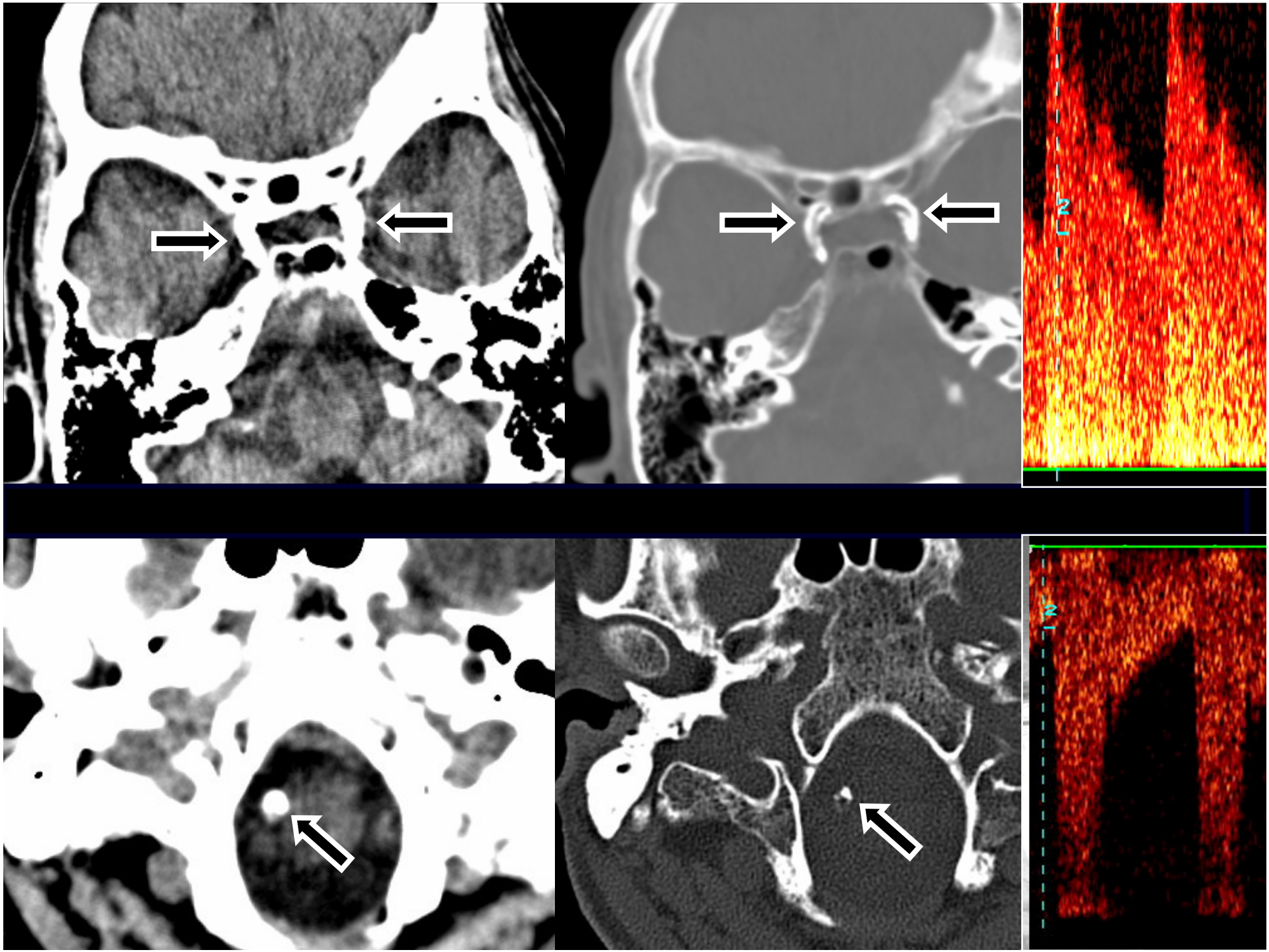
Intracranial stenoses may be underestimated in caucasians

the preferential sites of different macroangiopathic disorders (arteriosclerosis, dissection, vasculits…)

one should consider…

all informations availabel from CT/A and MRI/A before ultrasound


media sign
dot sign



What about machines ?

What about clinical knowledge ?

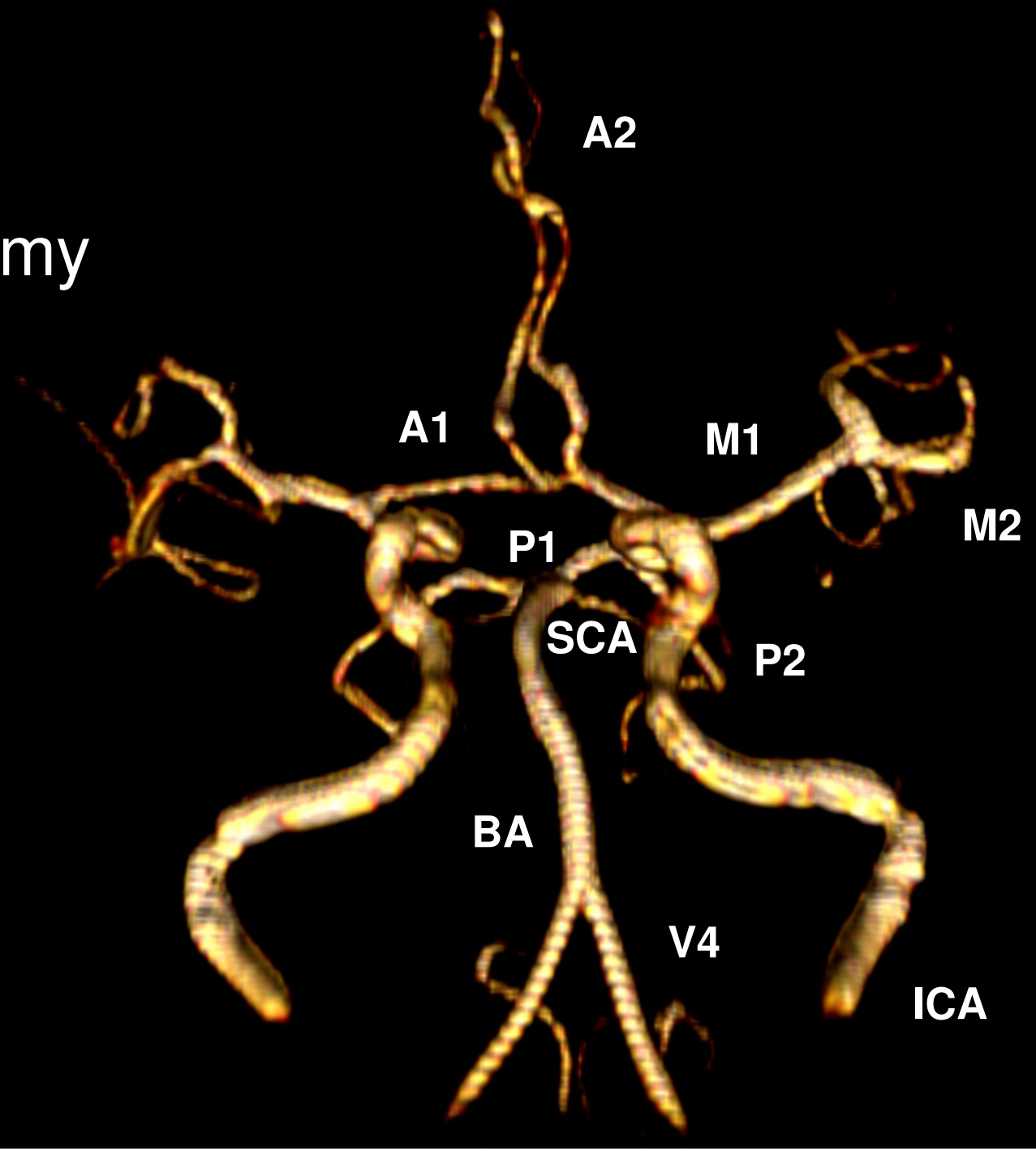
What about anatomical knowledge ?

What about examination techniques ?

What about books ?

What else ?

normal anatomy
variants
origin
course
segments
caliber
length



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Before starting TCCS a hypothesis has to be expressed about what is expected based on

- *patient age*
- *patient history*
- *vascular risk profile*
- *clinical manifestation*
- *CT scan, if done yet*
- *extracranial ultrasound findings*

Example

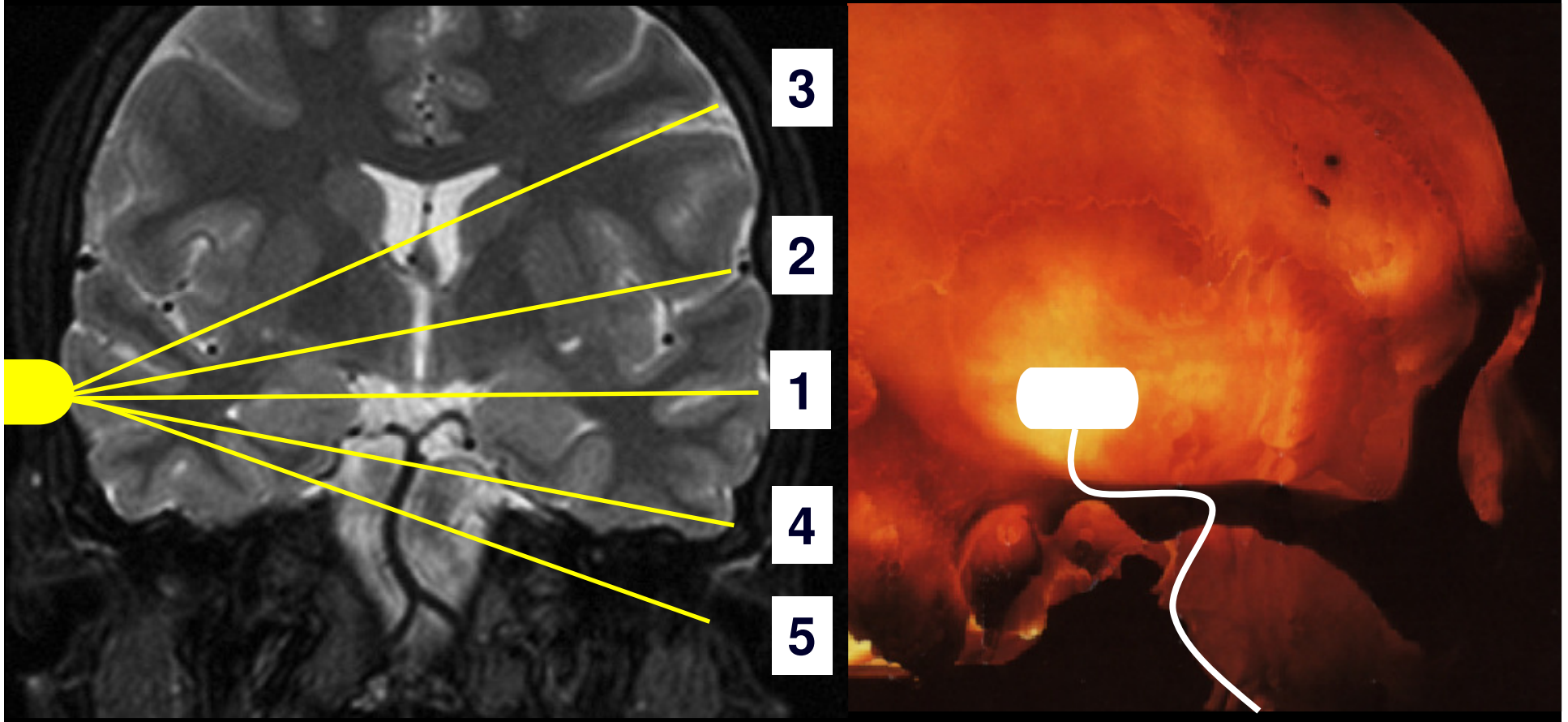
60-yr old man - left territorial MCA infarction – nicotine abuse and hypercholesterinemia – moderate arteriosclerosis of the extracranial vessels

? Ipsilateral stenoocclusive disorder of

ICA siphon or **M1-MCA** or M2 branch or C5-/C6-ICA

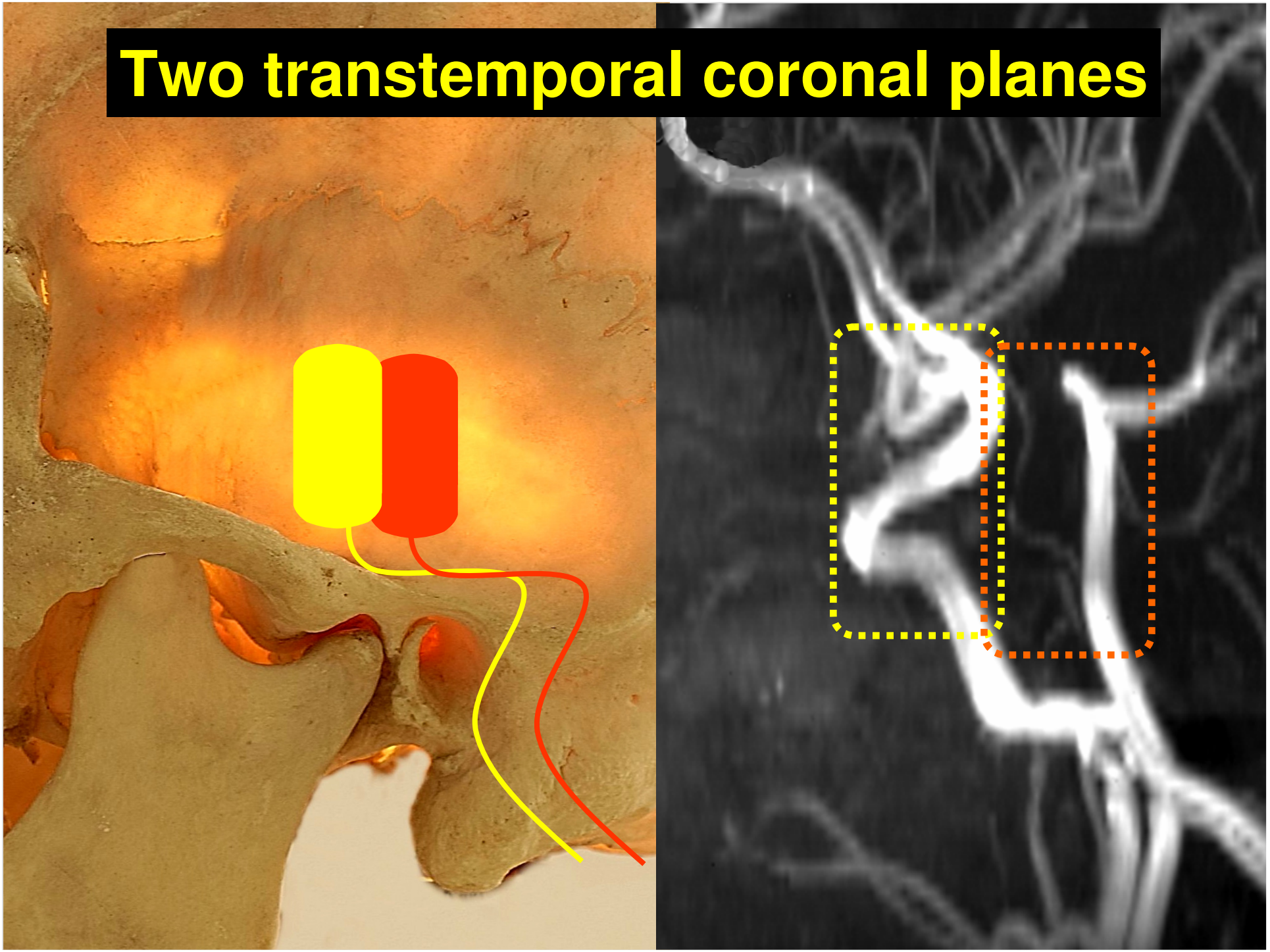
Routes	*transtemporal* *transforaminal* *transorbital* *(transfrontal)*
Planes	*axial* *coronal* *combined*
Structures for orientation	*bone* *parenchyma* *ventrikels* ***vessels***

Five transtemporal axial planes

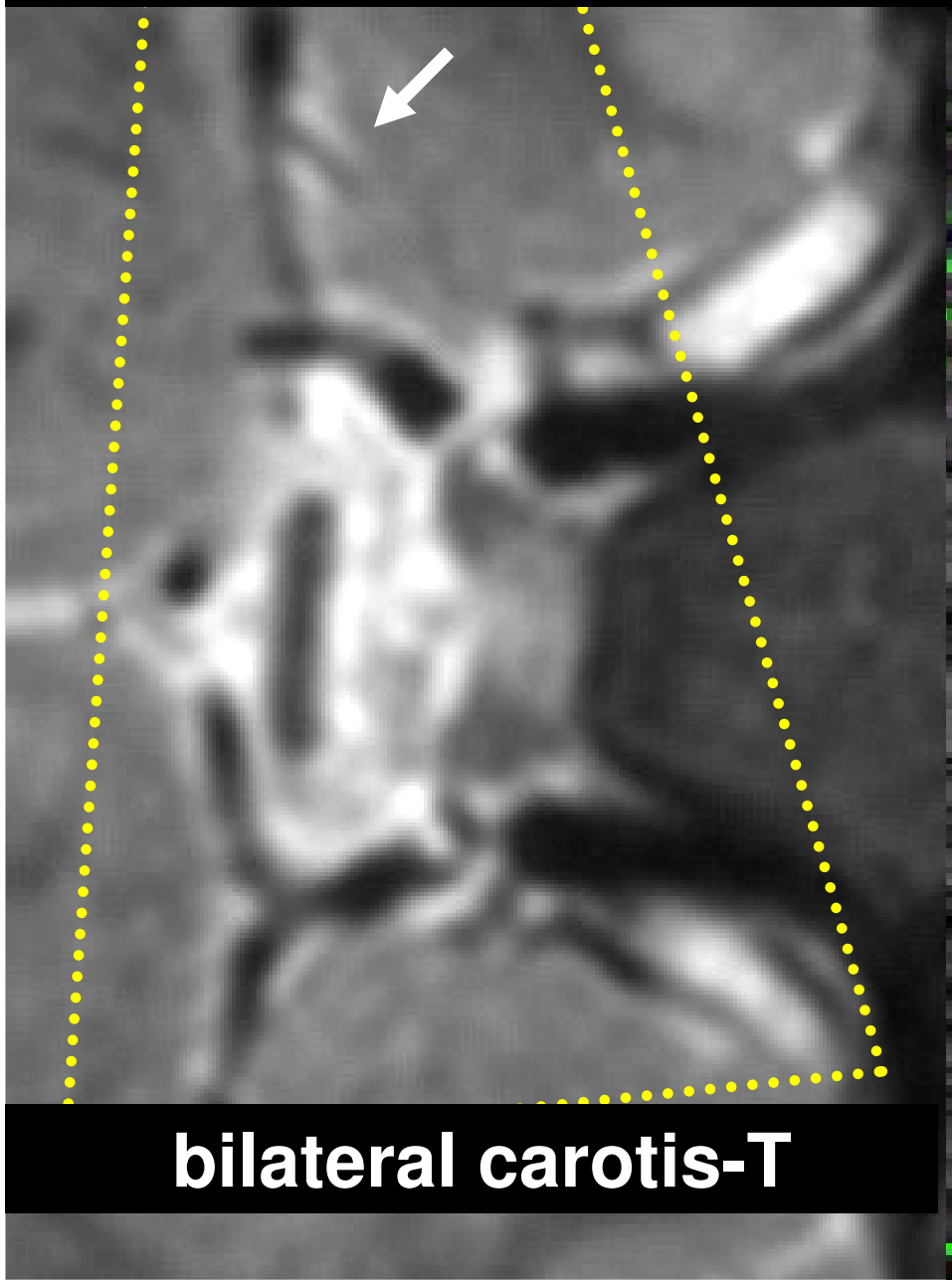


1 *midbrain,* ***2*** *thalamus,* ***3*** *cella media,*
5 *upper pons,* ***5*** *lower pons*

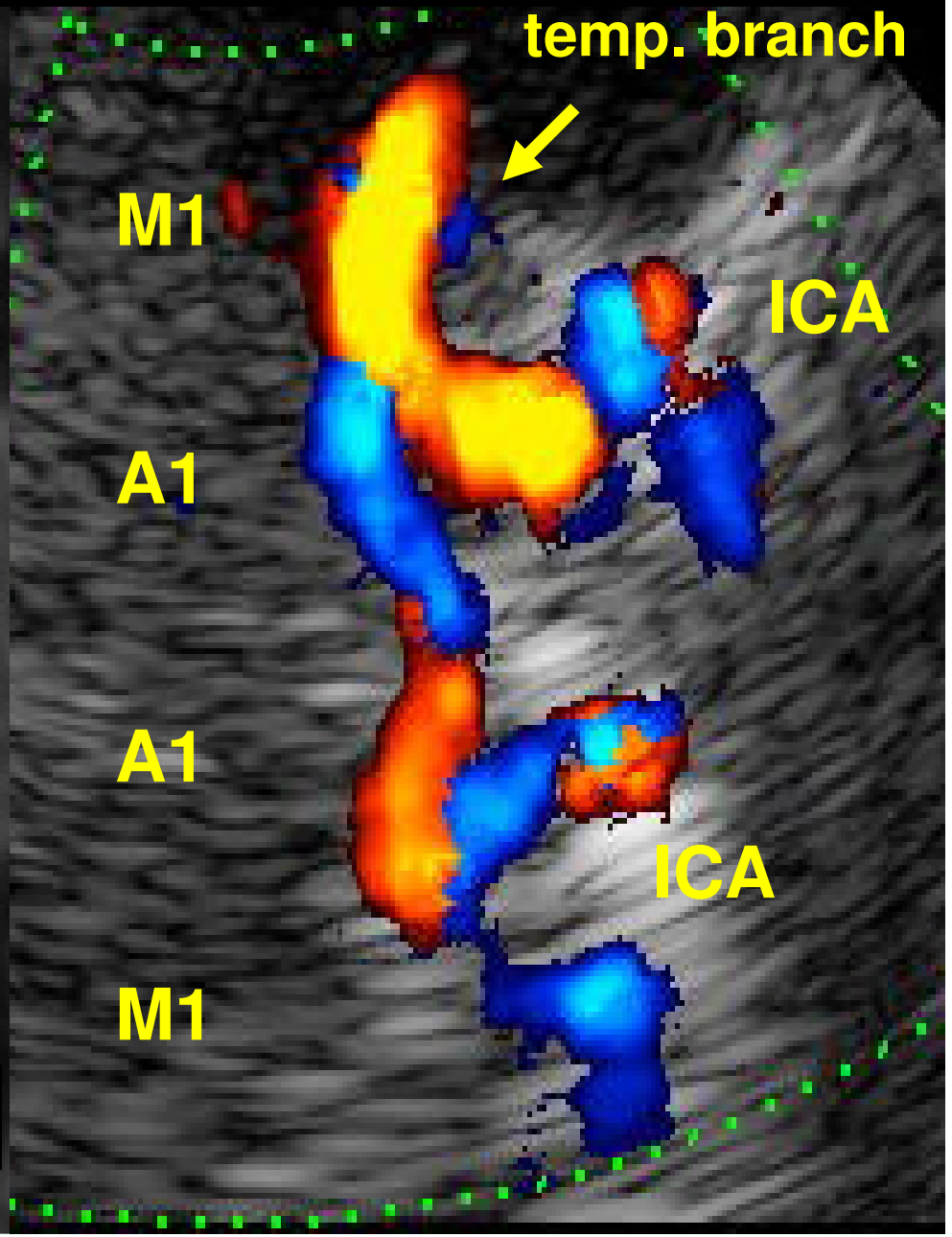
Two transtemporal coronal planes



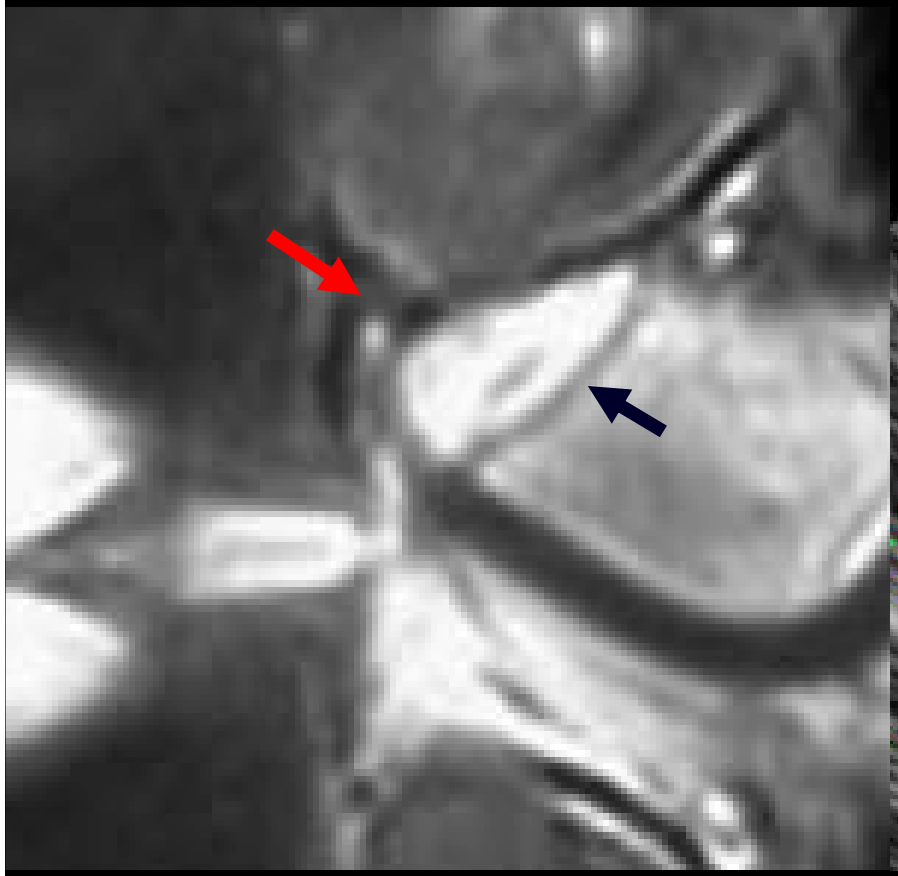
Anterior coronal plane

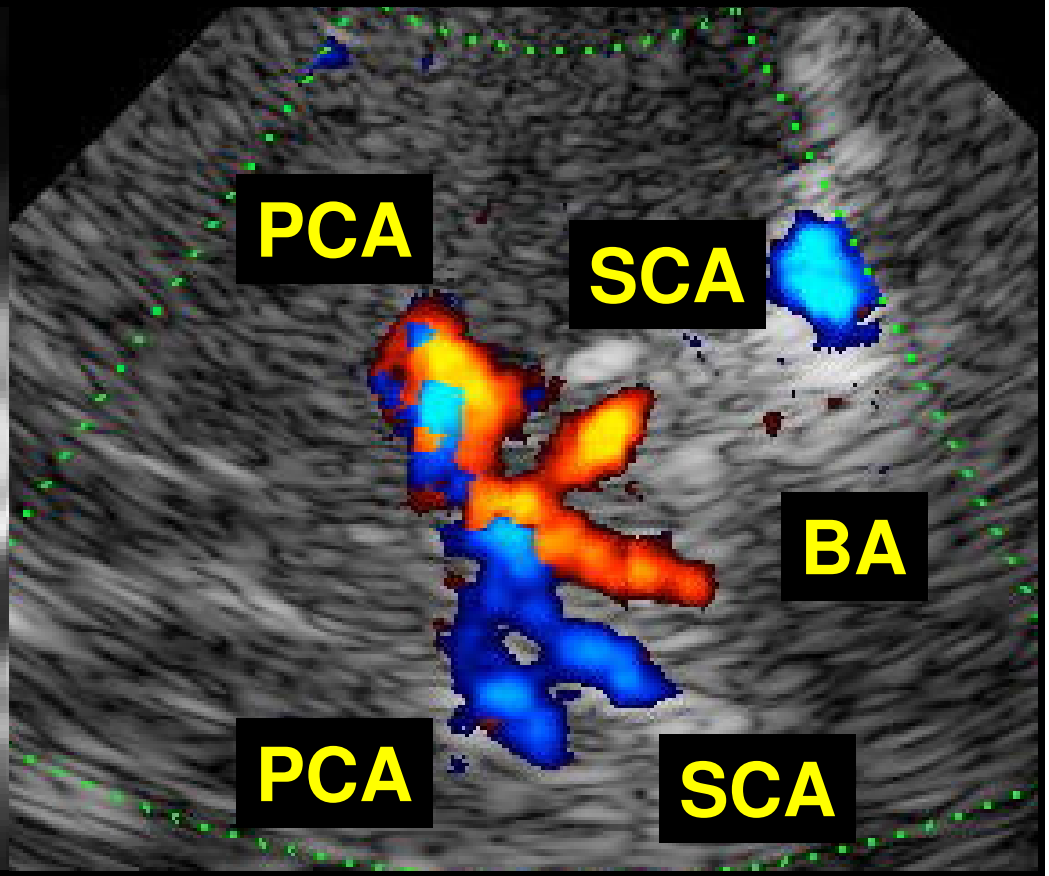


bilateral carotis-T



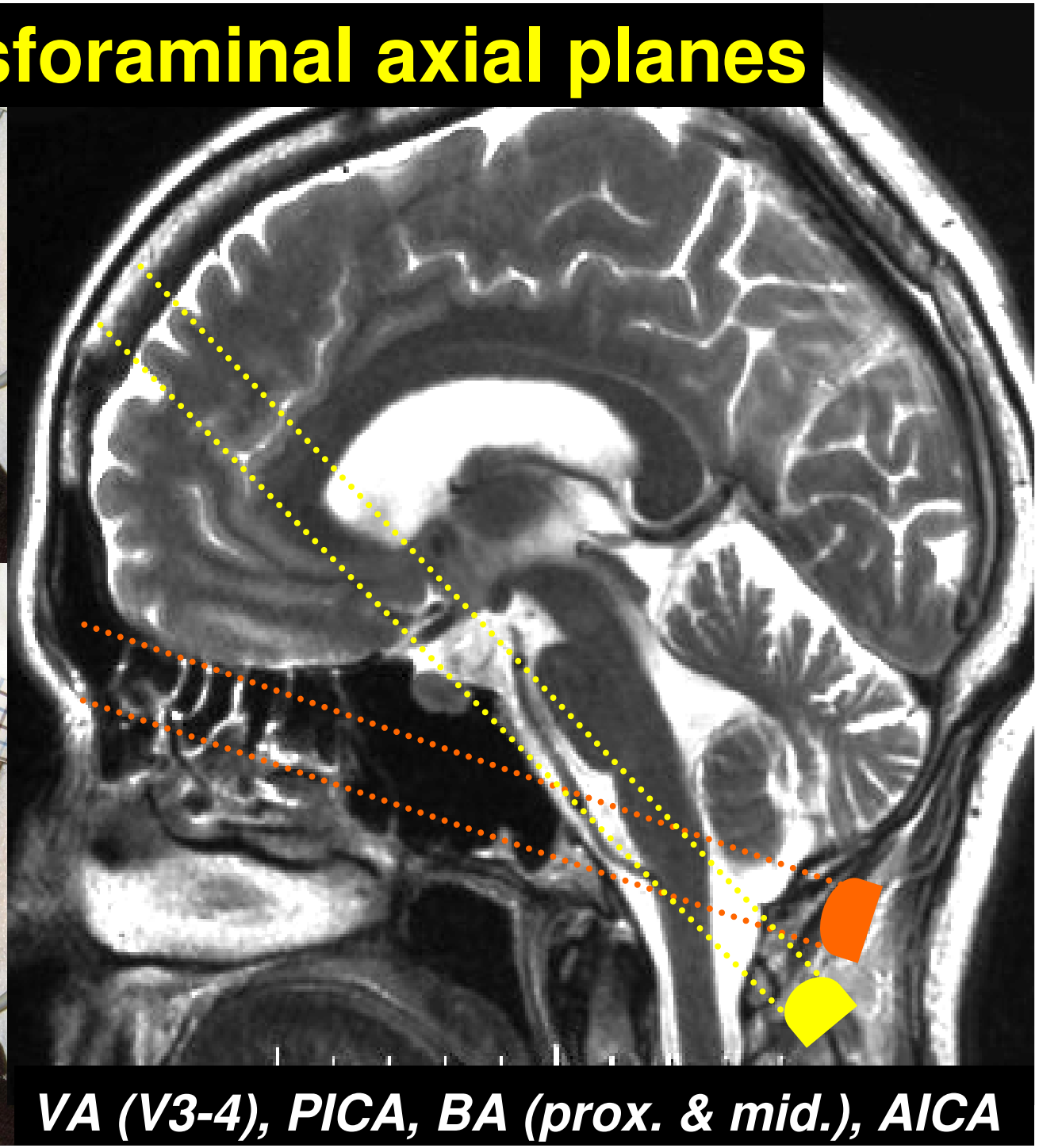
Posterior coronal plane





„Basilar-T“ with SCA- and PCA-origins

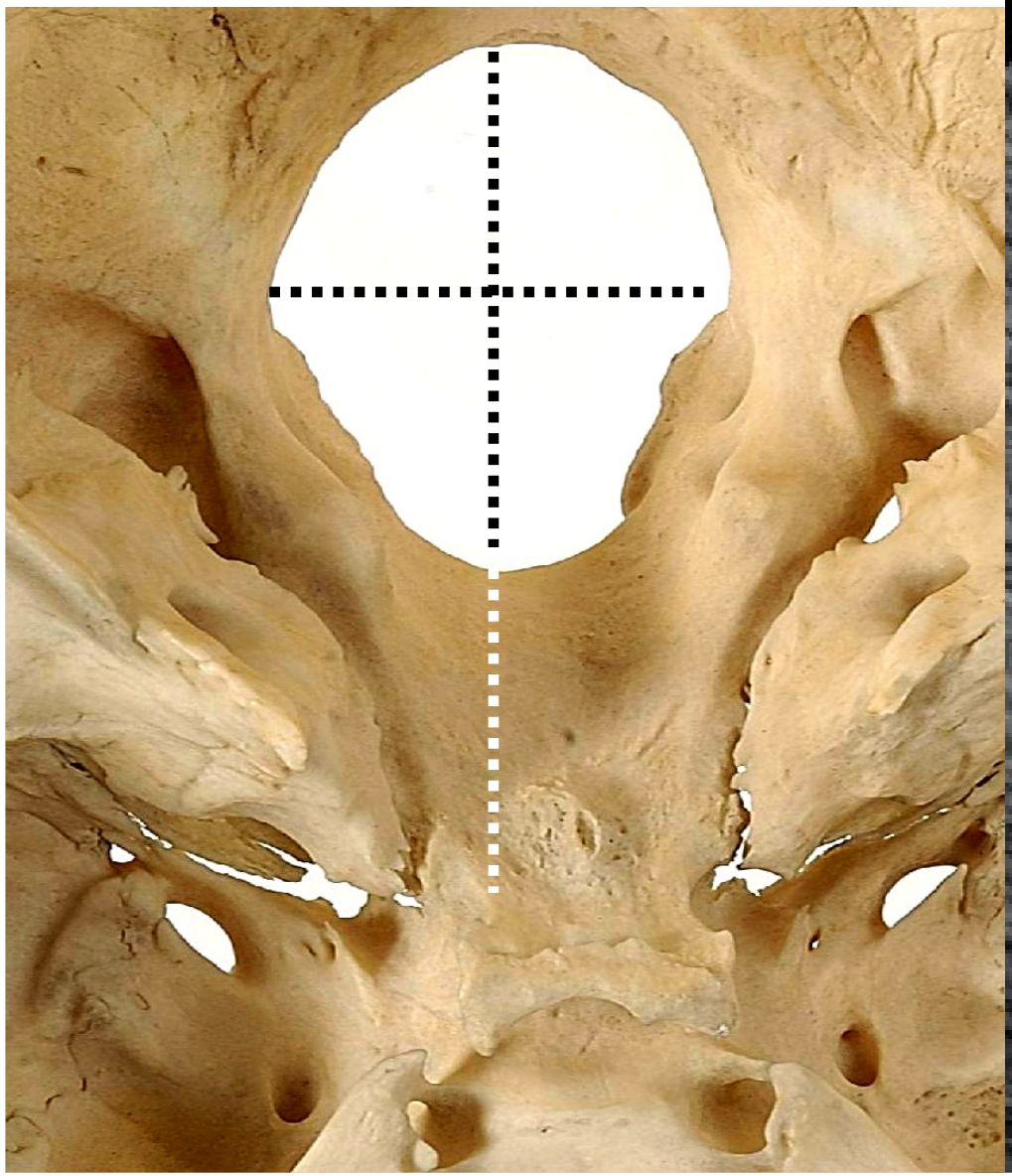
Two transforaminal axial planes

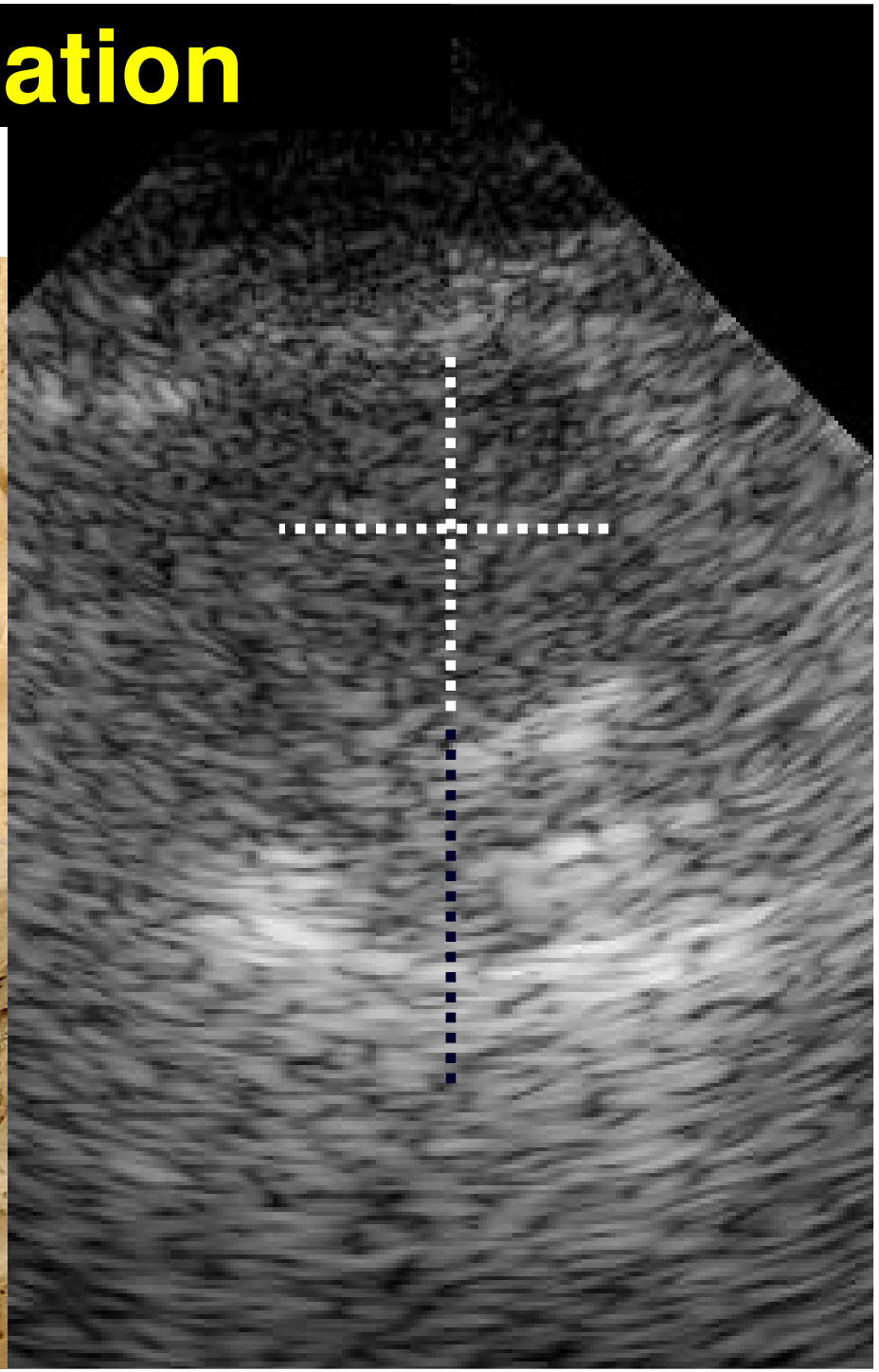


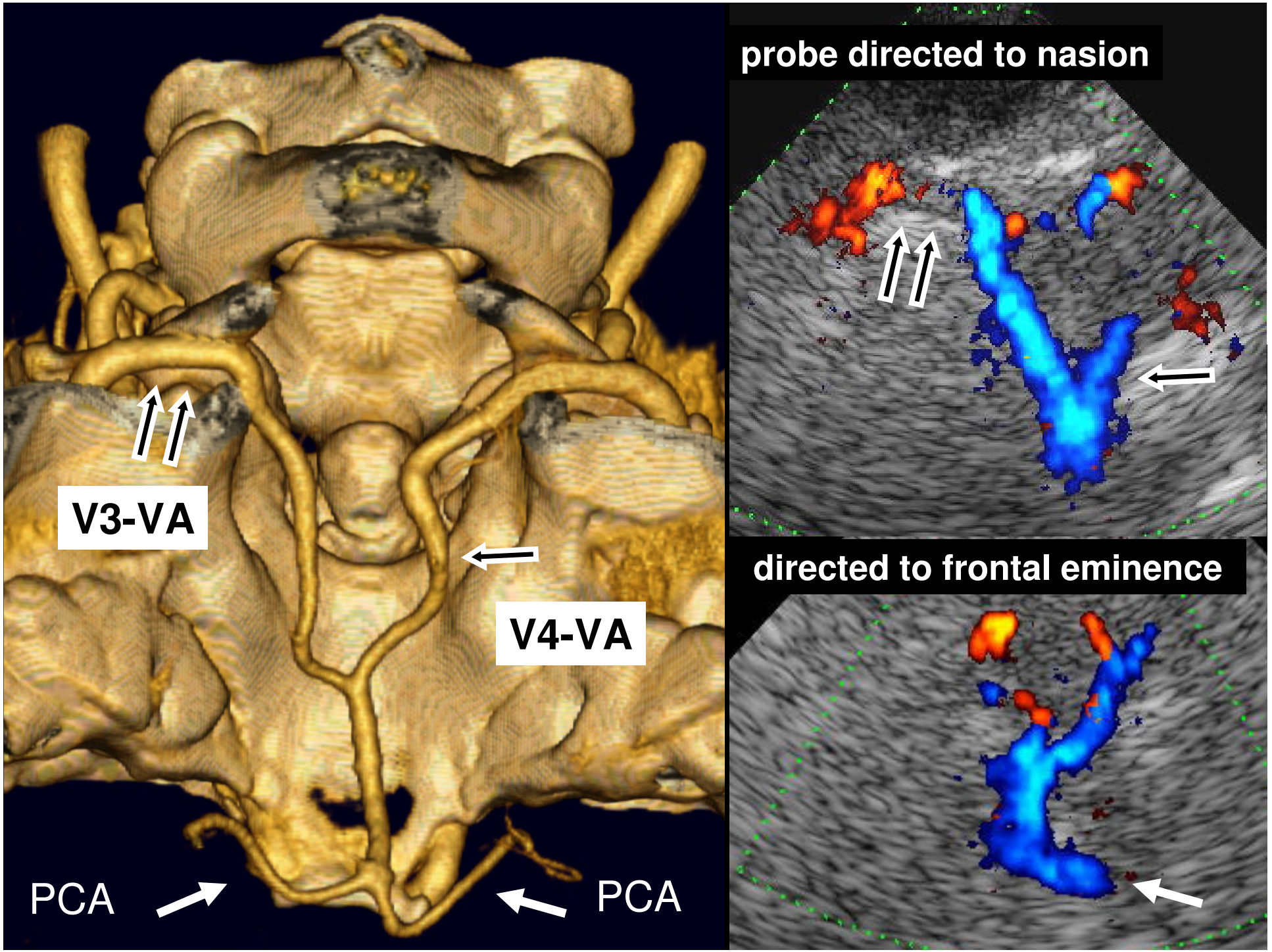
VA (V3-4), PICA, BA (prox. & mid.), AICA

Structures of orientation

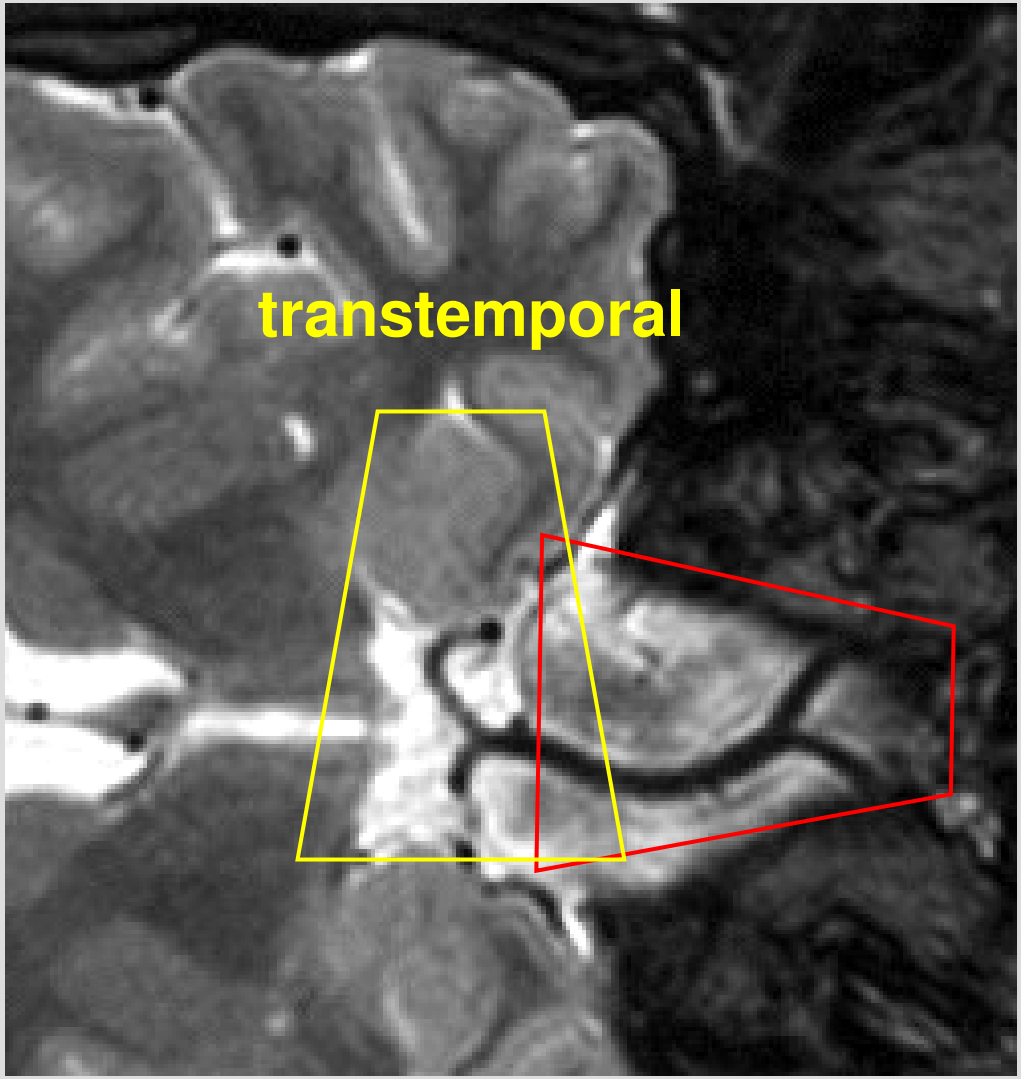
Foramen magnum & Clivus






V3-VA
V4-VA
PCA
PCA
probe directed to nasion
directed to frontal eminence

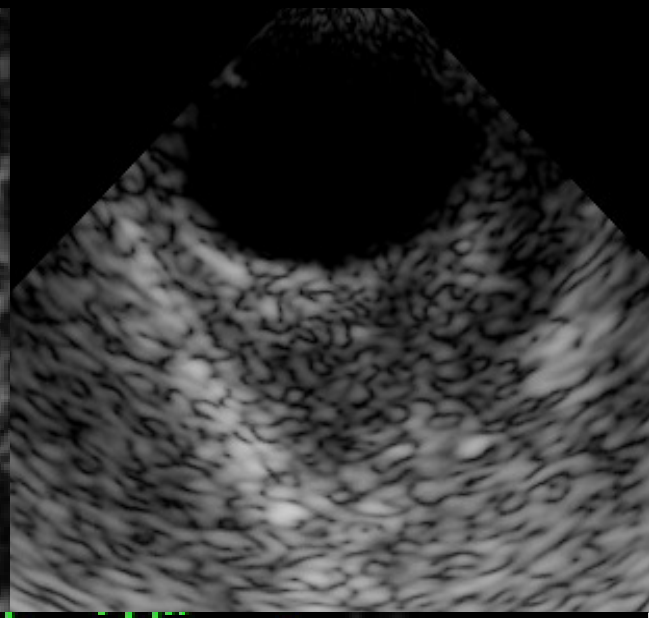
A combined transtemporal and transforaminal approach may allow a complete examination of the basilar artery

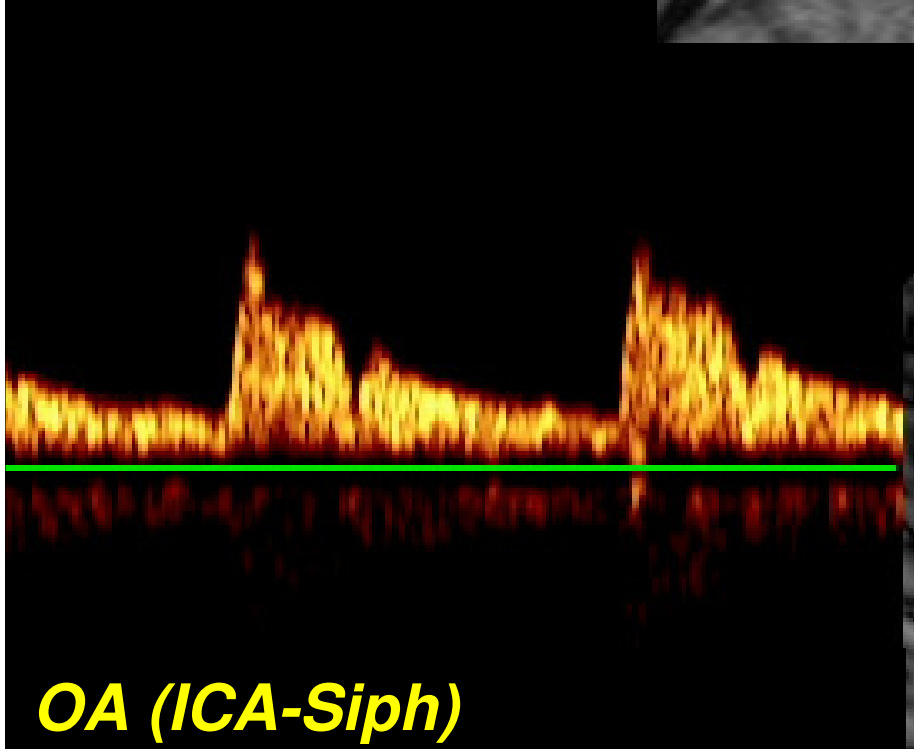


transforaminal

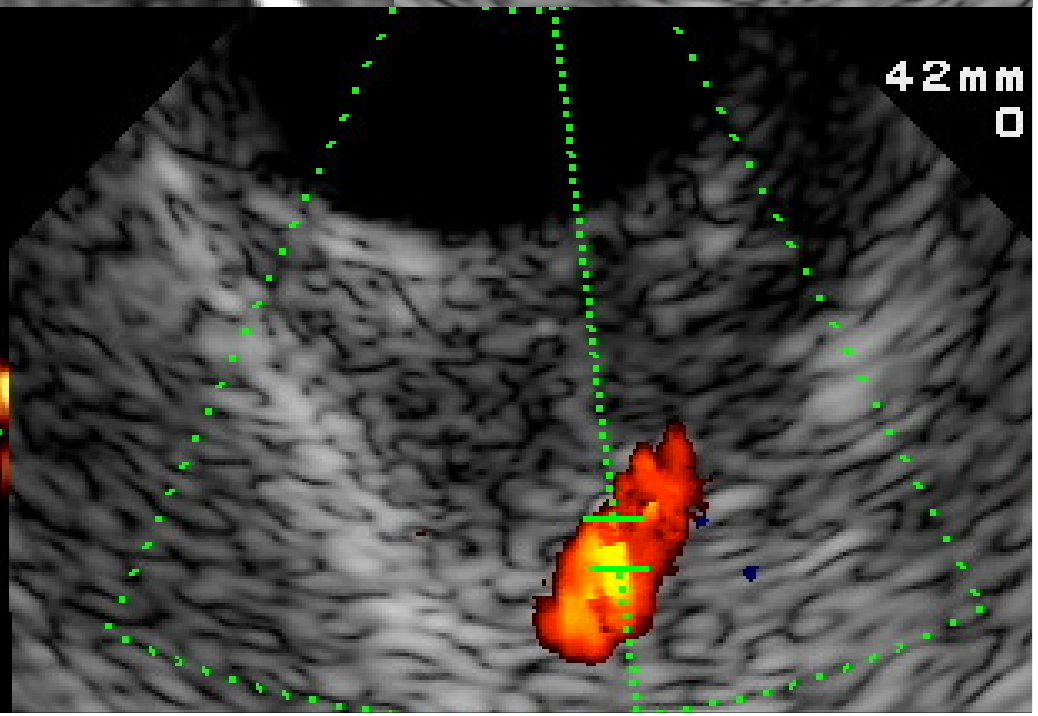
Pade et al. 2007

One transorbital plane





OA (ICA-Siph)

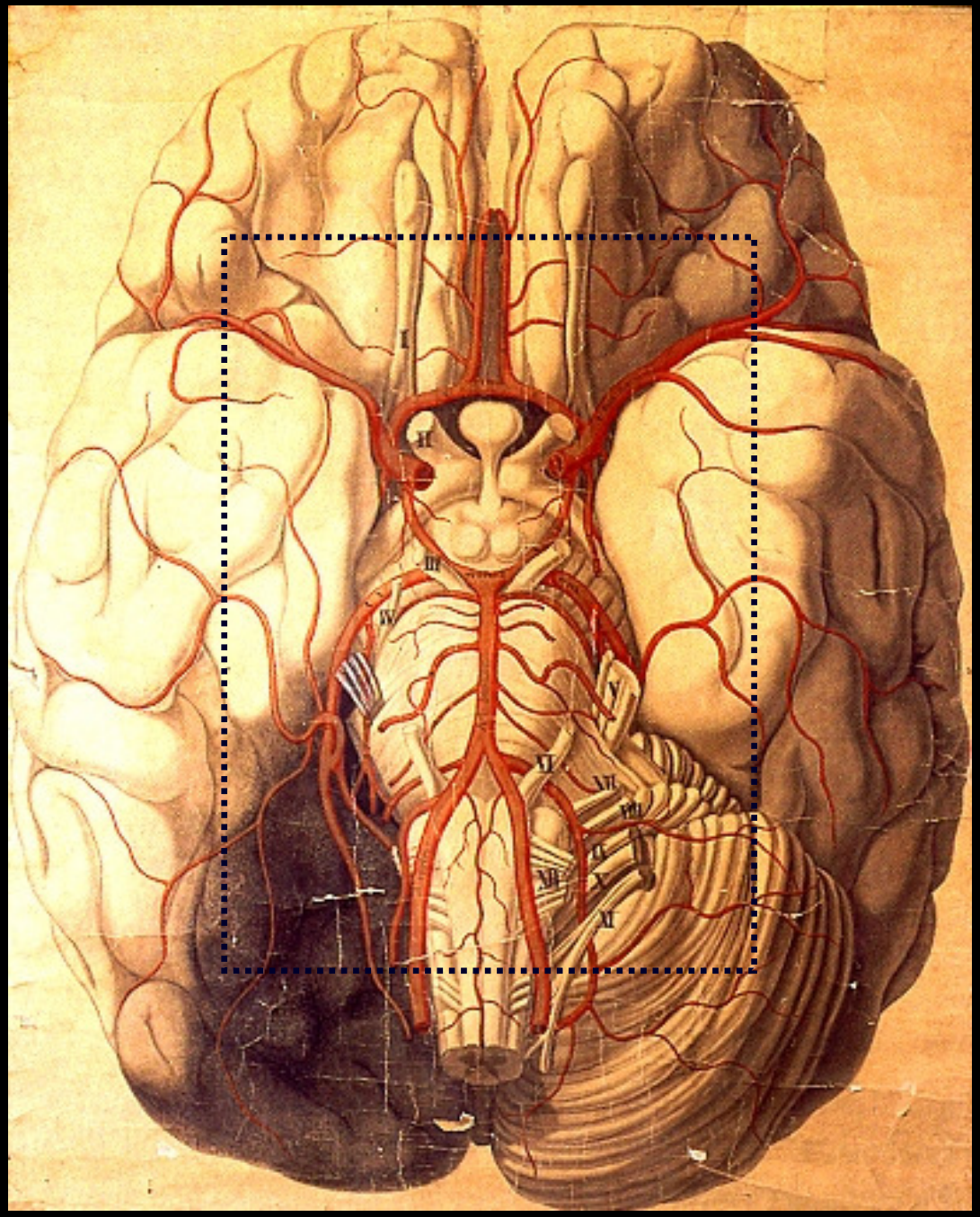


reduce insonation power

Doppler: 10 - 20 mW/cm^2

Duplex: MI < 0.26

short examination



ARTERIES TO GET

C5-C6-ICA
Siph-ICA (C3-4)
TICA (C1-2)
OA
PCoA
M1-M2-M3-MCA
A1-A2-A3-ACA

V4-VA
BA
PICA
AICA
SCA
P1-P2-P3-PCA
PCA cortical branches

You need a good machine

TCCS is better than TCD

You need anatomical knowledge

You need good examination techniques

You need clinical knowledge

You need a clear hypothesis before starting

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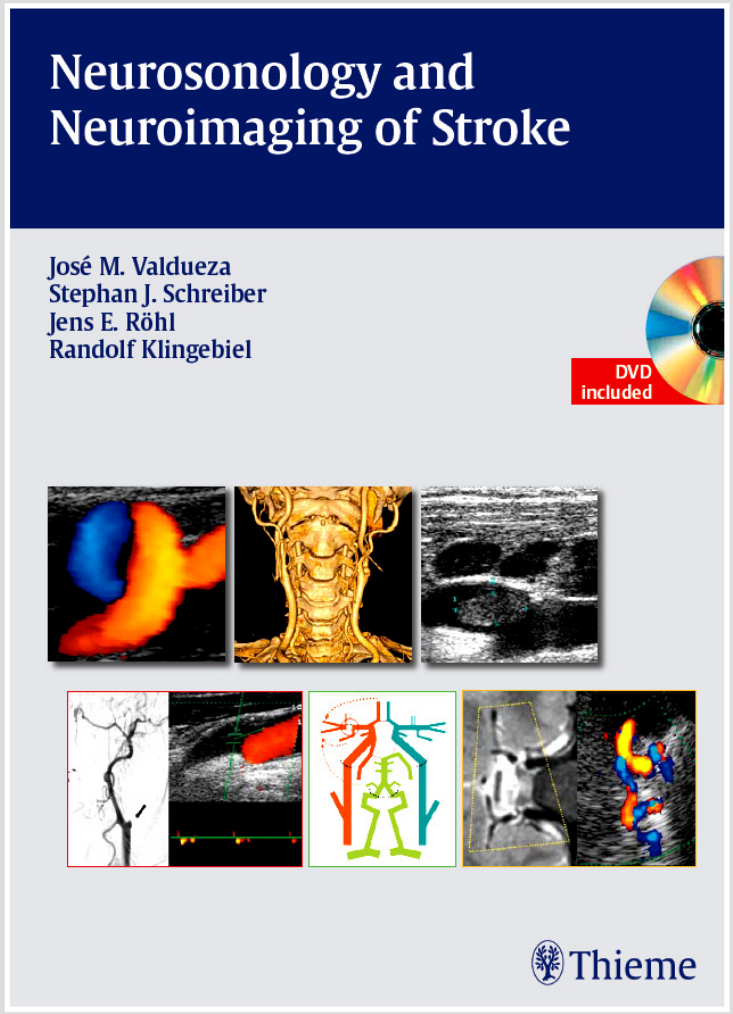

International Teaching Course of Transcranial Duplex Ultrasound and Cerebral Venous Drainage Analysis

Berlin, at the Humboldt University Hospital Charité

On 1-2 of April 2011

Fees: 300 Euro

For more information contact me or Dr. Stephan Schreiber

stephan.schreiber@charite.de