Advanced Tutorial TCCS

Principles, instrumentation, technical requirements and how to carry out a cerebrovascular examination

José M. Valdueza
Neurological Center
Bad Segeberg, Germany

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

M1-MCA: 105 cm/s syst.

M2-MCA: 277 cm/s syst.
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.

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

low

0.2 MI

0.6 MI

1.0 MI

high

Intensity
Frequency of transducer

Low

2 MHz

2.5 MHz

3 MHz

High

Intensity

Resolution
Color (frequency) mode
+ indicates flow direction

Power (intensity) mode
+ not depending from angle

Combined mode
Pulse repetition frequency (PRF)

Color mode  Power mode  Combined mode
Gain

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, vasculitis...)

one should consider...

all informations available from CT/A and MRI/A before ultrasound
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
What about machines?
What about clinical knowledge?
What about anatomical knowledge?

What about examination techniques?

What else?
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

temp. branch

ICA

M1

A1

A1

M1

ICA
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
probe directed to nasion

directed to frontal eminence
A combined transtemporal and transforaminal approach may allow a complete examination of the basilar artery

Pade et al. 2007
One transorbital plane

OA (ICA-Siph)
reduce insonation power

Doppler: 10 - 20 mW/cm²

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
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

jose.valdueza@segebergerkliniken.de

stephan.schreiber@charite.de