The role of Transcranial Doppler in Acute Medicine

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• What is TCD?
• What information does TCD give us?
• How can TCD be used in acute medicine?
What is Transcranial Doppler?

- Insonation of cerebral vessels through the skull
- Temporal window
- (Occipital window)
What is Transcranial Doppler?

- Non-imaging and/or imaging (TCDi) technique
- Investigation of cerebral artery velocities
Cerebral vessels detectable by TCD

Temporal window

- Middle Cerebral Artery
- Anterior Cerebral Artery
- Internal Carotid Artery
- Posterior Cerebral Artery

Occipital window

- Basilar Artery
- Vertebral Artery
Doppler waveform

**Velocity cm/s**

Flow towards probe above line

Flow away from probe below line

$V_S =$ systolic peak velocity

$V_M =$ TAMV  
time-average max velocity

$V_D =$ end diastolic velocity
What information does TCD give?

- Blood velocity
  NB not flow = velocity x area
  (we don’t know vessel diameter)
- Waveform shape
- Absence of occluded vessel
- Abnormalities of flow direction
- Presence of emboli
Blood velocity

- Typical MCA $V_M$ 35-100cm/s (35-65cm/s in over-60s)

- High velocity $>200$cm/s: severe stenosis / vasospasm

- Low velocity $<30$cm/s: trickle flow/critical stenosis
Waveform Shape

- Normal waveform
- “Damped” waveform: severe proximal stenosis
Waveform Shape

- Pulsatility index (PI) = \( \frac{(V_s - V_D)}{V_M} \)

- Increased PI and/or reduced \( V_D \):
  high distal resistance
  eg raised ICP

- Brain death: characteristic bidirectional waveform with zero net flow
Normal circulation

L) MCA
L) ACA
L) PCA
R) MCA
R) ACA
R) PCA
Absence of occluded vessel
MCA occlusion
Abnormalities of flow direction
ICA occlusion with cross flow

L) MCA
L) ACA
L) PCA
R) MCA
R) ACA
R) PCA
Embolus detection

- Emboli manifest as high intensity transients within the waveform.
- For spontaneous emboli may require continuous monitoring >30 min.
- Detection via machine or human ear.
Role of TCD in stroke

- Indicate proximal stenosis
- Emboli detection
- Intracranial stenosis
- Detect occlusion of MCA
- Grading of residual MCA flow
- Monitor MCA recanalisation
- Augmented thrombolysis
Augmented thrombolysis

• Use of transcranial ultrasound in conjunction with thrombolytics to increase residual flow and speed up thrombolysis

• Mechanism not well understood

• ? Mechanical disruption of thrombus structure => increased penetration of fibrinolytics
Role of TCD in head trauma

• Assess cerebral blood flow/perfusion
  – MCA velocities $V_M$, $V_D$

• Indicate raised ICP
  – MCA: low $V_D$/high PI

• Identify vasospasm
  – High $V_M$
TCD in acute medicine

• Pros
  – Quick, simple bedside test
  – Relatively cheap equipment
  – Non-invasive
  – Repeatable

• Cons
  – Requires experienced operator
  – Narrow vessels/low flow particularly difficult
  – Not possible in all patients
    (15% of over-60s have poor window)
THANK YOU FOR LISTENING