

# STROKE PROTOCOL & PERFUSION CT GUIDE

## Stroke Protocol

- The radiologist or radiologist assistant is required to call the ordering clinician with the results of the non-contrast portion of the stroke CT workup whether it includes CTA, perfusion imaging or just non-contrast CT. The time of the call must be documented in the report itself not just in the RAs log book.
- It is also preferable to call back with the CTA/perfusion results (necessary if positive for emergent large vessel occlusion). This time should also be documented in the report.
- The non-contrast CT call time is noted as part of the audit process of the stroke program for the hospital. The stroke team audits every single stroke protocol case that comes through to make sure the clinical care teams are still within the time windows, in order to give tPA in the appropriate time.

## CT Perfusion Guide

- First, make sure noncontrast head CT doesn't show subacute infarct or hemorrhage.
- Three main perfusion metrics to report (each reported in mL):
  - 1) Tmax >6 seconds
  - 2) CBF <30%
  - 3) Mismatch volume ("penumbra")
- Tmax (green area) – time to maximum contrast arrival, when greater than 6 seconds, which is an estimate of **hypoperfusion**. This is the portion of the brain that is likely to progress to infarct if there is no reperfusion. If Tmax is 4-6 seconds, it is unlikely to progress to infarct. If Tmax >10 sec, this indicates poor collateral flow which can result in rapid infarct growth.
- CBF (pink area) – cerebral blood flow is an estimation of the **core infarct**. This area is likely irreversibly injured from ischemia. The best threshold is less than 30% of normal cerebral flow (which means there is a 70% reduction in the normal cerebral blood flow). This is reported as CBF <30%.
- Mismatch volume ("penumbra") – the difference between the hypoperfused area and the core infarct. Mismatch volume = (Tmax >6s) – (CBF <30%).
- Who should get endovascular therapy? Based on the DEFUSE 3 trial inclusion criteria, patients with:
  - Core infarct volume up to 70mL.
  - Mismatch ratio  $\geq 1.8$  (this is the ratio of CBF/Tmax).
  - Mismatch volume  $\geq 15$ mL
  - (Other DEFUSE 3 inclusion criteria were: age 18-90, NIHSS  $\geq 6$ , femoral puncture 6-16 hrs after symptoms, occlusion of ICA and/or MCA M1 segment).
- Limitations
  - Motion – There is a chart of motion but the best way to decide motion is to look at the AIF (arterial inflow with ROI at MCA) and VOF (venous outflow with ROI over transverse sinus). The two graphs should nearly mirror each other with a steep slope and steep decline with at least a change in HU (Hounsfield units) of 150 to confirm appropriate opacification of vessels and that motion isn't a limiting factor. Motion in the latter half of the exam is less important and doesn't matter as long as the AIF and VOF are good.

- Subacute infarct – If you can see the infarct on CT, the system will at times give you an overestimation of the penumbra because you will not be able to find the core infarct which can overestimate the mismatch volume.
- Chronic occlusion with stenosis and good collaterals – You will see an increased Tmax everywhere with only core infarct in the real region of ischemia. This will overestimate the mismatch volume.
- Notes
  - CT perfusion only reflects the hemodynamics at the time of the scan and does not include historical information on the patient.
  - The ischemic core can disappear after the recruitment of collaterals. Correlate with HCT, need symptoms timeline.
  - If everything looks normal with CBF <30 and Tmax >6, but patient has symptoms, you can change thresholds to look for subtle perfusion changes.
  - Interpretation should also be based upon head CTA. Look for large vessel occlusion.
  - This document is for anterior circulation strokes. Because basilar/vertebral strokes can be so devastating, the time limits for posterior circulation reperfusion are not relevant.

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