On Call Guide to CT Perfusion

Updated: March 2011
CT Stroke Protocol

1. Non contrast CT brain
2. CT perfusion: contrast 40cc bolus
   - dynamic imaging at 8 slice levels ~ 60 sec
   - creates perfusion color maps (including MTT & CBV)
3. CTA head & neck: contrast 70cc bolus
   - Aortic arch through vertex
   - Goal: check for intraluminal thrombus in “big vessels” to guide interventional options (lysis, clot retrieval)

Remember: Basic Stroke Time Guidelines
   - Symptoms < 3 hours: OK for IV tPA
   - < 6 hours: OK for intra-arterial tPA or IR clot busting
   - < 8-24 hours: may still RX basilar artery thrombosis
CT Perfusion Maps

- **MTT** (mean transit time)
  - Area of delay = non-specific perfusion deficit
  - Could be salvageable tissue or infarct

- **CBV** (cerebral blood volume)
  - If decreased = “infarct core” (dead tissue)
  - If normal or increased = “penumbra” (salvageable; shows presence of good collateral supply)

- Ignore CBF (cerebral blood flow) & TTP (time to peak)

- Summary Maps (there will be 2 in PACS labeled “right” and “left”)
  - Look at both but not reliable (I do not use them and try to avoid relying on these alone) Green = penumbra; Red = dead tissue

- **Tips:**
  - Open perfusion maps on color monitor (split screen 2:1 or 4:1 to look at MTT & CBV side by side)
  - To figure out which color is high or low remember to check the scale bar on far right
Guide to Reading Stroke Protocol On-Call

1. **Check Noncontrast CT**
   - Look for acute hematoma or large obvious infarct: may be *contraindications* for tPA

2. **Check CT perfusion maps**
   1. **Review MTT** for asymmetric perfusion defect
      - Delayed area may mean infarct or tissue at risk
   2. **Correlate area with CBV** for “matched” defect
      - Low CBV = infarct (dead tissue)
      - Normal or high CBV = tissue at risk (salvageable)
      - If majority of defect shows preserved CBV then patient is good candidate for tPA or neuro IR intervention

3. **Check CTA**
   - **Look for intraluminal thrombus** in major vessels (especially ICA, MCA, basilar artery); don’t worry about distal vessels
      - If **NO clot** present then patient is usually NOT candidate for NIR intervention since no clot big enough to lyse
Example 1: Penumbra

- **MTT**: perfusion defect with delayed MTT (blue) in right MCA territory
- **CBV**: mostly normal or slightly increased CBV (red) in majority of right MCA territory
  - represents intact collaterals
- **Note**: smaller area of low CBV (black) in right basal ganglia represents infarct core due to small end artery supply in perforator territory
- Large area of penumbra (tissue at risk)
- Good candidate for RX
Example 2a: Hyperdense left MCA

- Hyperdense left MCA
- CTA: left M1 thrombus
- Remember: thick reformats often best to see clot.

NCCT

CTA: thick reformats
Example 2b: Large left MCA Penumbra

- MTT: large left MCA perfusion defect
- CBV: defect shows mostly increased CBV (red) represents vasodilatation and good collaterals
  - Note: subtle low CBV (dark) in left basal ganglia region (BG)
- Summary map:
  - Green = penumbra
  - Pitfall: infarct core in BG not seen
- Great candidate for RX. CTP predicts lots of tissue at risk.
Example 3: Infarct Core

- MTT: right frontal perfusion defect (blue) in MCA territory
- CBV: matched defect with mostly low CBV
  - Dark center = infarct core (proven by DWI)
  - Note: CBV slightly smaller than MTT defect represents small peripheral rim of penumbra
- Summary map is accurate
  - red = infarct core
  - green = penumbra
- Overall: majority of defect is infarct core. Not ideal candidate for intervention
Example 4: Infarct Core

- MTT: Large left MCA perfusion defect
- CBV: large defect with mostly low CBV = infarct core
- Summary map also shows infarct core
- Poor candidate for intervention
Example 5: Old infarct with summary map pitfall

- NCCT & DWI: old infarct
- MTT & CBV show matched defect consistent with infarct
- Beware of reading summary maps alone.
  - Shows “penumbra” in setting of remote infarct.
  - Caveat: could have new ischemia along infarct margin but more likely this is spurious.
Example 6: summary map pitfalls.

- Mixed penumbra with infarct core on right
- Pitfall: Green “penumbra” in left cerebellum, occipital lobe without clear defect on MTT.
- Reminder: do not use summary map alone
Summary

- CT perfusion & CTA directs possible intervention
- MTT: perfusion defect
  - Delayed: may be tissue at risk
- CBV: predicts collaterals
  - Low: infarct core
  - Normal or increased: penumbra, salvageable
    - Best candidate for intervention
- Beware summary maps