



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

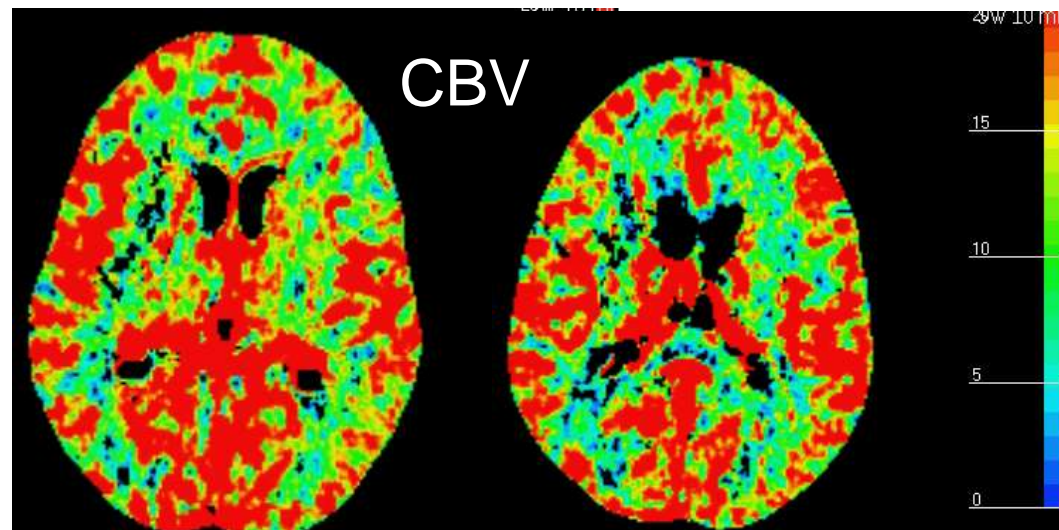
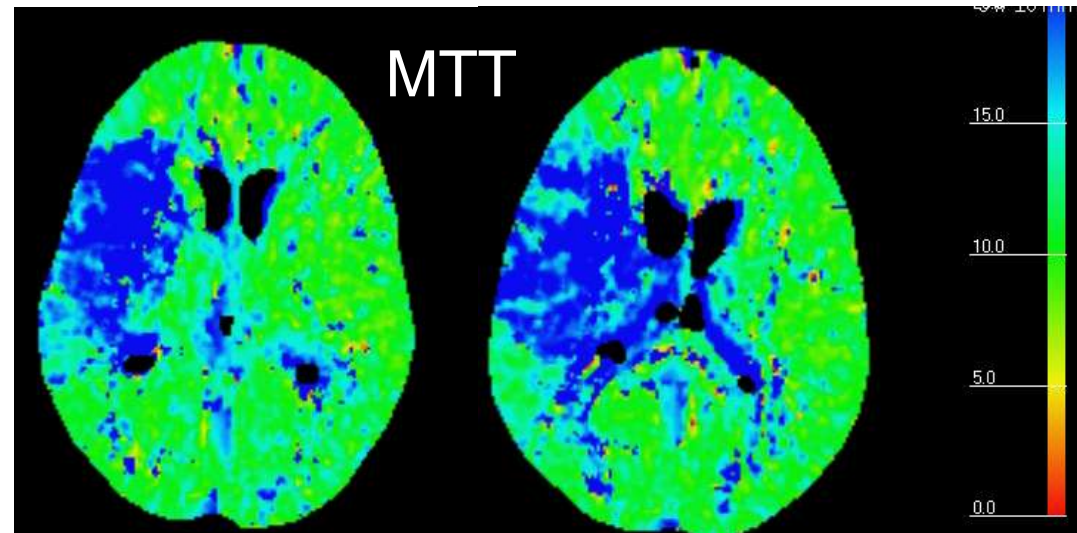
- Low CBV = infarct (dead tissue)
- Normal or high CBV = tissue at risk (salvageable)
- If majority of defect shows preserved CBV then patient is good candidate for tPA or neuro IR intervention

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

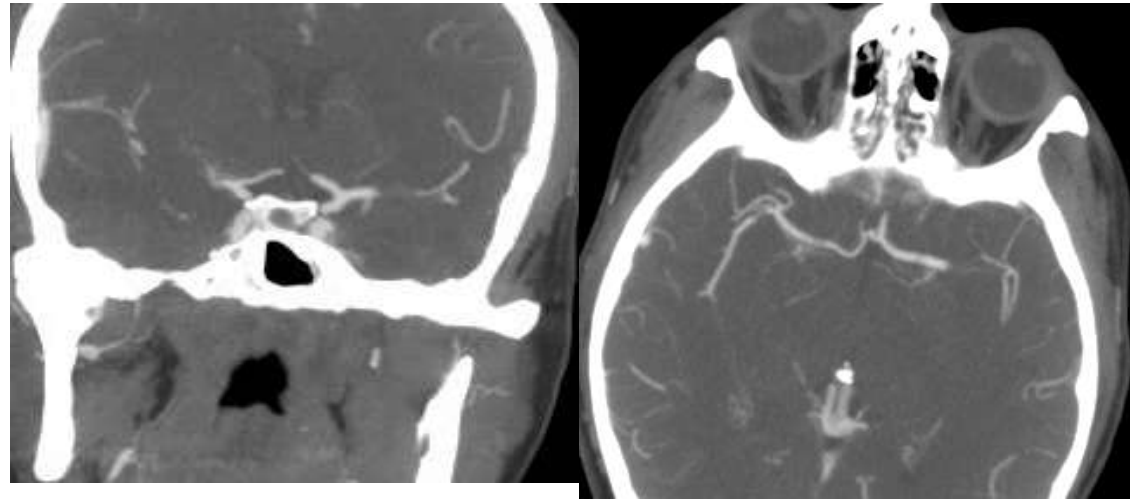
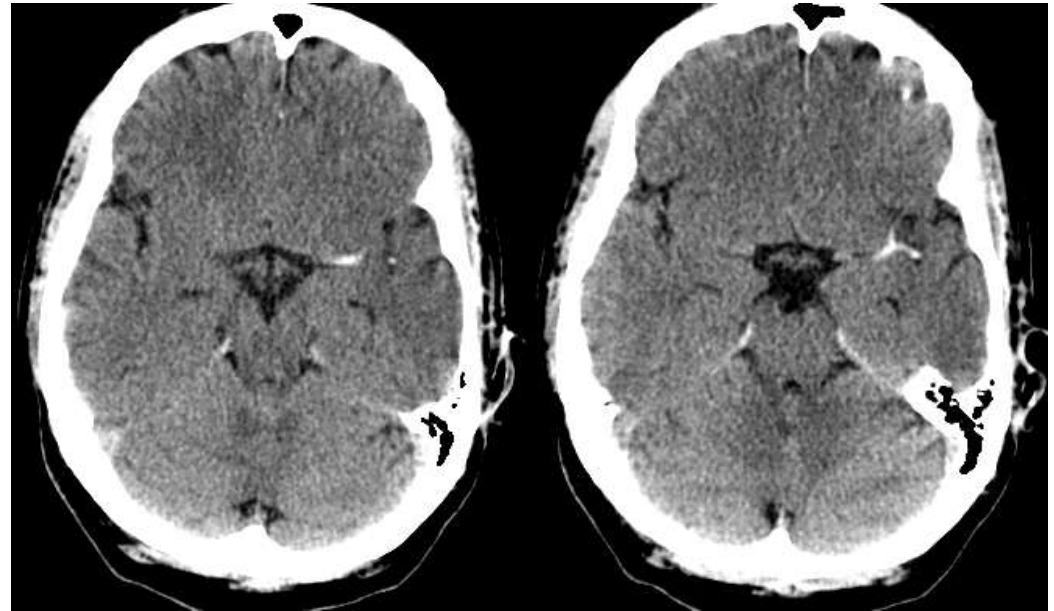
- MTT: perfusion defect with delayed MTT (blue) in right MCA territory
- CBV: mostly normal or slightly increased CBV (red) in majority of right MCA territory
 - represents intact collaterals
 - Note: smaller area of low CBV (black) in right basal ganglia represents infarct core due to small end artery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



Example 2a: Hyperdense left MCA

NCCT

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

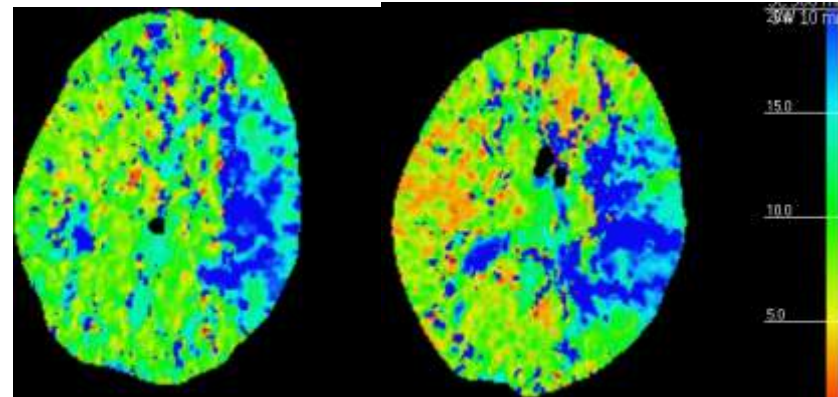


CTA: thick reformats

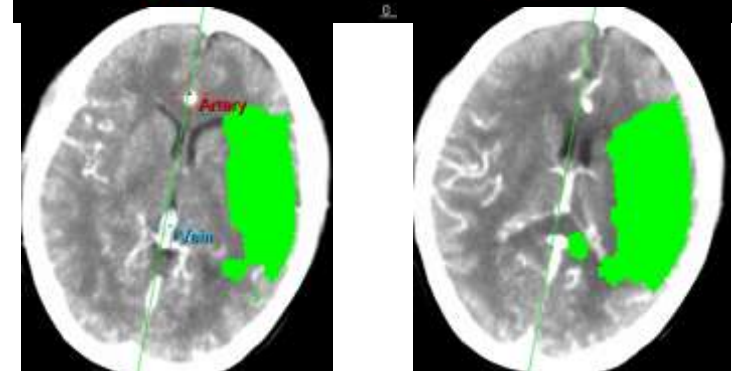
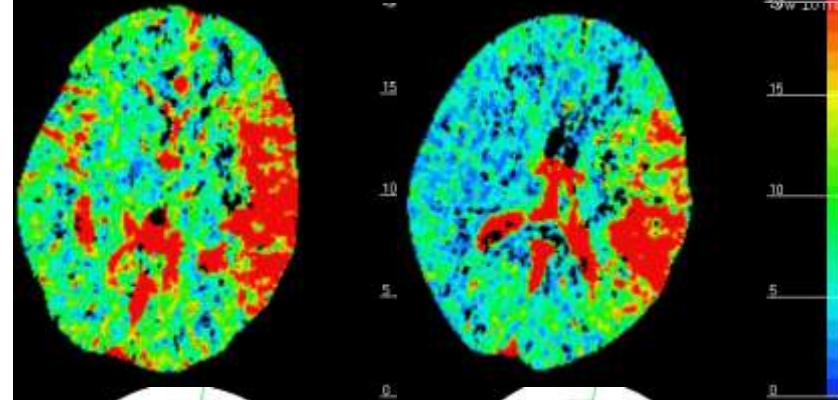
Example 2b: Large left MCA Penumbra

- 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.

MTT

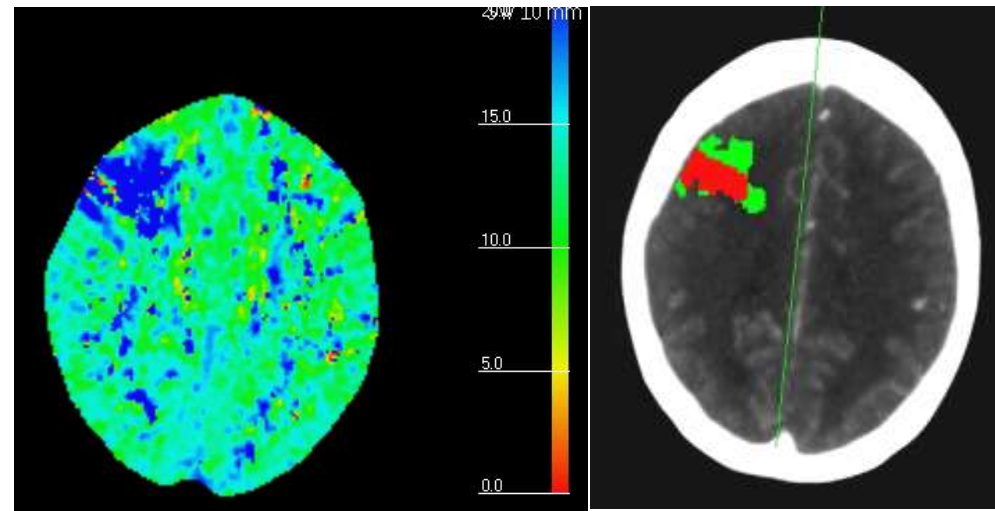


CBV



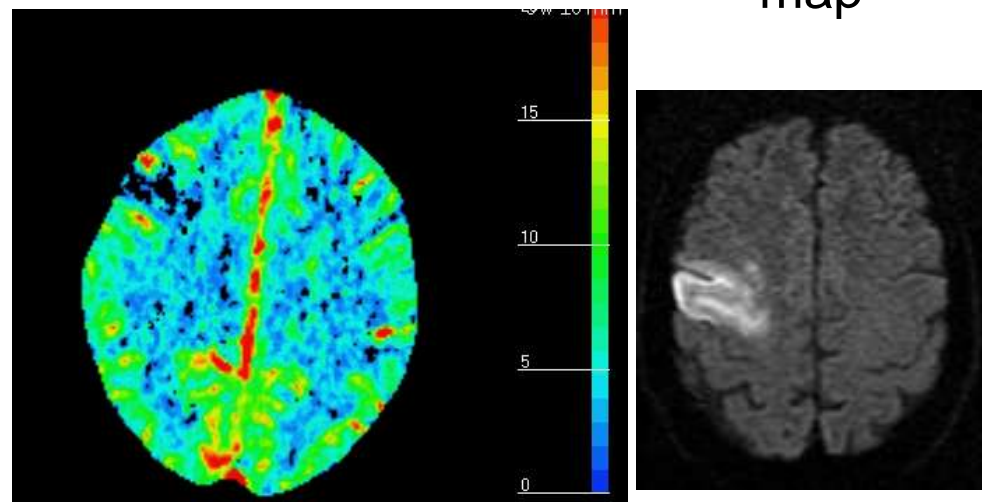
Example 3: Infarct Core

- 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



MTT

Summary
map



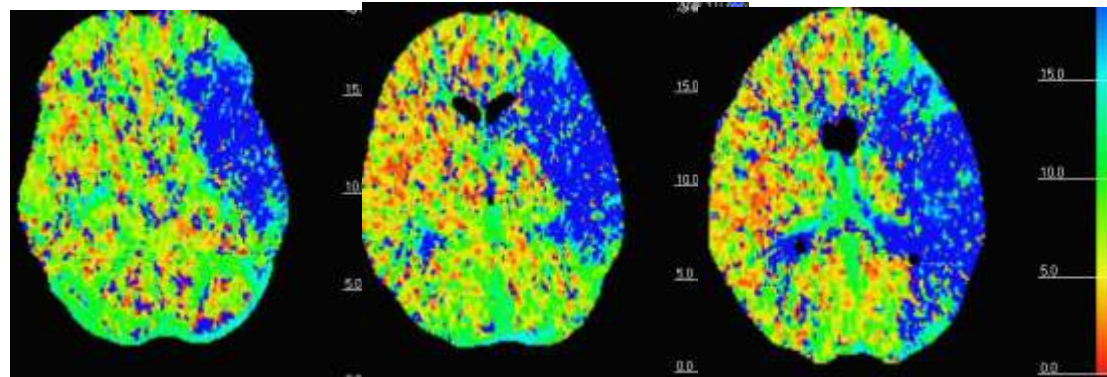
CBV

DWI

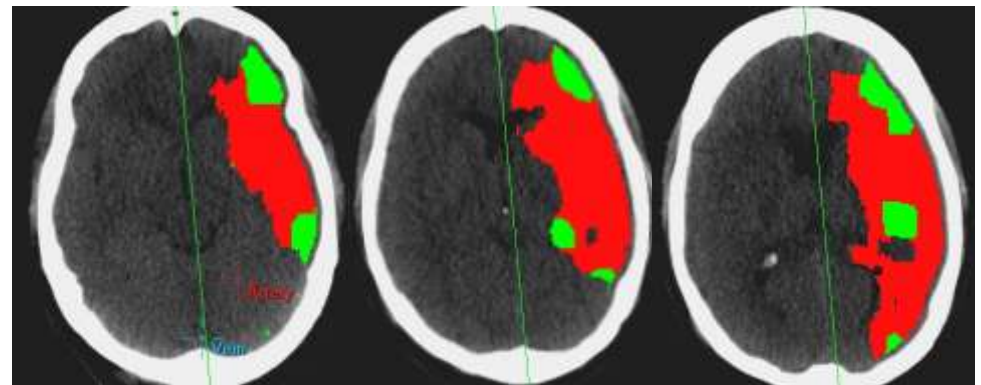
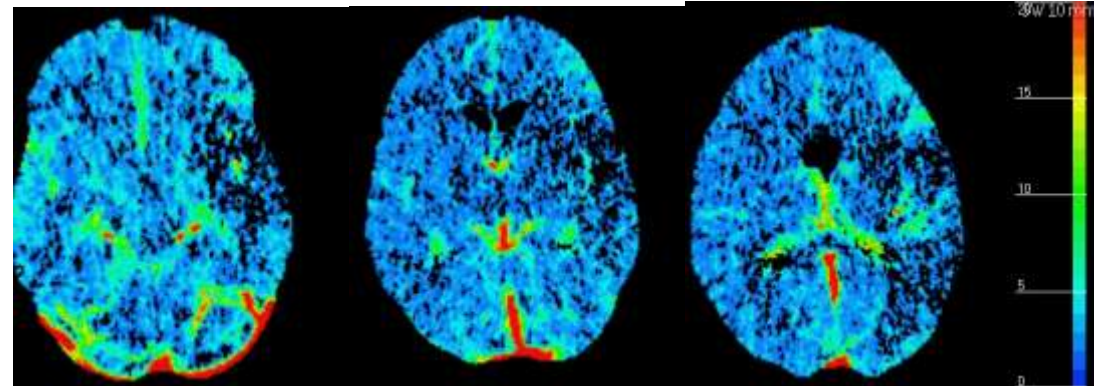
Example 4: Infarct Core

- 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

MTT

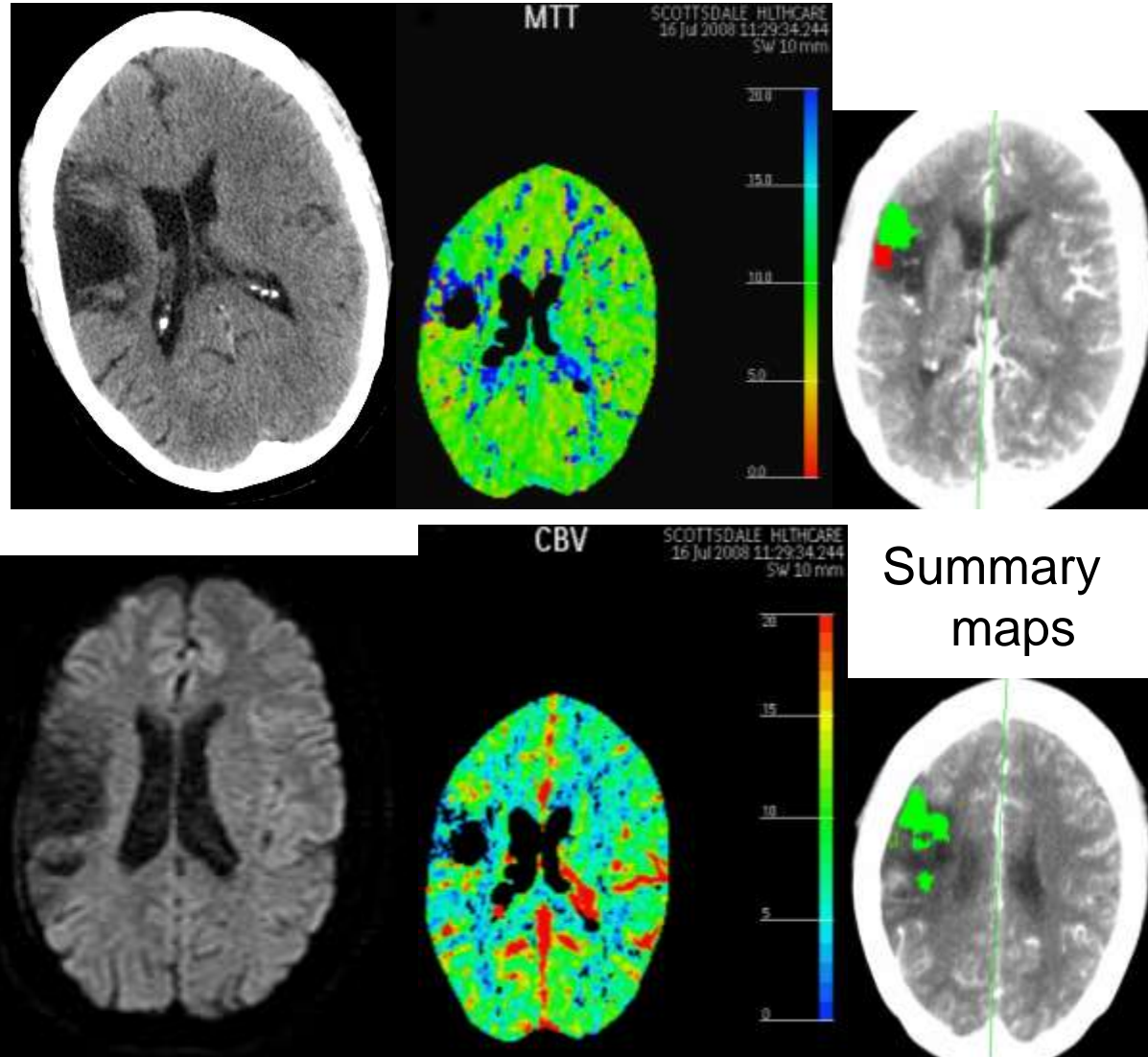


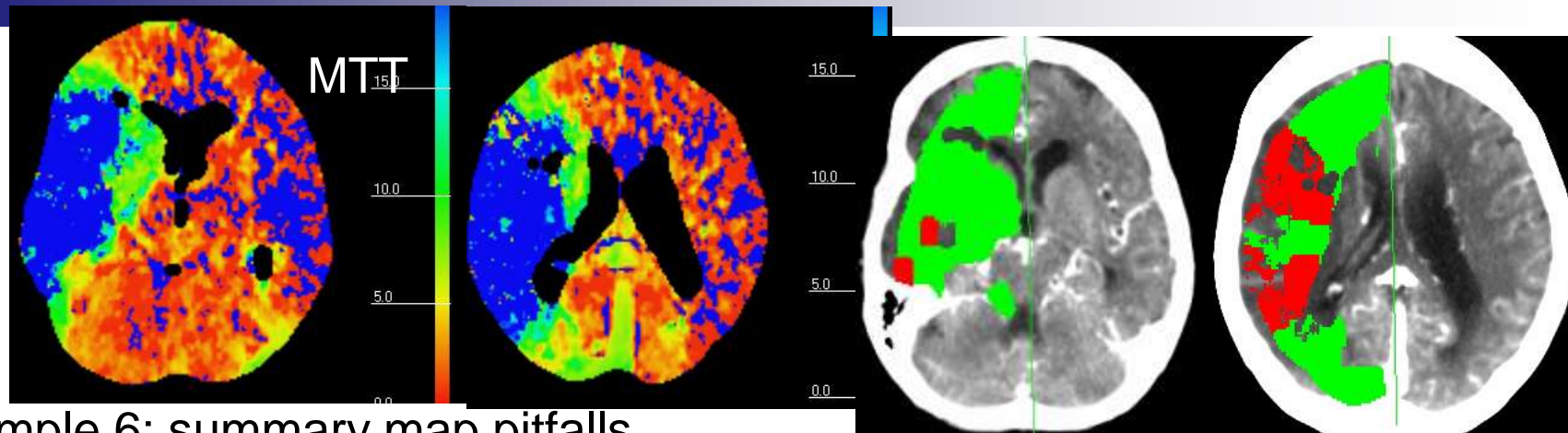
CBV



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.

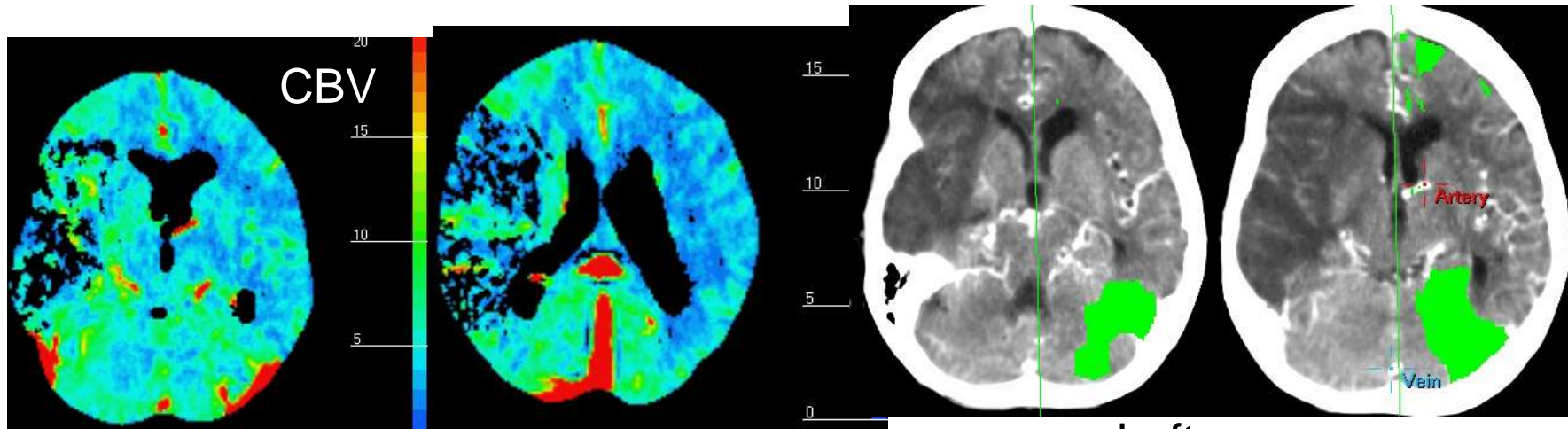




Right summary map

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



Left summary map

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