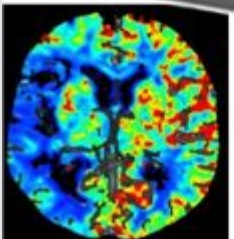


“Perfusion CT: A worthwhile enhancement?”

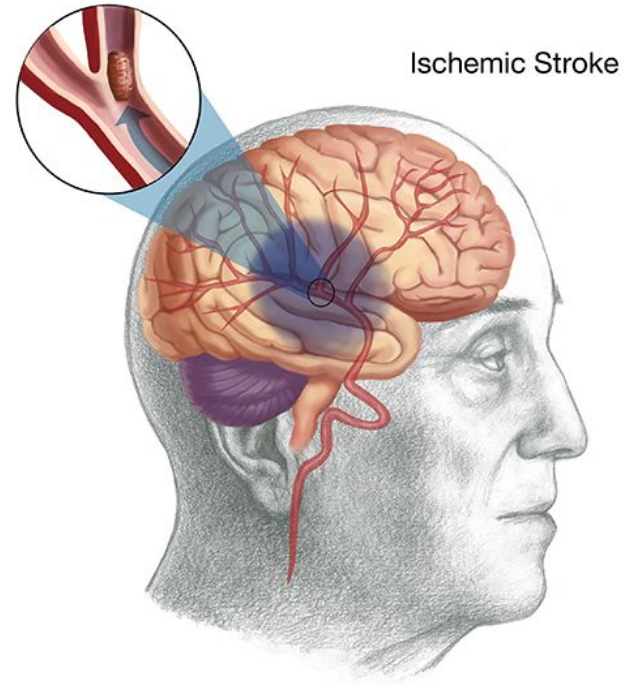
Computer Integrated Surgery II Checkpoint Presentation

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- A dedicated Cone-Beam Computed Tomography (CBCT) scanner for the detection and evaluation of intracranial hemorrhage (ICH) is being developed at JHMI
- 87% of stroke cases are diagnosed as ischemic rather than hemorrhagic
- One established method for the evaluation of ischemic stroke is brain perfusion imaging which describes the passage of blood flow through the brain's vasculature



(N&EA, 2015)

Perfusion CT: a worthwhile enhancement?

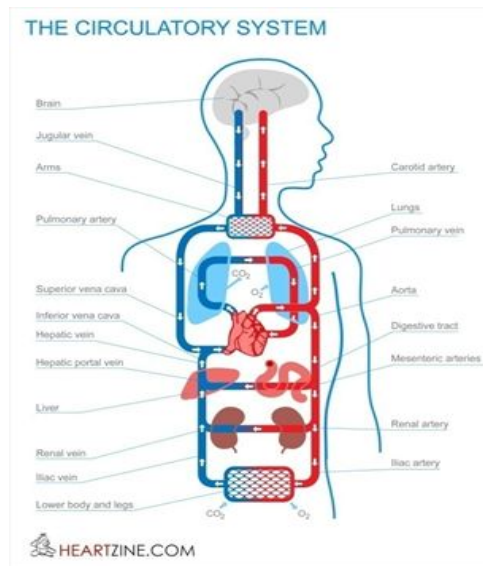
K A Miles and M R Griffiths

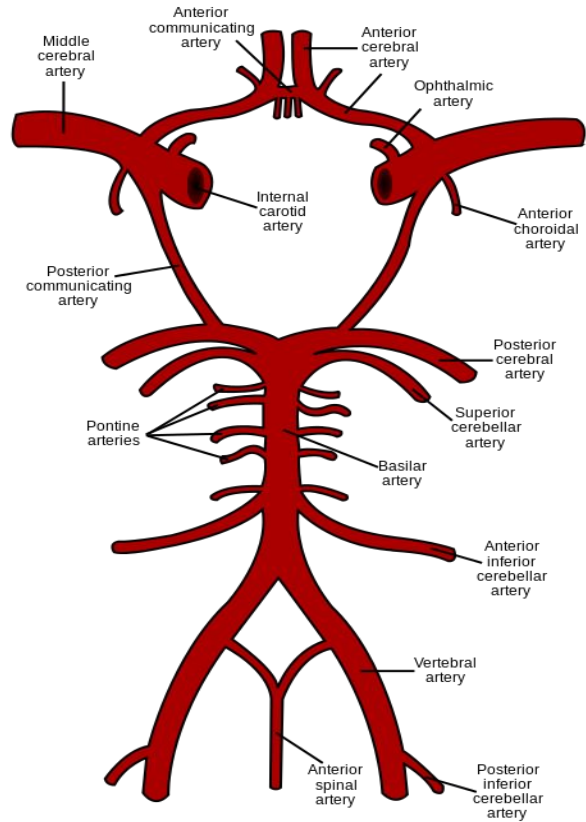
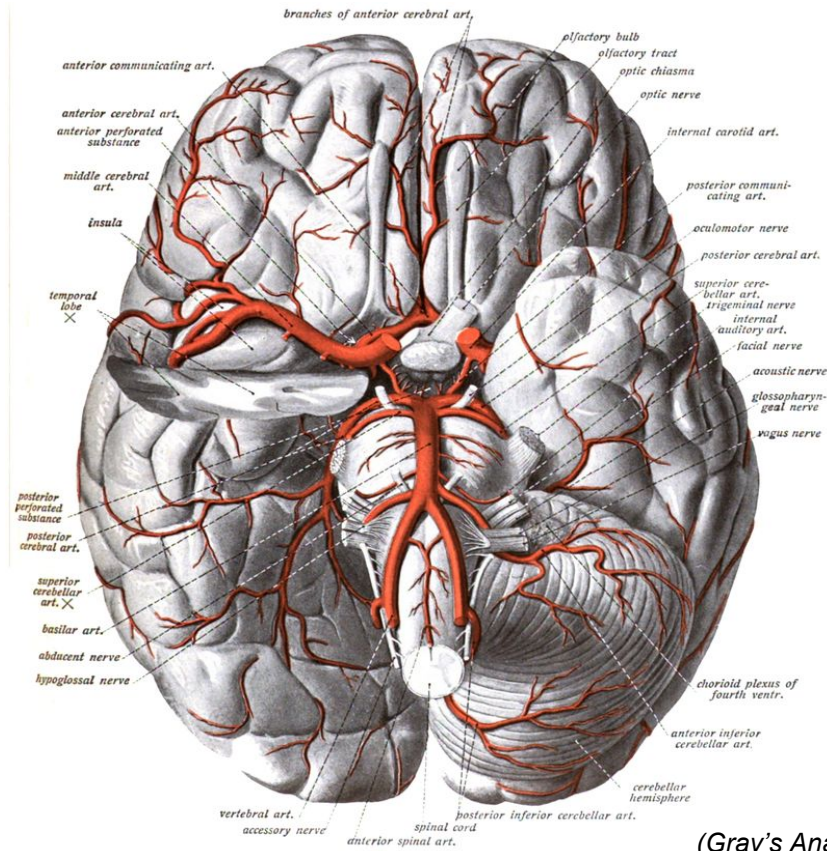
The British Journal of Radiology 2003 76:904, 220-231

This paper was chosen because it:

- Places our perfusion phantoms into clinical context.
- Gives an overview of CT perfusion and its utility
- Discusses common perfusion parameters considered in practice

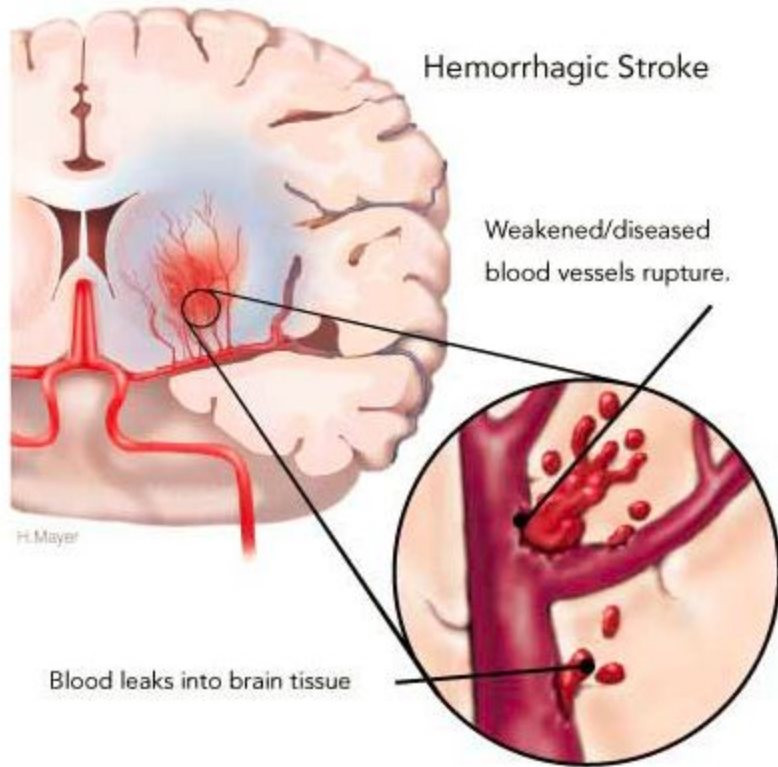
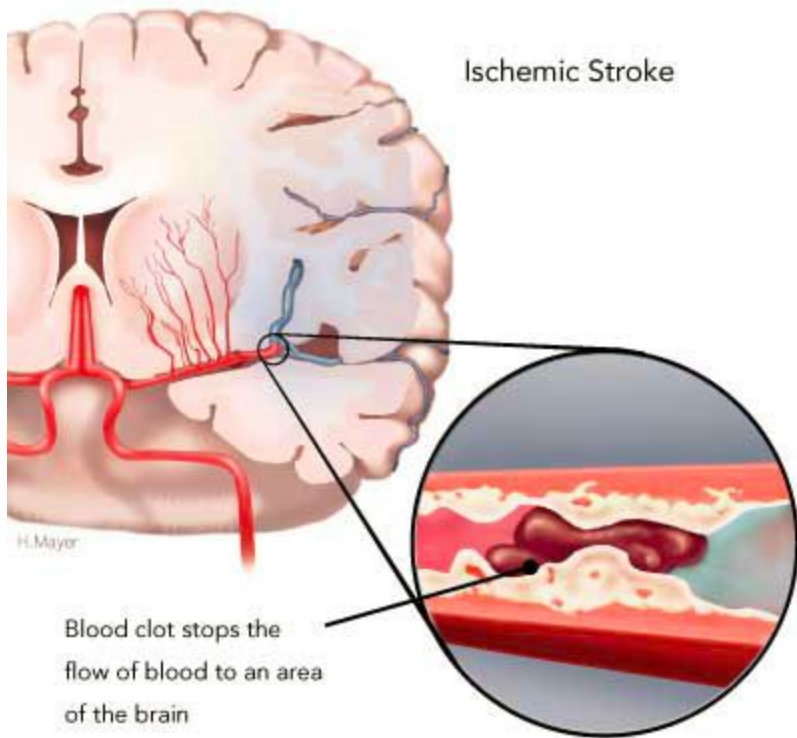
Perfusion - A continuous supply of oxygenated blood pumped to the cells of the body through vessels.





(Gray's Anatomy/Wikipedia)

Fig. 548.

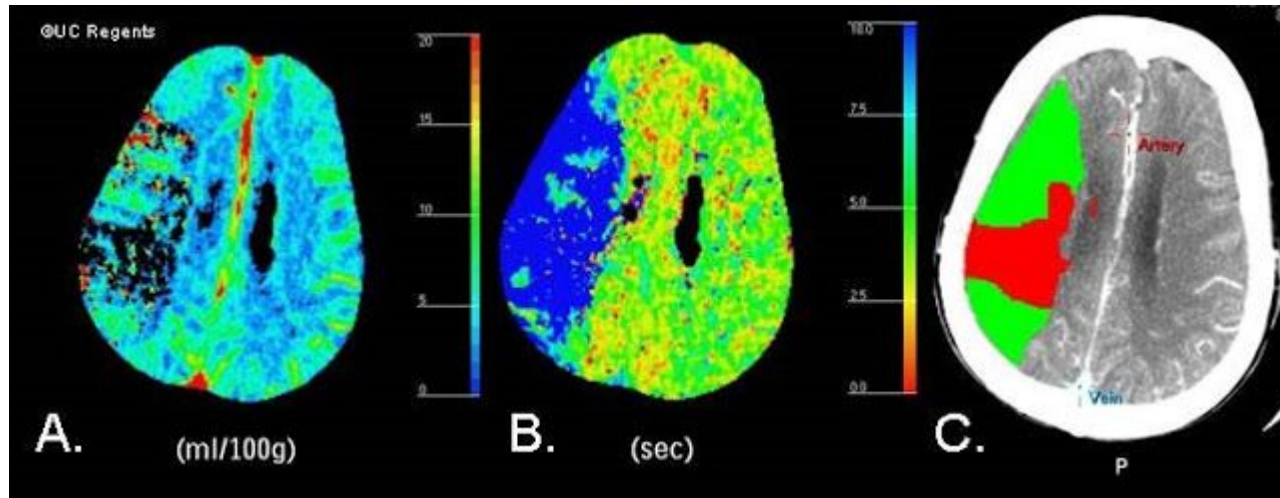


Adapted from: Heart and Stroke Foundation.
(2008).

What do you think?



Image courtesy of Max Wintermark, MD.



CT perfusion imaging of (A.) cerebral blood volume (B.) mean transit time in a patient with ischemic stroke. (C.) Shows a prediction: red is likely to be irreversibly damaged (core infarction) and green is penumbra ischemic (ischemic penumbra) but may be salvageable if blood flow is restored rapidly. Image courtesy of Max Wintermark, MD.

Table 1. Summary of functional CT findings with worsening ischaemia

	Perfusion	Blood volume	Transit time
Autoregulatory range	N	+	+
Oligaemia (misery perfusion)	-	++	++
Ischaemia (metabolic impairment)	-	+	++
Irreversible damage (necrosis)	--	-	-/+

N, normal; +, raised; -, decreased.

Above table depicts the different phases of perfusion from normal functioning to necrotic damage.

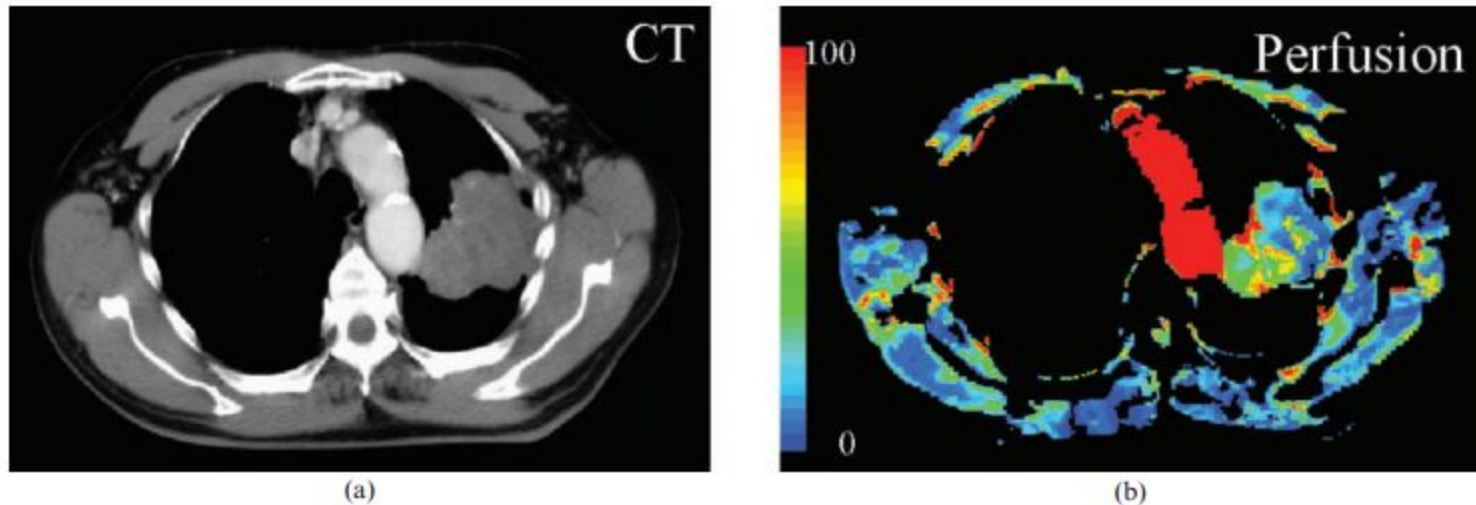


Figure 2. Perfusion CT of a lung nodule obtained using the deconvolution method. (a) CT image, (b) perfusion image. Note the heterogeneous distribution of perfusion within the nodule.

(Griffiths et al.)

3 main approaches to performing CT Perfusion:

- Moments method: Assumes perfusion passes through one time. Models perfusion through the gamma variate function.
- Slope method: Uses compartment analysis along with Fick's Law to model the perfusion through tissue.
- Deconvolution method: Thinks of blood flow as a linear system with an idealized tissue curve which can be used to find the perfusion curve through a deconvolution process.

With Regard to validation of CT perfusion methods:

- Moments method has been validated with high correlation through the use of radioactive microspheres.
- Slope method has a shorter acquisition time compared to deconvolution method
- However, deconvolution method is less prone to bias from individual sample noise

This paper is helpful to the project because it:

- Again, gives the much needed clinical context.
- Provides a starting point for experimental design as phantom begins testing phase.
- Points out common pitfalls and issues to keep in mind.



Medrad Mark V Plus



(Orth, 2008)



*Masterflex L/S
Economy Pump
System*

Pros:

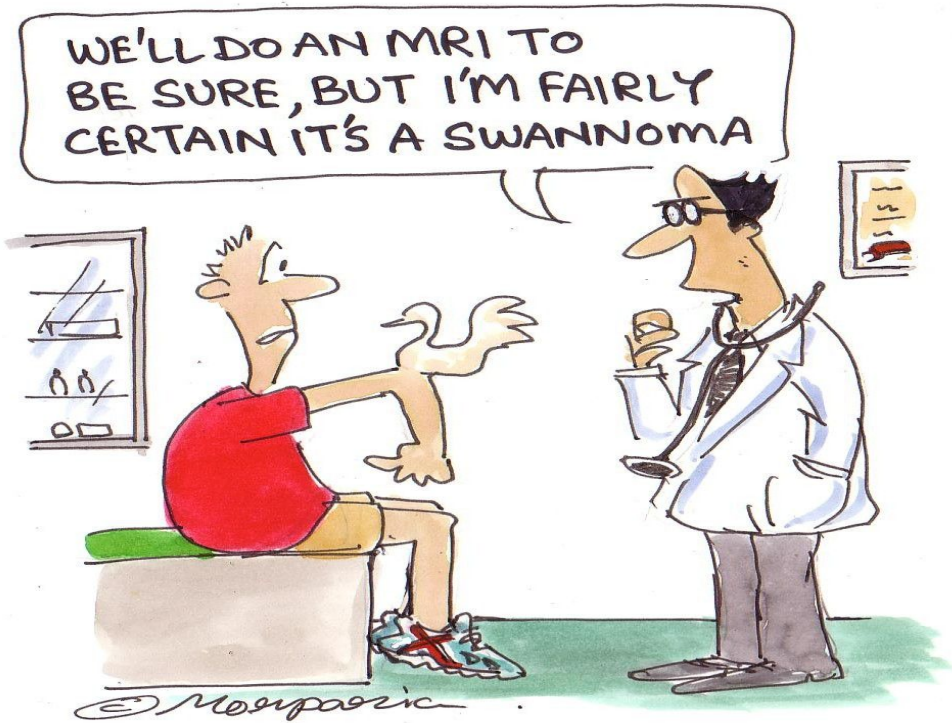
- Good general overview of CT Perfusion (CTP)
- Nice physiological explanations
- Gave big picture idea of the precision and accuracy of CTP

Cons:

- Did not talk too much about perfusion setup/protocol
- Not terribly helpful on setting/fine tuning parameters

Conclusion

In our application, the slow rotation speed of the C-arm CBCT may pose unique challenges. In summary, CT Perfusion and related imaging modalities *can be worth it*.



But we should
keep our options
open...