

Cardiac PET (perfusion and viability)

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Why PET?

- Improved resolution-not really required in cardiology
- Improved sensitivity – this may be important-financially as reduced acquisition time
- Improved attenuation correction-good
- Look at metabolism-could be very good

F-18 FDG

- Most commonly available PET radiopharmaceutical
- Uptake dependent on glucose drive in cells
- Related to hypoxia
 - Glucose to lactate (no O₂) = 4ATP per molecule
 - Glucose to Krebs cycle = 32 ATP per molecule
- So ischaemic tissue needs lots of glucose but remember in diabetics competitive uptake so need blood glucose <6mmol/l

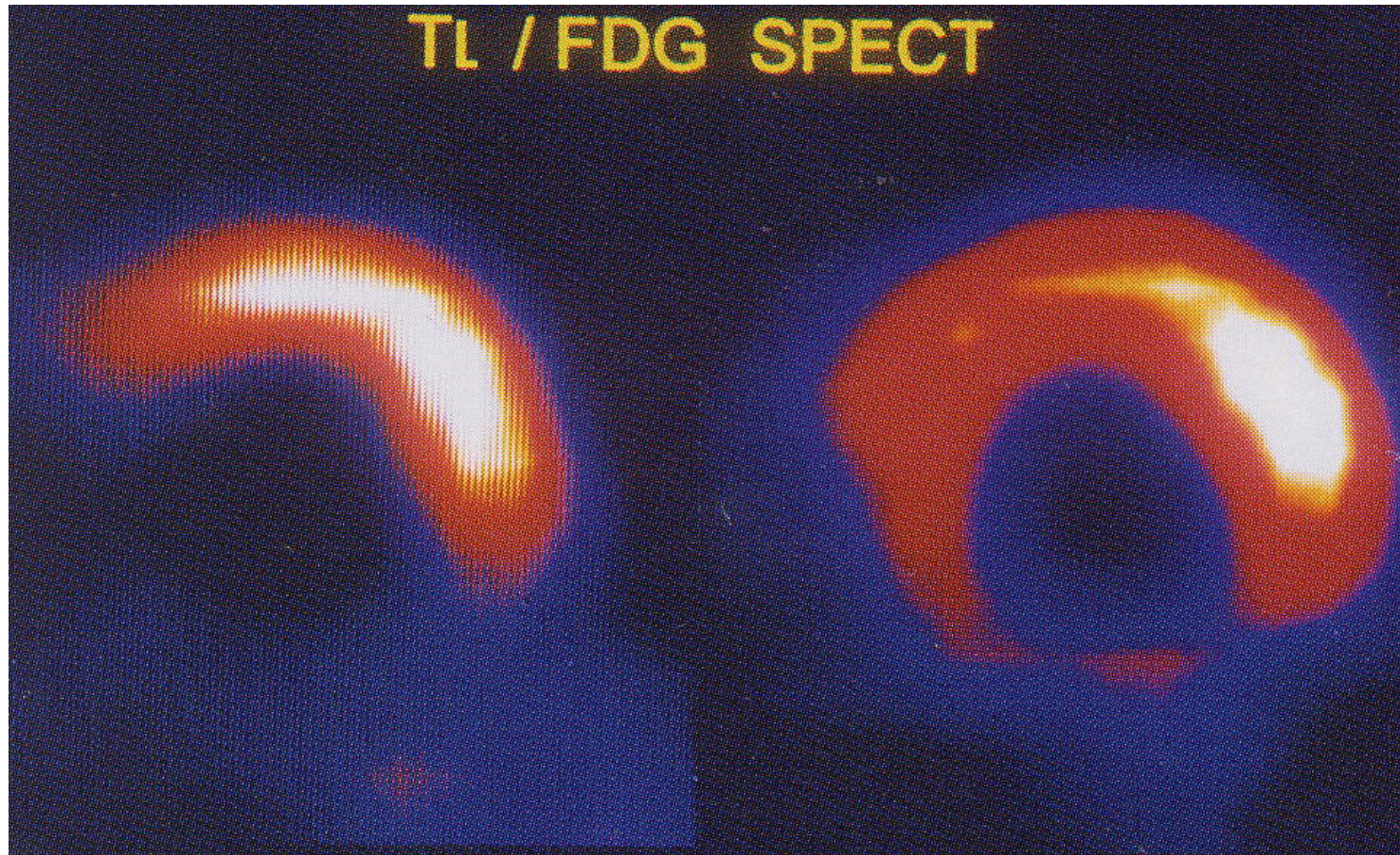
Viability

- In patients with severe ischaemia identification of viable heart very important
- Revascularisation may result in improvement in flow and over time return of function
- Prognosis dependent on LVEF in these patients is viable myocardium not improved 32% 1 year survival vs 7% if improved (Dy Carli et al JTCS 1998)
- F-18 FDG can find that viability

Perfusion and viability

- Viability found with F-18 FDG (where uptake may be increased in severe ischaemia)
- How about perfusion
 - N-13 H_3
 - Rb-82
- However though not perfect can use single photon for perfusion

SPET and PET



FDG in action

- Wu et al Kyoto JNM 2007
- Looked at 41 patients with severe IHD
- Using TI-201/FDG PET mismatches identified (heart divided into 17 segments)
- 394 viable segments per heart were identified in 31 patients
- 29 had CABG, 76% of these had an improvement of >5% in LVEF

FDG in viability

- Slart et al Groningen JNC 2006
- 213 segments in 31 patients (17 segments per patient) were imaged with F-18 FDG before and just after CABG
- An increase in F-18 FDG uptake of more than 50% post surgery predicted improvement in LVEF in 93% of cases (specificity 85%)

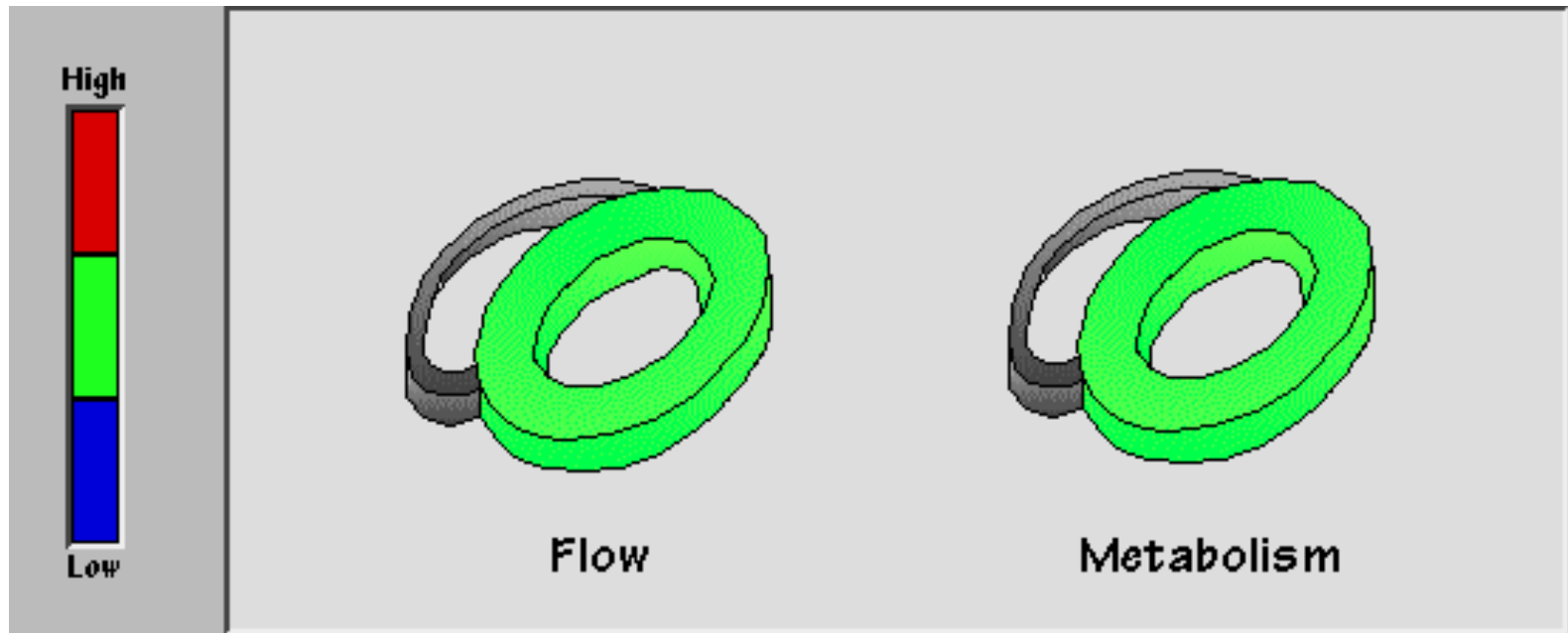
Comparing NH_3 and F-18 FDG

- Slart et al Groningen EJNMMI 2006
- Used combination of NH_3 and F-18 FDG PET to determine areas of viability (reduced NH_3 with normal or raised F-18 FDG) or normal NH_3 but raised F-18 FDG)
- 47 patients with severe IHD
- In 90% of these PET predicted an improved LVEF post surgery

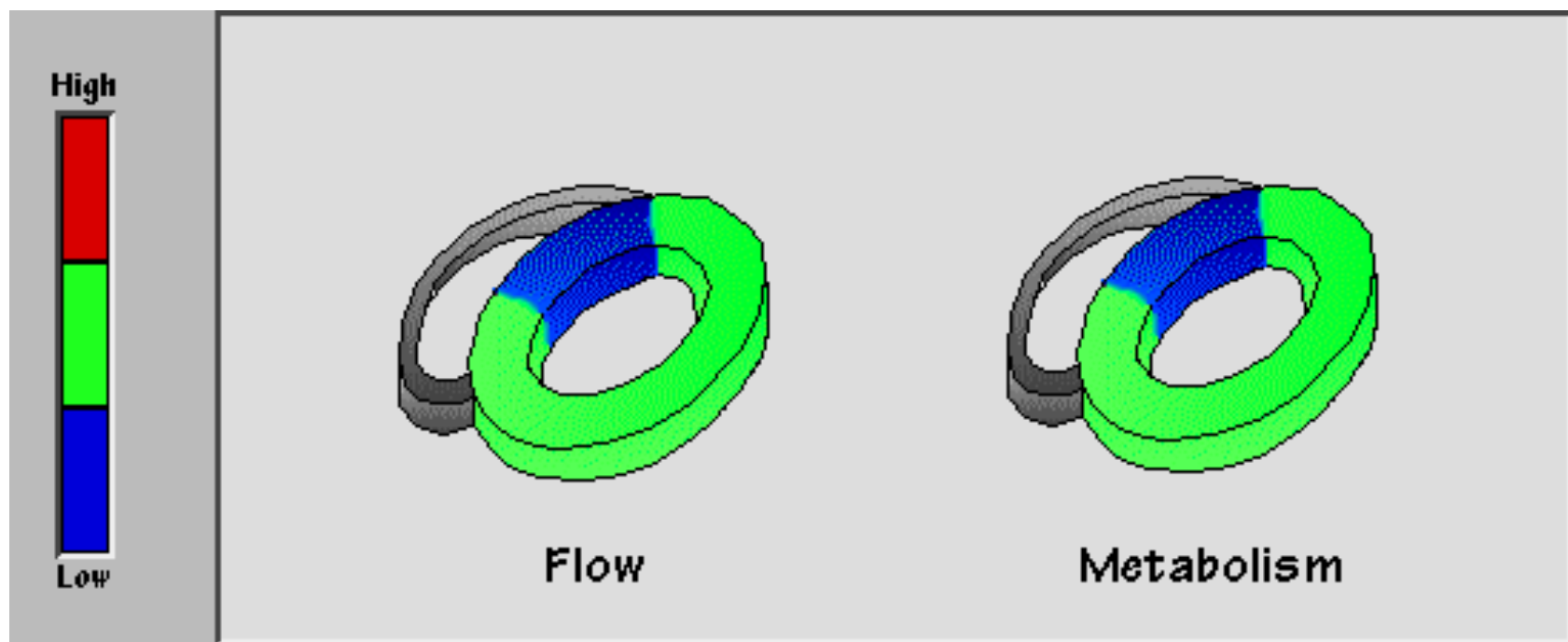
What can we see

- What follows is a series of perfusion maps of perfusion and viability
- Available on line from Brigham and Womens's hospital in Boston
- Only illustrative examples

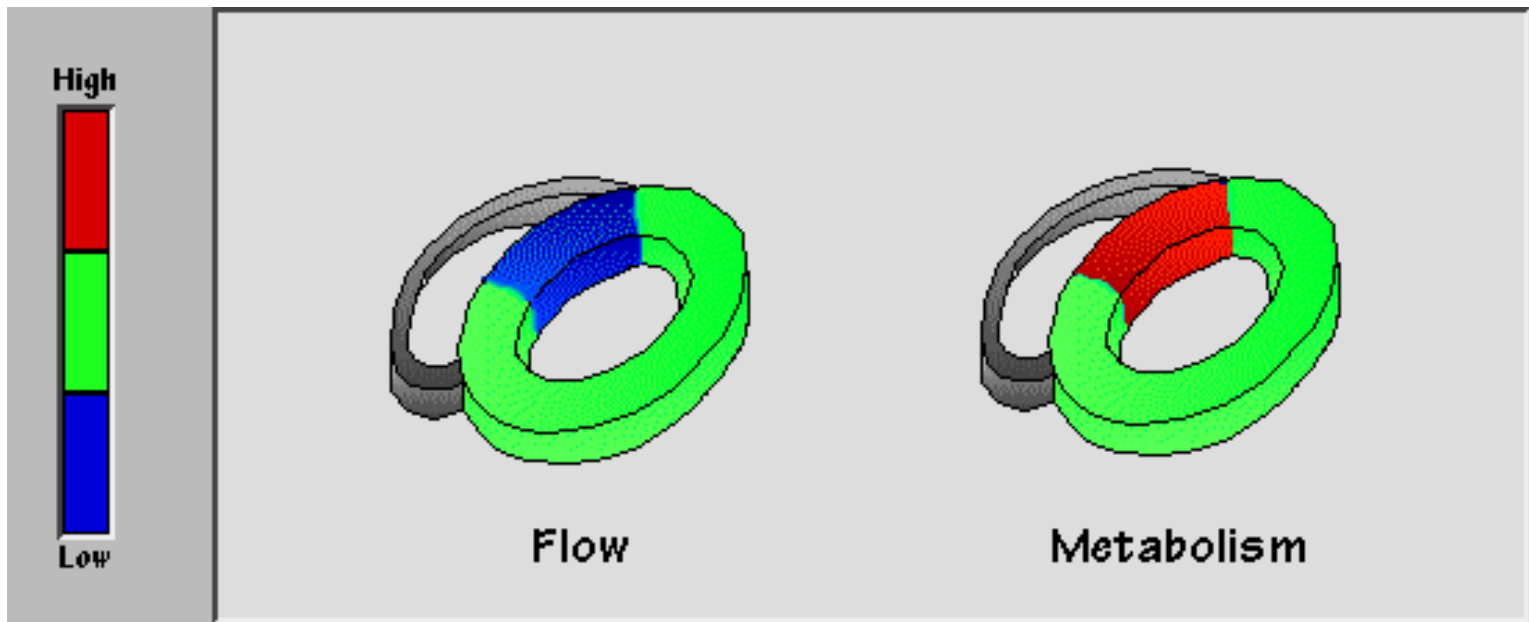
Normal



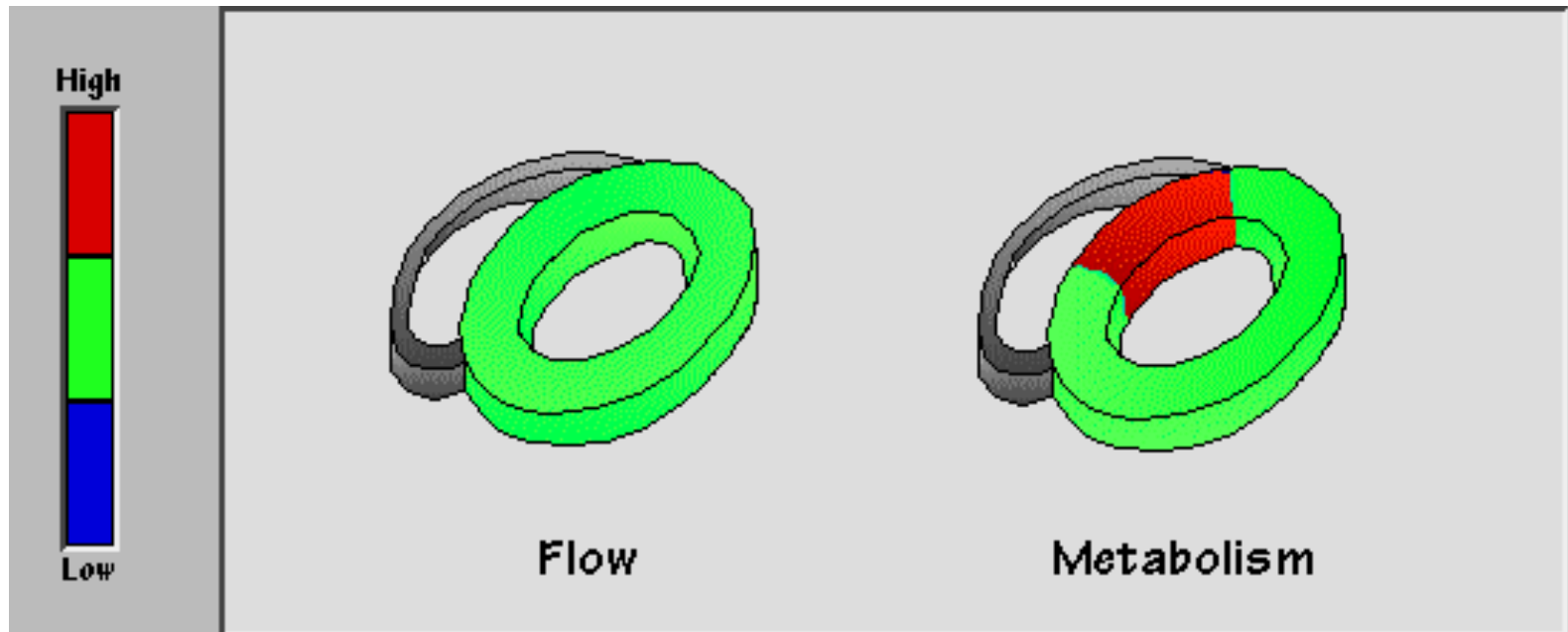
Infarct



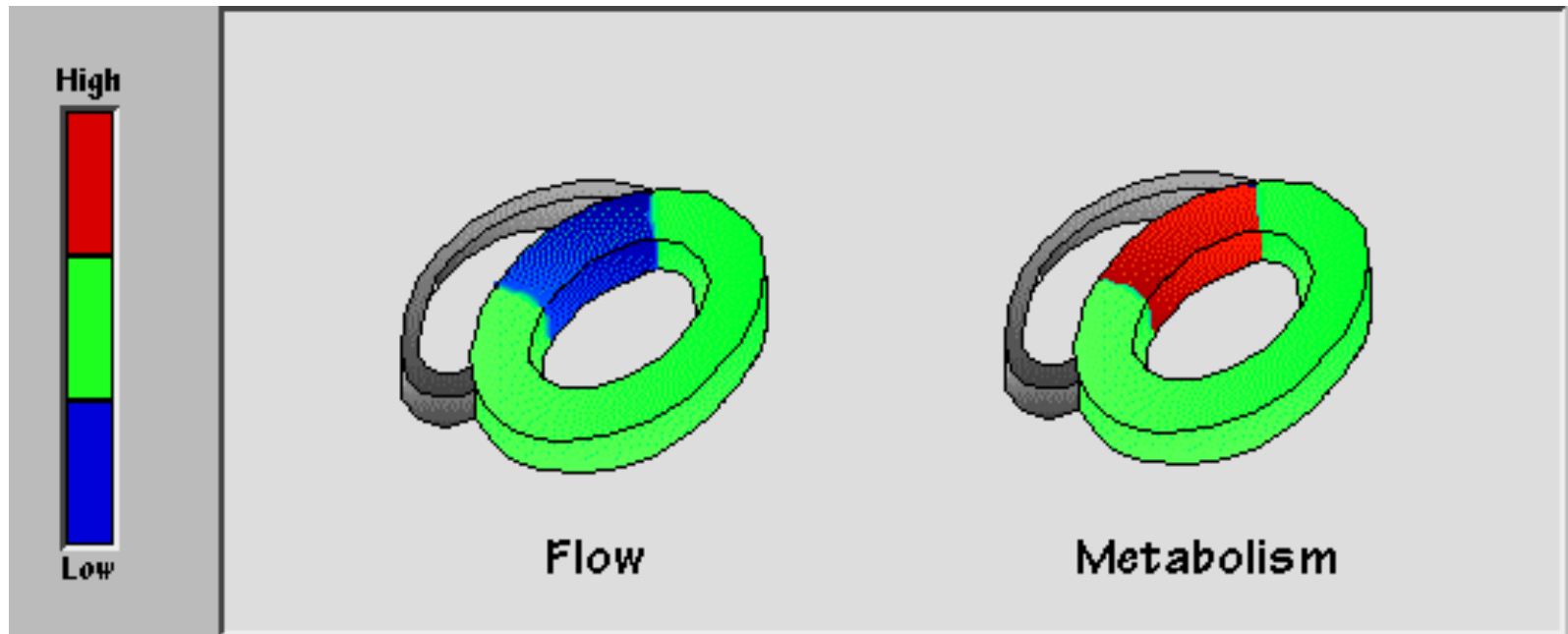
Viability



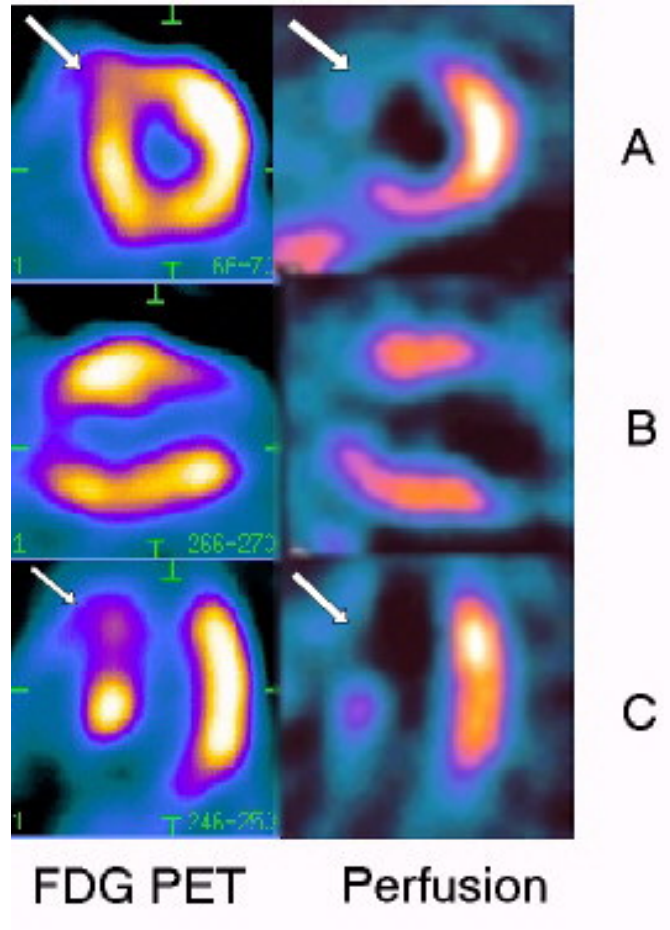
Hibernation



Cardiomyopathy



In reality what it looks like



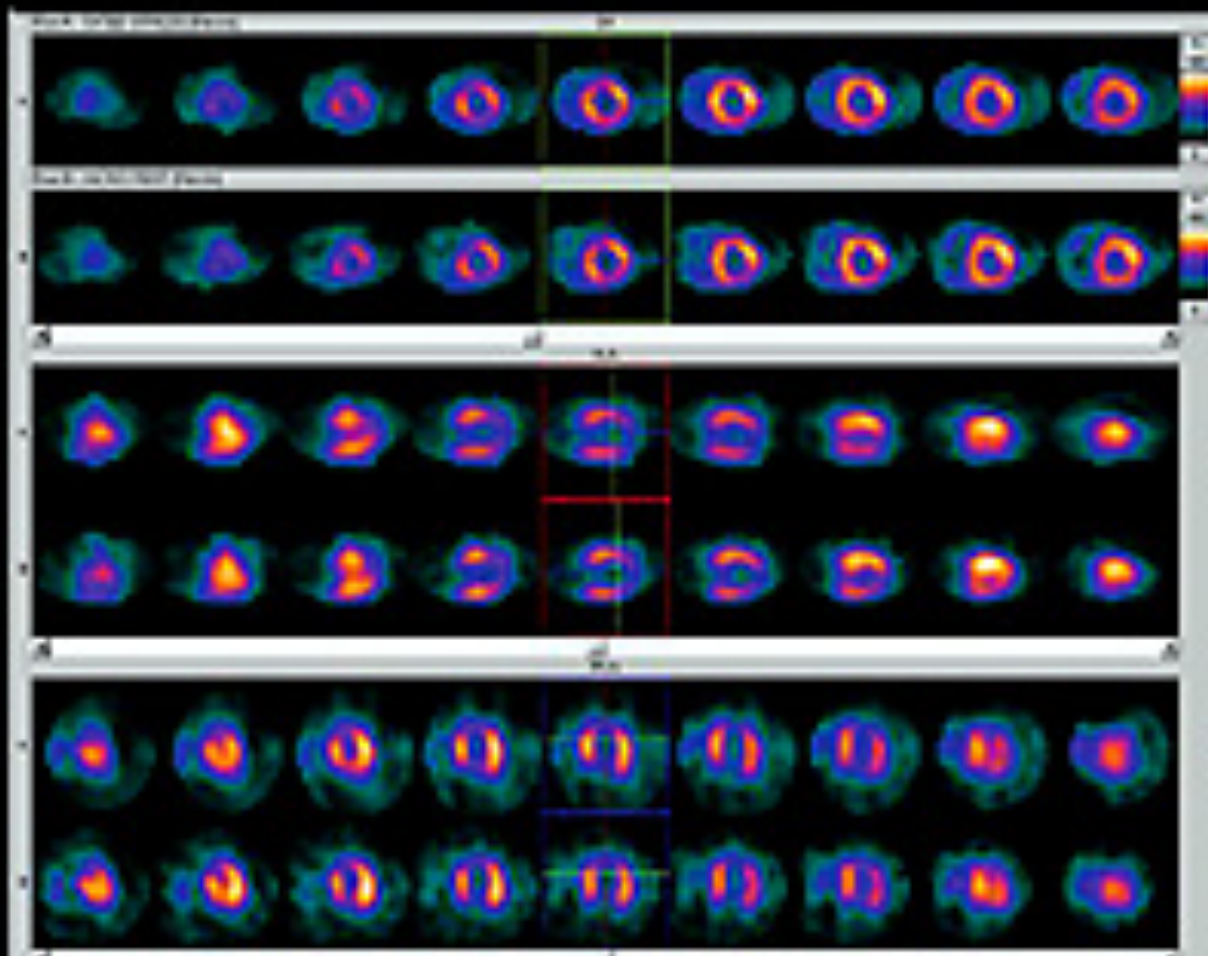
Improving the system

- Can we use PET to provide a better service
- Rb-82 may allow for faster more accurate imaging
- Possibly all can be performed in a (one stop shop)
- Especially with 64 or 128 slice CT

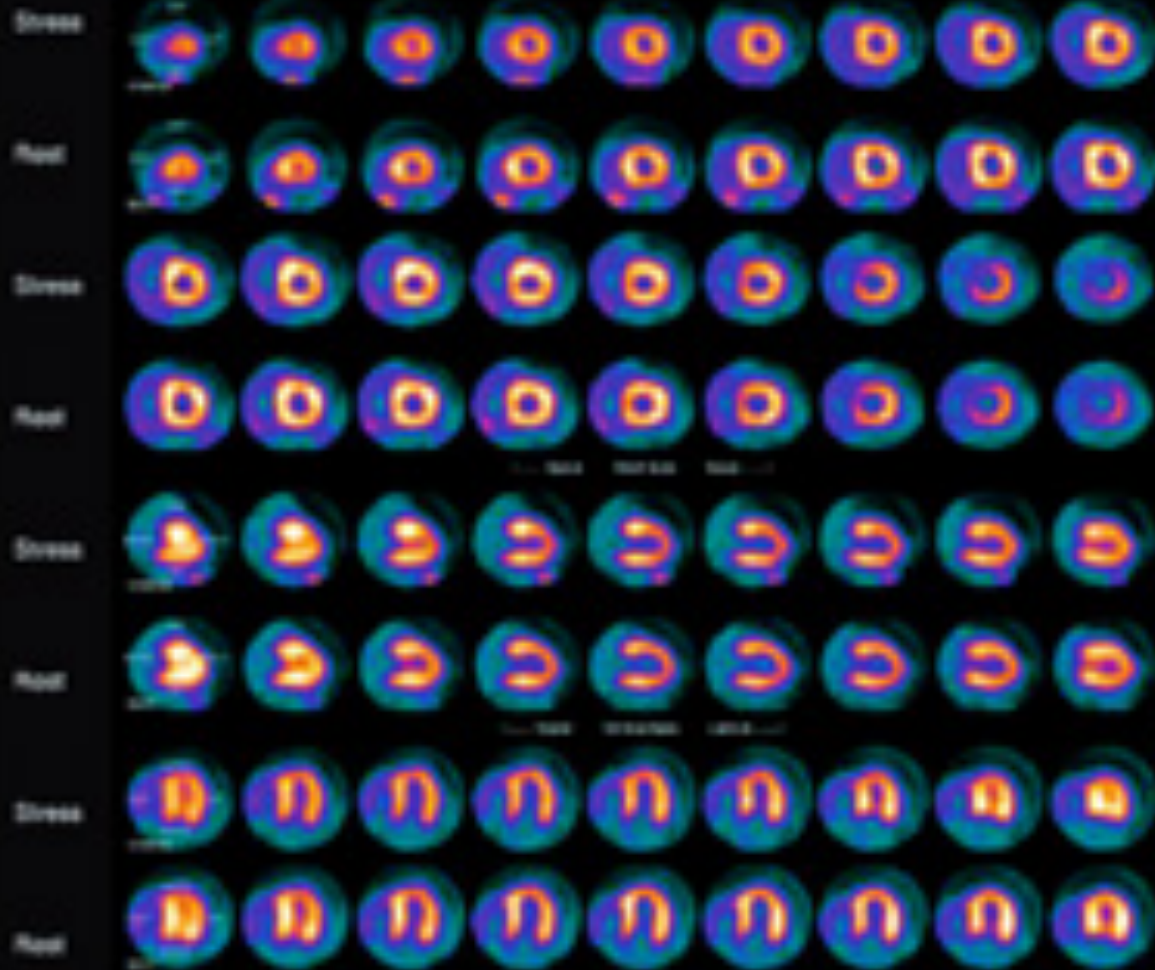
Rb-82 for perfusion

- Bateman et al Kansas JNC 2006
- 112 patients had Tc-99m MIBI and Rb-82 perfusion studies
- 4 blinded readers compared results with CABG (stenosis of 70%)
- Rb-82 had accuracy of 89% compared with 79% for SPECT ($p=0.003$)
- Rb-82 better in men and the obese

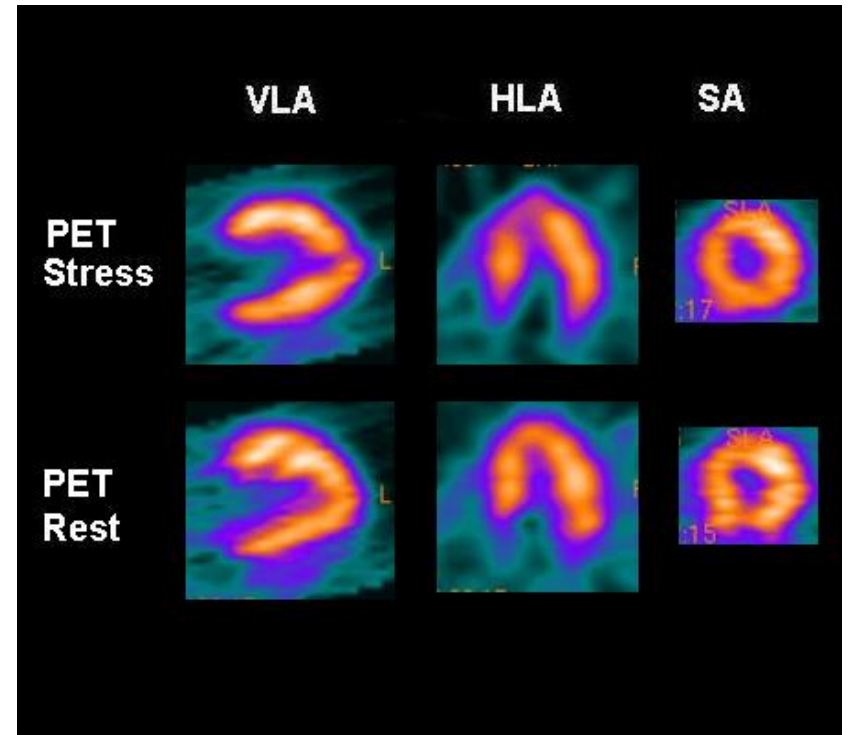
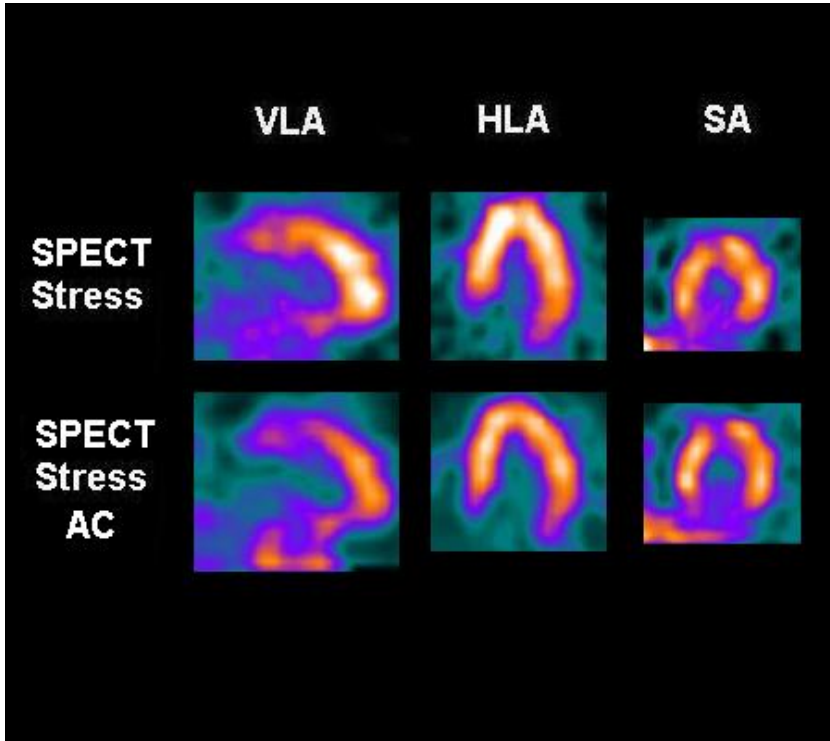
Case 1 With SPECT Imaging



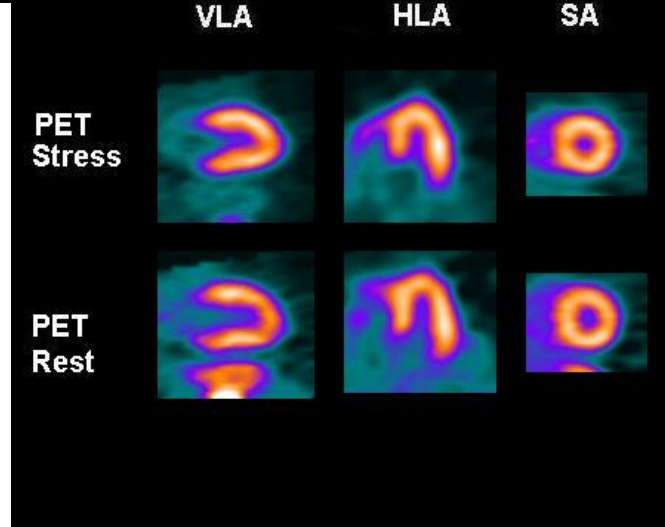
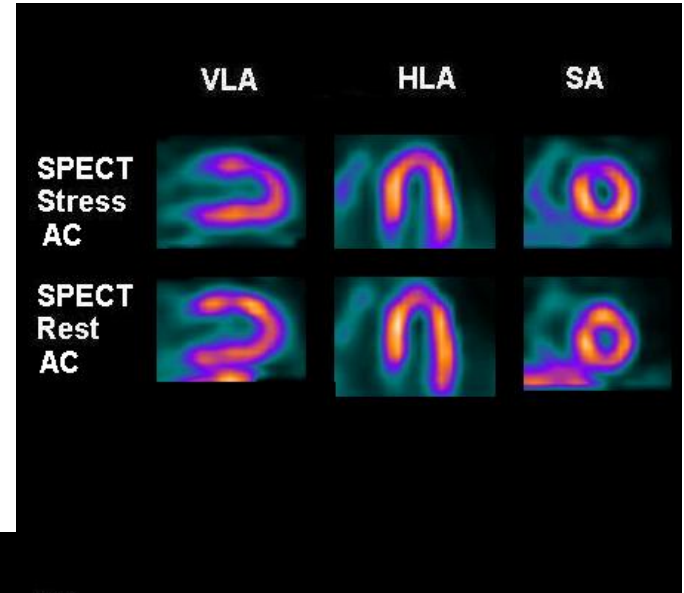
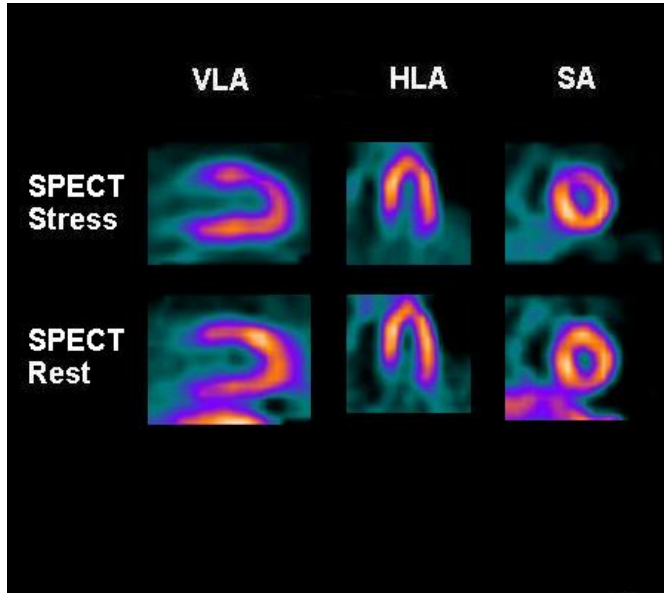
Case 1 With PET Imaging



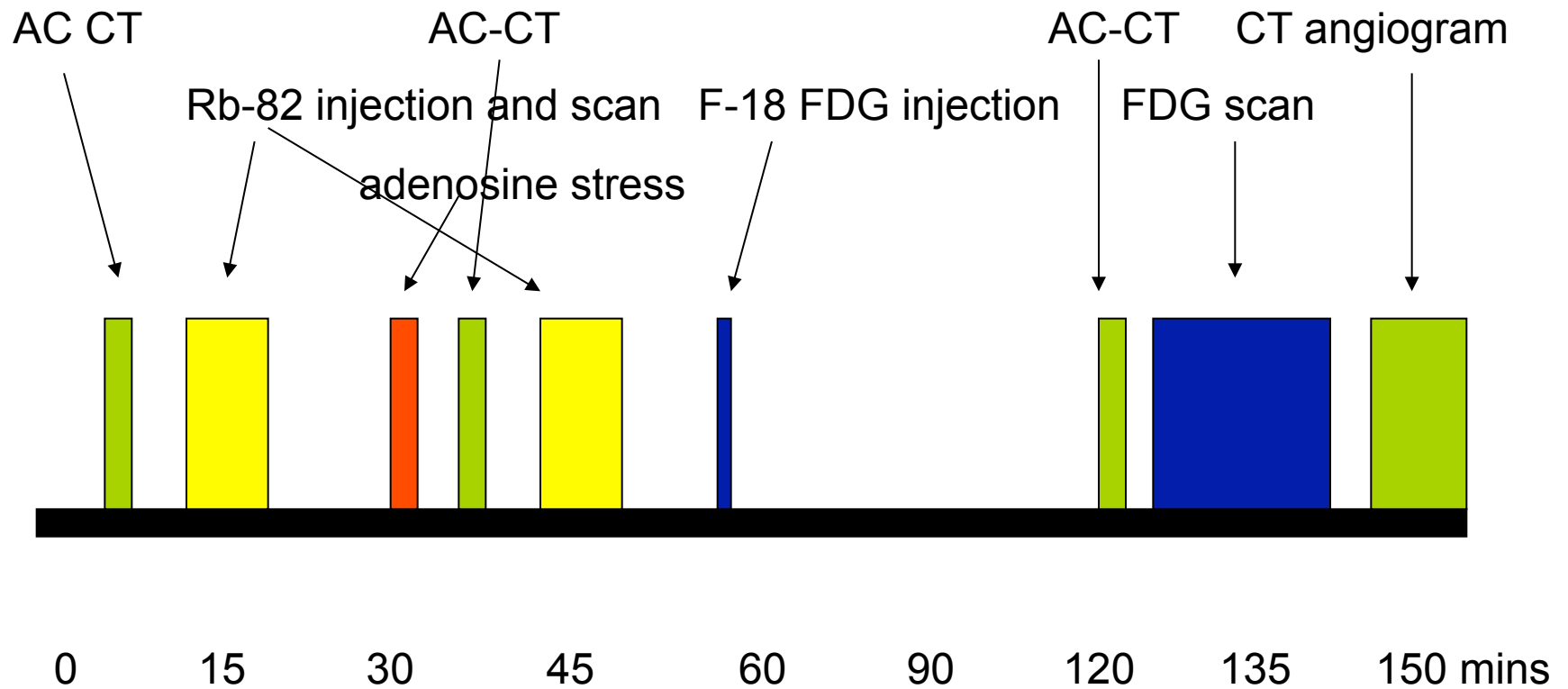
SPECT vs Rb-82 PET



AC vs PET



Proposed scheme for viability



18mSv without CT angiogram
42mSv with CT angiogram

Other tracers C-11 acetate



C-11 acetate uptake is related to fatty acid metabolism,
This is reduced when there is ischaemia which may be
due to classical ischaemia but also diabetes and
cardiomyopathies

In conclusion

- PET imaging is able to identify viability
- Probably best combination is Rb-82 (or N-13 NH₃) and F-18 FDG PET
- Finding viable myocardium and doing CABG saves lives
- Can be used to predict response to surgery