NHS
University College London Hospitals
NHS Foundation Trust

uclh

Imaging high activities of I-131 using fast mode and dead-time correction

Tom Sanderson[1], Matt Aldridge[1], James Scuffham[2], John Dickson[1]
[1] University College London Hospital
[2] Royal Surrey County Hospital NHS Foundation Trust

Speaker Name: Tom Sanderson

I have no financial interests or relationships to disclose with regard to the subject matter of this presentation.

Solving Kids' Cancer

NHS
University College London Hospitals
NHS Foundation Trust

MiNivAn

A Phase I study of 131-I **mI**BG followed by **Niv**olumab and ch14.18/CHO **An**tibody in children with relapsed/refractory neuroblastoma

- *Juliet Gray (Southampton)*
- *Mark Gaze/Aldridge/Bomanji (UCLH /GOSH)*
- *Holger Lode (Greifswald)*
- *Paul Sondel (University of Wisconsin, Madison)*
- *Ken Desantes (University of Wisconsin, Madison)*

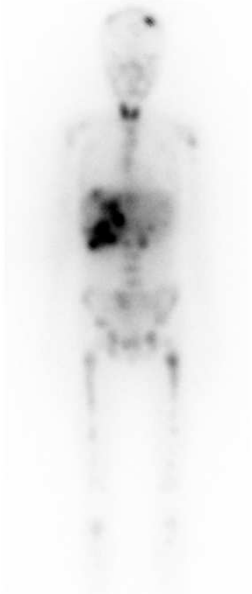
uclh

mIBG Teatment Schedule

University College London Hospitals
NHS Foundation Trust

Aim to deliver 2 Gy WB dose over 2 fractions

<u>Fraction 1</u>: administer 222 MBq / kg



Measure whole-body dose

<u>Fraction 2</u>: Administered activity linearly scaled to deliver total dose of 2 Gy

Measure whole body dose from fraction 2

Total WB dose = fraction 1 + fraction 2

Example: Patient Weight = 71 kg
Administered activity fraction 1: **14.1 GBq**
Whole body dose = 0.8 Gy
Need 1.2 Gy from fraction 2
Assume same Gy/MBq

Prescribed **22.0 GBq** for fraction 2

uclh

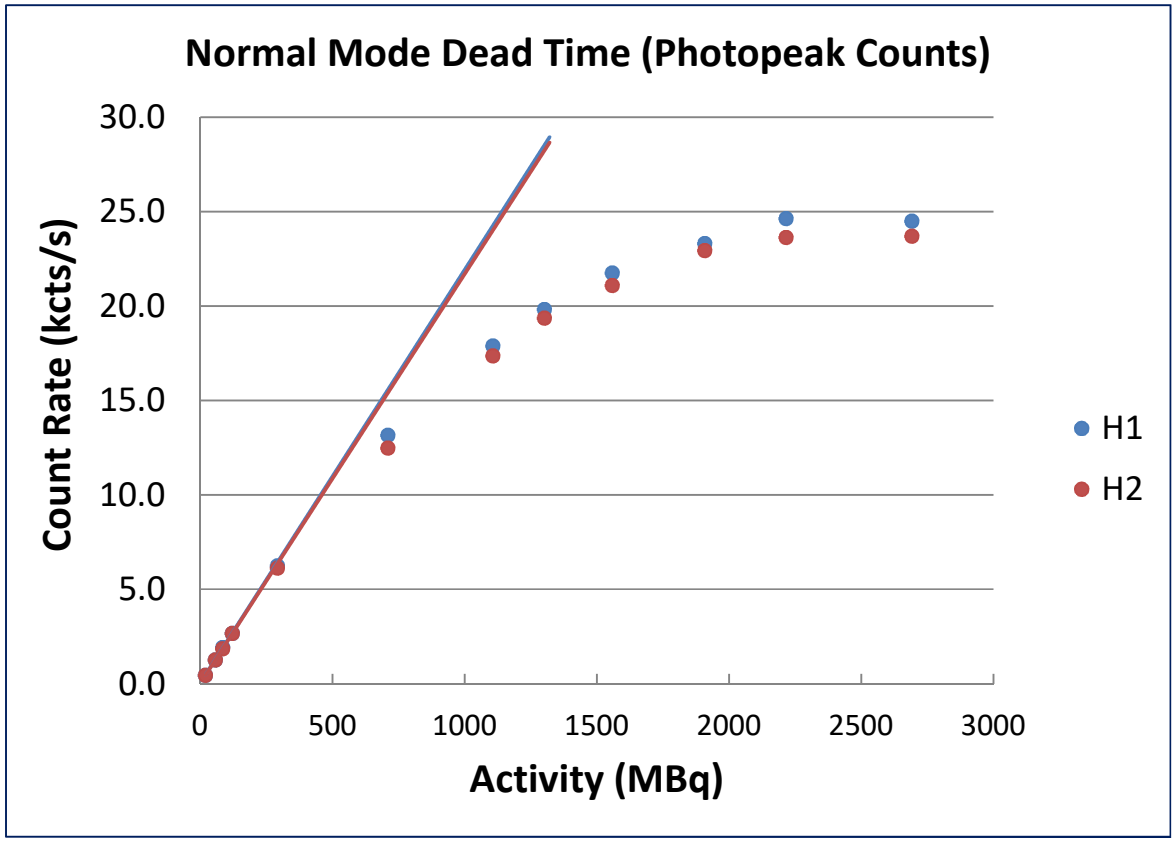
Trial Dosimetry

1.Wholebody absorbed radiation dose measurements from WB imaging and in-patient monitoring

2. SPECT/CT imaging for calculation of absorbed radiation dose to tumours, kidneys, liver and bone marrow

- Quantitative imaging at multiple time-points
- Aim for first scan at 24 hrs
- Requires dead time correction for I-131
- GE Discovery 670 SPECT/CT $\longrightarrow$ **Fast Mode**

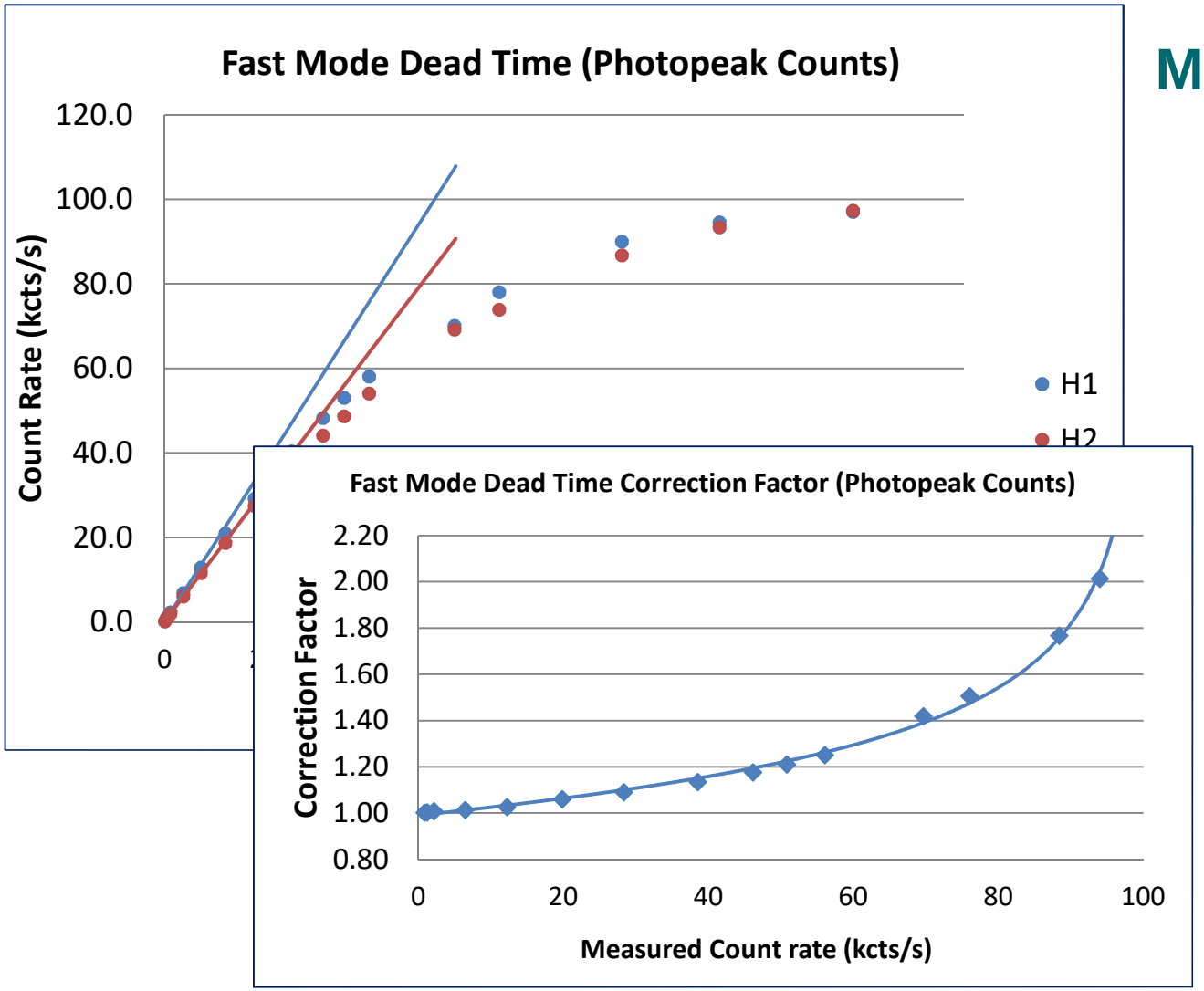
GE D670 SPECT/CT: Normal Mode HE



Maximum Count Rate:

24 kcts/s at 2.2 GBq

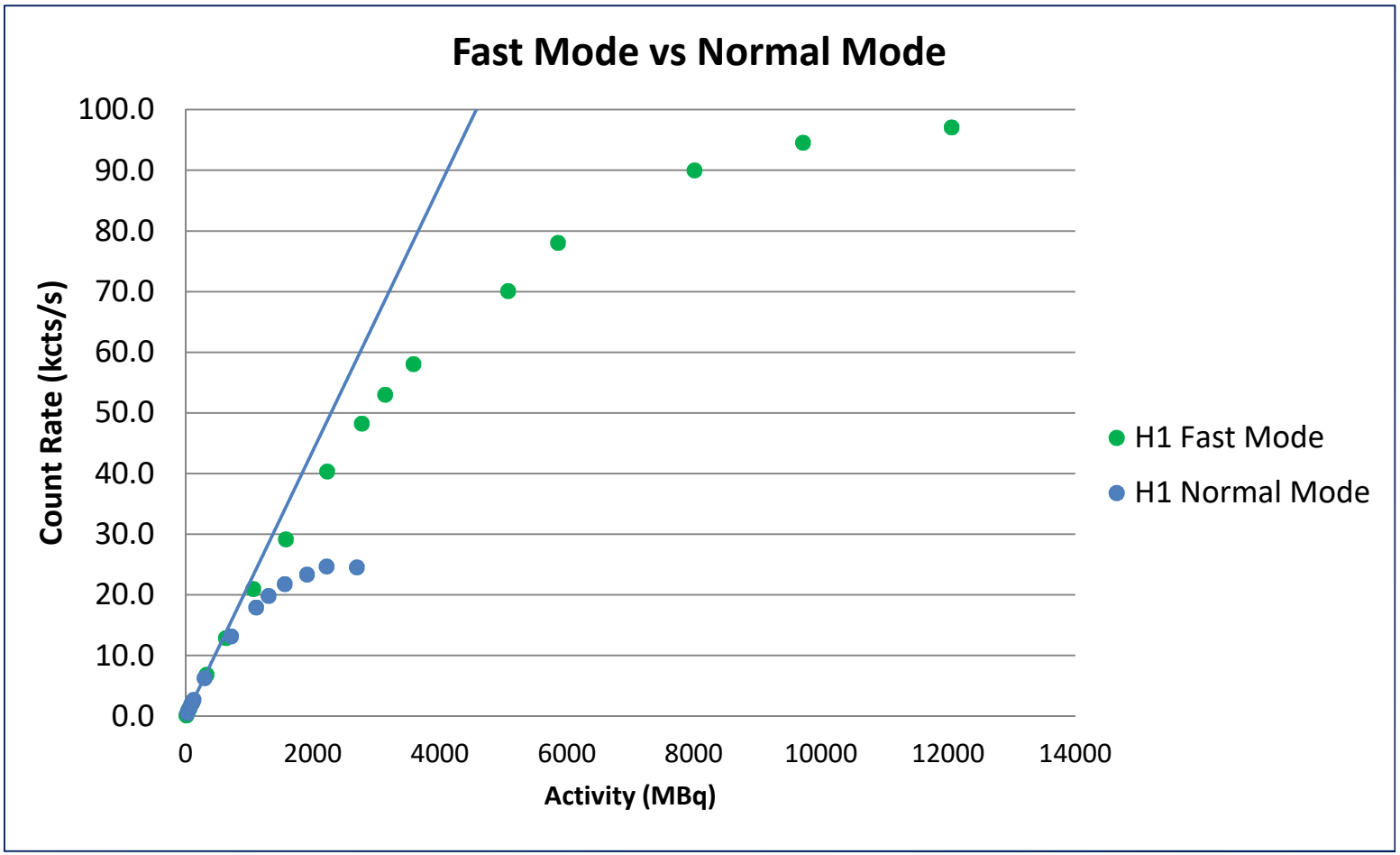
GE D670 SPECT/CT: Fast Mode



Maximum Count Rate:

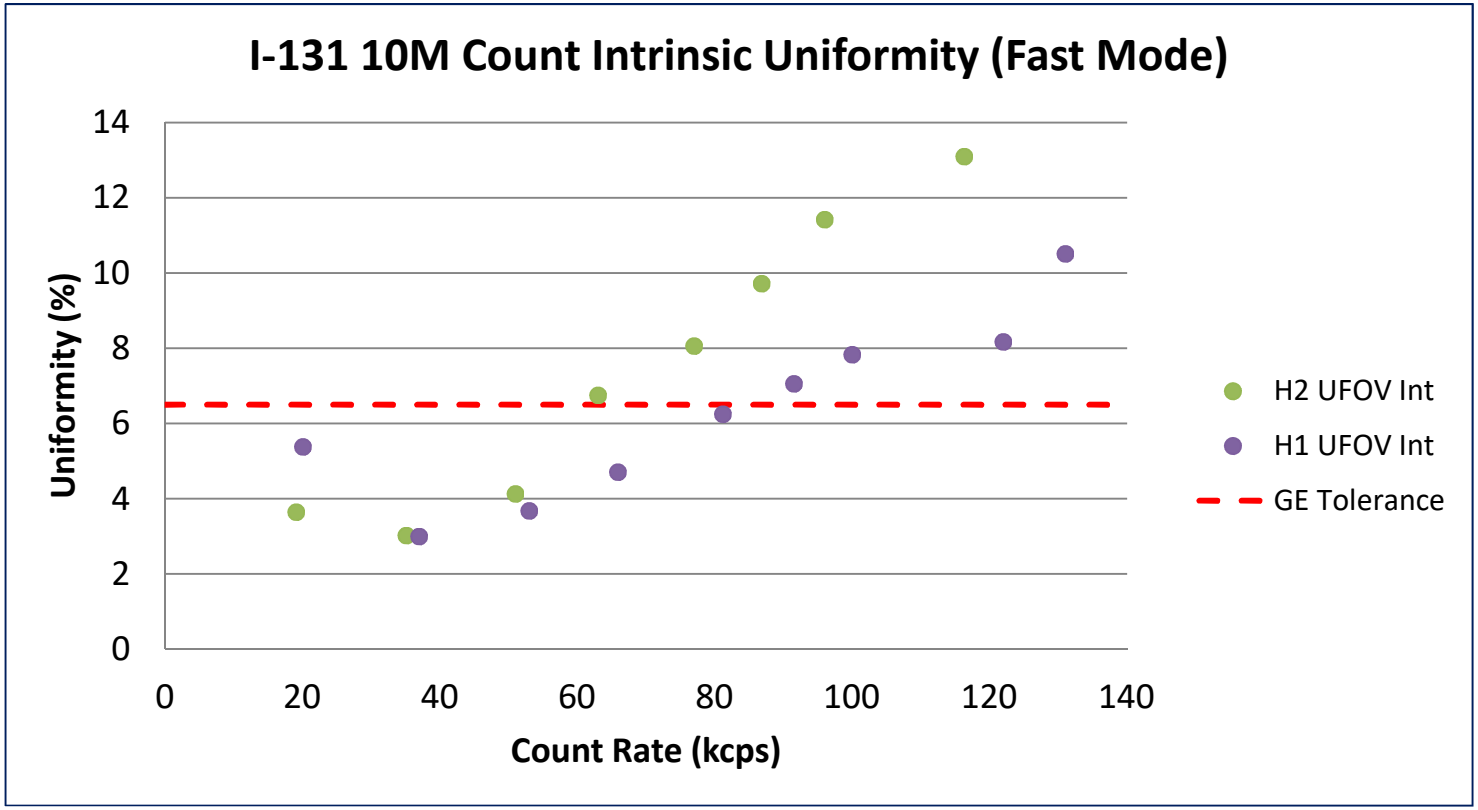
97 kcts/s at 12.1 GBq

Apply Correction Factor to every pixel in each projection


Fast Mode vs Normal Mode
Count Rate (kcts/s)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
2000
4000
6000
8000
10000
12000
14000
Activity (MBq)
H1 Fast Mode
H1 Normal Mode

	Photopeak 364 keV ± 10%	Upper Scatter 413 keV ± 3%	Lower Scatter 318 keV ± 3%
100 MBq			
1000 MBq			
3000 MBq			
5000 MBq			
8000 MBq			
12000 MBq			

Uniformity with Count Rate



- GE Tolerance for UFOV Integral 10M count Intrinsic Uniformity (6.5%) exceeded at approximately 60 kcps (H2)
- Equivalent to approximately 4 GBq in FOV (Extrinsic)

Patient Images

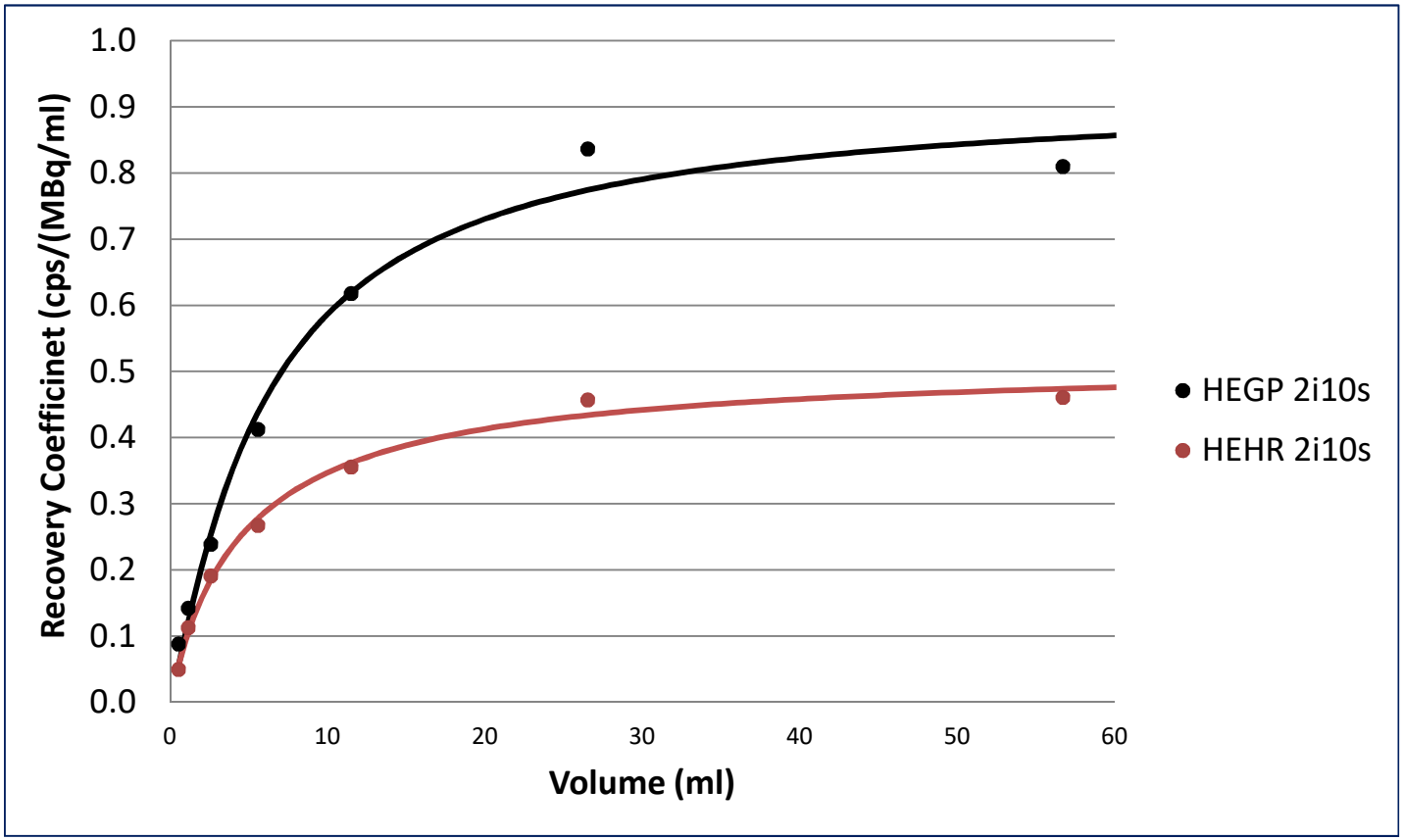
- Patient administered with 20 GBq
- Scan 24 hrs post administration: 6 GBq WB retention
- Average SPECT projection count rate of 62 kcts/s, indicating approximately 4 GBq in FOV
    - Dead time correction factor for 62 kcts/s = 1.31

Imaging Protocol

- Aim to perform first scan at 24 hrs
- Estimate WB retained activity
- For activity <2 GBq ⟶ **Use Normal Mode** with dead time and TEW scatter correction
- For activity 2-6 GBq ⟶ **Use Fast Mode** with dead time correction but no scatter correction
- For activity > 6 GBq ⟶ **Delay scan**

High Energy High Resolution (HEHR) Collimators

- Design prioritises resolution over sensitivity



Further work

- Investigate HEHR collimators
- Feedback to GE on scatter windows
- Alternative scatter correction method

Conclusion

- GE Fast mode allows quantitative imaging of high I-131 activities and count rates
- Uniformity becomes poorer with higher count rate