Renogram Processing
The Manchester Method

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The Manchester Method

- Renogram processing
  - Optimised background subtraction
    Rutland method is preferred

- Renogram display
  - Curves normalised to administered activity
    To get an idea of absolute function
  - Using consistent display parameters
    To aid serial comparison of studies

- ‘ManRen’
  - Manchester Renogram processing program
    Incorporates these features
Optimum Background Subtraction
Renogram Curves

• Raw kidney ROI curve has three components
  • Tissue background, blood background & kidney activity,

• Two background components to be subtracted
  • Difficult to achieve with single ROI

• After correct subtraction curve should rise from origin
  • Because kidney activity must start from zero
The Rutland Method *

• Two background ROIs
  • Tissue background
    Subtracted in proportion to size of ROI
  • Vascular background
    Subtraction factor calculated individually for each kidney
    Using the Rutland Plot

• Advantages
  • Deals well with kidneys with different vascularity
  • Robust and reliable

• Recommended by ISCORN Consensus Report

Background below kidney

Relative function
Left kidney: 76%
Right kidney: 24%

Right kidney under-subtracted
 stil some vascular background present)

Relative function over-estimated
Background above kidney

Relative function
Left kidney: 84%
Right kidney: 16%

Right kidney over-subtracted
(too much vascular background subtracted)

Relative function under-estimated
Peri-renal background

Relative function
Left kidney: 85%
Right kidney: 15%

Right kidney over-subtracted
(too much vascular background subtracted)

Relative function under-estimated
Rutland Method

Relative function

Left kidney: 81%
Right kidney: 19%

Both kidneys correct subtraction
Relative function correct
The Importance of Good Renogram Display
Serial Renograms

Previous renogram

Current renogram

Question 1 Has kidney function changed since previous renogram?
1=No change, 2=Got worse, 3=Got better, 4=Can’t tell

Answer: Can’t tell

Half cps could be change from 100 MBq to 50 MBq dose
or change from LEHS to LEGP collimator
Scale Uptake to Percent Dose

Percent uptake normalises kidney counts to administered activity
Allows for:

- Different administered activities
- Different collimators
- Different gamma camera
More Serial Renograms

Question 2: Has function of left kidney changed since previous?
1=No change,  2=Got worse,  3=Got better,  4=Can’t tell

Answer: No change – still 3% at 3 minutes
Confused by change of vertical scale
Computer has scaled each display to maximum in both curves
• Fixed maximum for vertical scale makes comparison of two studies easier
  • We use 15% of dose because normal MAG3 fits easily within this
  • Can see at a glance that these kidneys have poor uptake compared with normal
Another Patient

Previous renogram

Current renogram

Question 3: Has emptying of left kidney changed?
1=No change, 2=Got worse, 3=Got better, 4=Can’t tell

Answer: No change – still peaks at 2½ minutes
Change of horizontal scale has changed shape of peak
Computer has scaled each display to duration of study
Standardise Horizontal Scale

- Use standard scales for all renograms
  40 min is longest of any of our renograms
  - Makes serial comparison easy
  - Makes comparison with ‘normal’ pattern easy
ISCORN Recommendations *

• ISCORN Consensus Report recommends
  • Curves displayed as cps
  • Y axis should be scaled to highest peak count

• But changing Y axis each time is confusing

• And cps give no idea of absolute function
  • Because cps depends on dose and collimator

• Conversion from cps to percent uptake gives a measure of absolute function
  • Percent uptake will correlate with renal clearance
    eg GFR or ERPF

• So how do we calculate percent uptake . . . .

Calculating Percent Uptake

% Uptake = \frac{\text{Kidney cps}}{\text{Dose cps}} \times 100\%

\text{Dose cps} = \text{Administered activity (MBq)} \times \text{Decay factor} \times \text{Sensitivity (cps/MBq)}

- **Administered activity**
  - Measure each patient dose in isotope calibrator

- **Decay factor**
  - Calculated from time between dose measurement and patient injection

- **System sensitivity**
  - Measured once for each camera & collimator used
Sensitivity Measurement

- Known activity in saline bag
  - approx 2 MBq
- In bowl of water
  - 7.5 cm below surface
- Acquire 1 min image
  - with gamma camera
- Draw ROI round bag
  - as for kidney
- Draw background ROI
  - as for kidney background
- Calculate net counts
  - after background subtraction
- Calculate sensitivity
  - cps/MBq at 7.5cm depth
Allowing for Kidney Depth

- This standard sensitivity measurement assumes both kidneys lie at 7.5cm depth
  - This is adequate for most adults

- For children kidneys are not so deep
  - Estimate kidney depth based on child’s weight *
  - Increase sensitivity by 12% per cm less depth

- Can easily use any other formula for kidney depth
  - Or enter measured depths for each kidney

‘ManRen’ Program Display

- Rutland background method
- Regions & curves in same colour
- Fixed vertical scale
- Percent dose not cps
- Summed 5min images
- Functional results
- Processing parameters
- Fixed time scale

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Conclusion

• In Manchester we believe that all these features are an aid to correct interpretation of the renogram
  • We have been using them for over 20 years

• ISCORN recommendations recognise the advantage of the Rutland method for background subtraction
  • But contradicts the Manchester display method

• We believe that display using percent uptake rather than cps gives an indication of absolute function
  • Using fixed axes makes serial comparison easier

• ‘ManRen’ is an in-house Aladdin program that runs on GE Xeleris computers
  • It incorporates all these features
  • Used by several hospitals in the UK