What does Nuclear medicine contribute to Nephrourology?

Katharine Halliday
Queen’s Medical Centre

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Questions

- Function?
- Pyelonephritis?
- Scarring?
- Reflux?
- Obstruction?
- Is the transplant perfused?
DMSA

- $^{99}$Tc-Dimercaptosuccinic acid
- Cortical imaging agent
- ~40% retained by renal tubules
- Protein bound, filtered by glomerulus proximal tubule mediated endocytosis
- Depends on blood flow, GFR, endocytosis
- Image at 2-4 hours, no sedation necessary
Function

LT KIDNEY = 55624
50.3%

RT KIDNEY = 54935
49.7%
Acute pyelonephritis
CT - Pyelonephritis

- As good as DMSA in piglets\(^1\)
- IV contrast
- Radiation dose

\(^1\)Majd Radiology 2001
MRI - Pyelonephritis

- As good as DMSA (Gd enhanced)
- No radiation
- Sedation/GA
Pyelonephritis and Scars

- Permanent defects only develop in abnormal areas on the acute scan
- Approx 50% defects remain
- No need to follow up isolated lower tract infections
DMSA scarring

• Good interobserver agreement

• Not infallible
Mag 3

• Mag 3 excreted by both filtration and tubular secretion
• 40-50% extraction
• Better images in babies and patients with poor renal function
• Wait until 3 months
Indirect Radionuclide Cystography

- Need potty trained cooperative child
- No catheterisation
- Less accurate at detecting reflux (only during voiding)
- Useful in older children
Direct radionuclide cystography

- Need catheterisation/abdominal puncture
- Sensitivity high
- No anatomical information
  - Urethra
  - Intrarenal reflux
- Low dose
  - Less of an issue with modern equipment
Function estimate

- Early part of the curve
- Before significant excretion
- Agrees with DMSA
- Can be affected by frusemide
Pelvi-ureteric junction obstruction

- Flank pain and hydronephrosis
- Failure of peristaltic wave to pass into proximal ureter
- 50% aberrant vessel
- Histology poor musculature, increased collagen
12 yo boy
Antenatal Dilatation

- 1-3% of all pregnancies
- Major workload and management issues
Pelvicalyceal dilatation—PUJ obstruction?

- Pathology similar at PUJ
- Only 11% (v 50%) crossing vessel
- 104 children with dilatation and good function 4 developed pain with fluid load

1Dhillon BJU 1998  2Hanna Urology 2000
Is this the same condition?

- In some cases
- Natural history frequently benign
- Initial enthusiasm for surgery has waned
Postnatal US

- Relative dehydration after birth can lead to significant underestimation of hydronephrosis
- Some conditions need urgent treatment
May be due to reflux

- All dilatation may be secondary to reflux
- Cannot exclude reflux with US
- If intend to treat then need MCUG
How to identify those who will deteriorate

- No clear definition of obstruction
- Loss of function
- Recurrent UTI
- Loin pain
Who needs diuretic renography?

- Risks of pyeloplasty increase with increasing AP diameter
  - 15-20mm 7%
  - 30-40mm 61%
  - 50mm 100%

Dhillon 1998
Calyceal dilatation

- Probably greater significance than pelvic diameter
- Extrarenal pelvis can be dilated with normal intrarenal pelvis
- Do not follow up unless present
Mild  Moderate
Diuretic renography

Renal pelvis > 1 cm at hilum, prone image
Frusemide

- F-15  Radionuclide arrives in renal pelvis at time of maximum diuresis
- F0 similar results and easy in children
- Can interfere with function estimation
- F20
  - may not need to give diuretic
  - More equivocal results
  - May miss flow dependent obstruction

Turkolmez Clin Nuc Med 2004
Obstruction and renography

• T1/2

• Depends on renal blood flow and function, affected by state of hydration, size of renal pelvis
Obstruction and renography

- Output Efficiency
- Pelvic Extraction Efficiency
- Normalised Renal Activity
- All measure out as proportion of in, affected less by differences in function
5/12 boy

4cm
L=64%  
R= 36%
L = 98% OE R = 42%
Other factors affecting drainage

- Size of collecting system
- Full bladder
- Gravity
- Post micturition view
2/12 boy

2.5cm
Can express residual function at 60 mins as a percentage of maximum

Is this a better method to differentiate between sluggish and obstructed flow?

Initial results pre and post pyeloplasty suggest this is a promising assessment.
L=76%  
R=92%
13/12

L = 53%
R = 47%
L=54%  R=48%
Post natal scan 4/52
UTI
19/12