

Renal Cortical Scintigraphy

DMSA scan

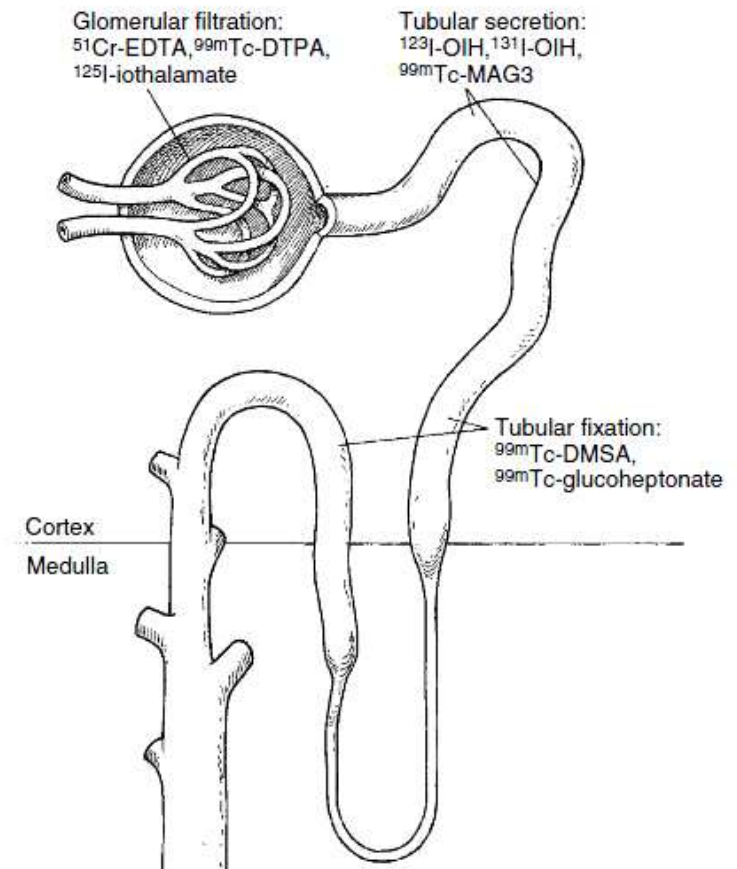
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Nuclear Medicine in Urology

Glomerular filtration: ^{99m}Tc DTPA (80%), ^{99m}Tc Mag3, ^{123}I OIH or ^{131}I OIH

Tubular secretion: ^{99m}Tc DTPA (20%), ^{99m}Tc Mag3 or ^{131}I OIH

Tubular Retention: ^{99m}Tc GH and ^{99m}Tc DMSA



In the past few years

	DMSA	SPECT DMSA
2008	203	0
2009	200	0
2010	160	0
2011	188	3
2012	214	4
2013	196	4
2014	320	1
2015	232	0
2016	237	0
2017	244	1

Renal cortical agents

They are mainly bound in the proximal tube in the renal cortex for a prolonged time after injection and are suitable for static renal imaging to demonstrate renal mass or defects in the renal parenchyma.

DMSA

30/40% of
renal
parenchyma
retention

GH

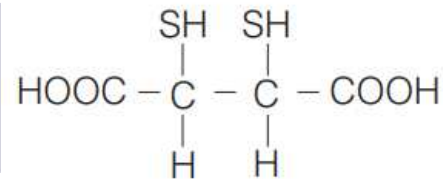
5/10% of
renal
parenchyma
retention

^{99m}Tc -DMSA (Dimercaptosuccinic acid)

Physical characteristics

- decays by isomeric transition
- physical half-life of 6.02hr

DMSA Structural formula



Clinical pharmacology

- Distributes in plasma, bounded to plasma proteins;
- Activity in red cells is negligible;
- Activity is cleared from plasma with a half time of 60 min and concentrates in the renal cortex;
- 40% activity uptake in the kidneys 1 hour pi;
- Approximately 16% of the activity is excreted in the urine within two hours;
- At six hours about 20% if the dose is concentrated in each kidney.

Clinical Indications

- Detection of focal renal parenchymal abnormalities;
 - Acute pyelonephritis;
 - Detection of scarring;
 - UTI in paediatrics;
- Differential renal function estimation;
- Assessment of horseshoe, solitary or ectopic kidney;
- Localization of the poor or very poor functioning kidney;
- Detection of residual functioning renal tissue following direct trauma;
- Assessment of renal function in the presence of an abdominal mass.

Preparation for the scan

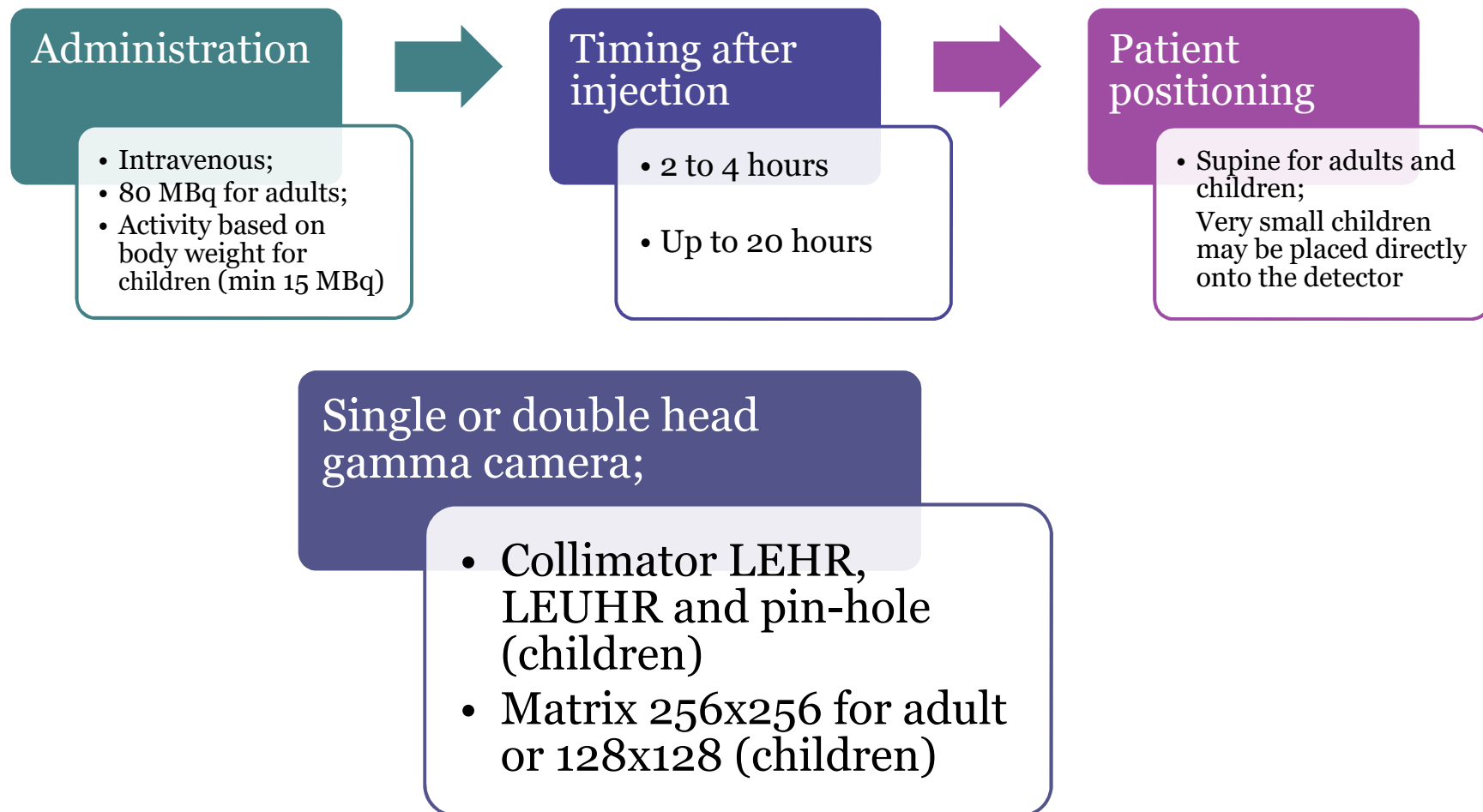
All relevant available clinical, biochemical and imaging information should be collected.

Good hydration before and after radiopharmaceutical

Study explained to the patient and verbal consent acquired.

Childbearing age female patients should be checked for possible pregnancy

Protocol/Image Acquisition



Protocol/Image Acquisition

Views:

Adults

Posterior 300-500
kcounts
RPO and LPO 150-
200 kcounts

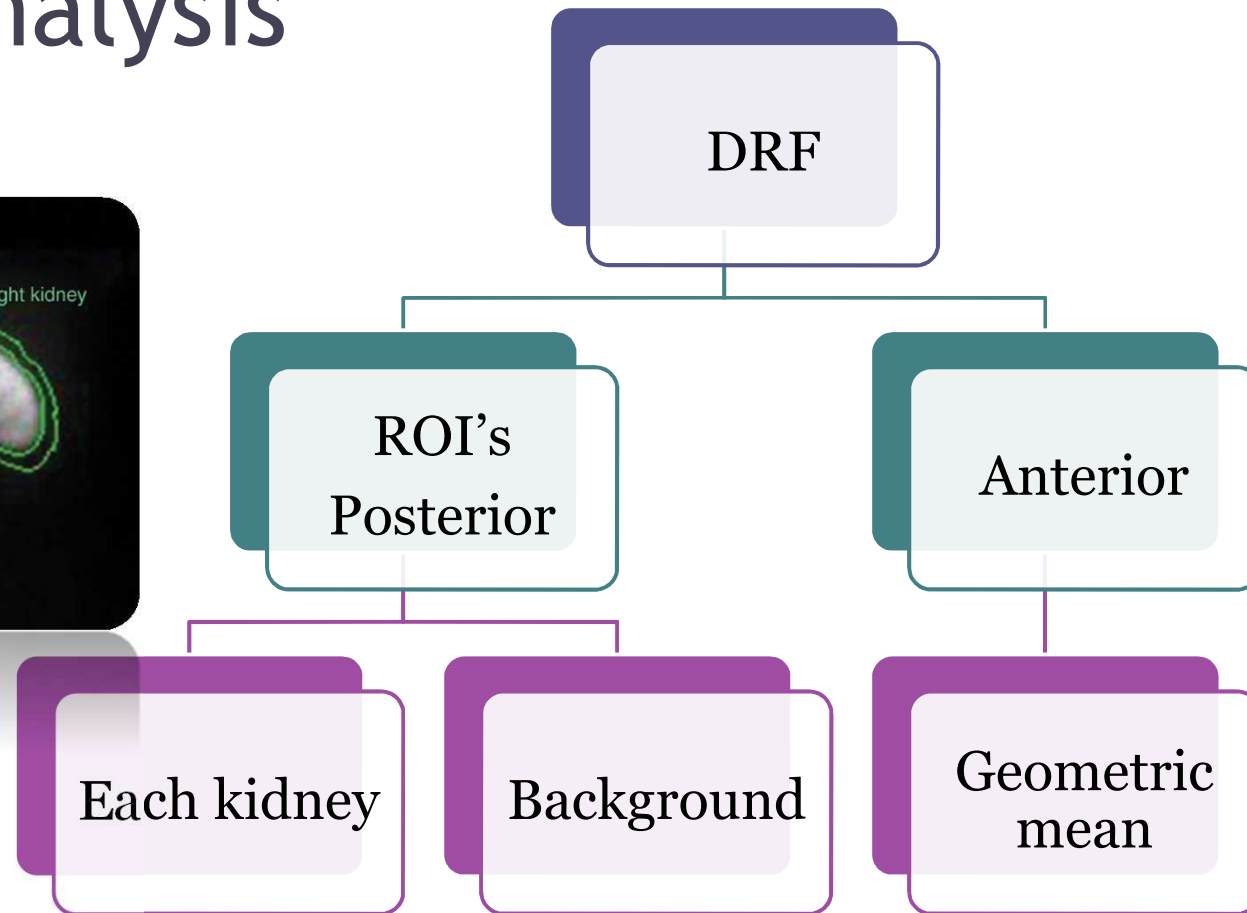
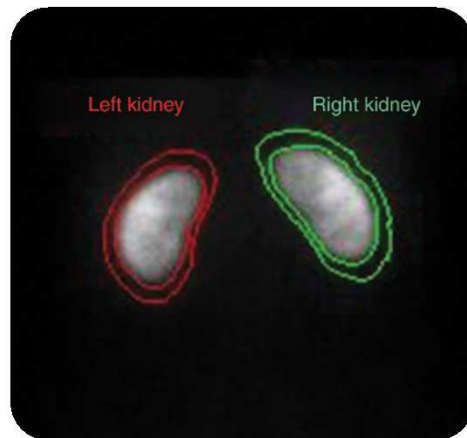
Anterior should be
acquired whenever
possible

Paeds

Posterior
RPO and LPO

Anterior should be
acquired in case of
horseshoe or
ectopic pelvic
kidney

Data Analysis



$$\text{geometric mean} = \left(\prod_{n=1}^k x_n \right)^{\frac{1}{k}}$$

Why not SPECT?

Planar vs SPECT

De Sadeleer et al. 1996

^{99m}Tc -DMSA SPECT in normal volunteers

10 adults (19-25 years old) 5 men 5 woman underwent planar and SPECT imaging

No abnormalities could be found on the planar images. However, SPECT revealed, in seven kidneys the presence of a hypoactive upper pole

Because of the heterogeneous configuration of the cortical structures of the kidney SPECT could bring some reporting errors if normal anatomical variants are not recognized

Planar vs SPECT

Majd et al 1996

Pathologic and Image Findings Urine	Pos.	SPECT		
		Neg.	Pos.	Neg.
Positive (20)	18	5*	49	2*
Negative (4)	0	20	1	20
Sensitivity			96%	
Overall accuracy			95%	96%

*One was the same kidney. Pos. = positive; Neg. = negative

Although the sensitivity of the SPECT for the detection of acute pyelonephritis is slightly better than the pinhole, the overall accuracy of these two techniques is essentially the same.

Planar vs SPECT

Brenner et al 2008

Compared planar parallel-hole cortical scintigraphy and dual-head SPECT for detection of cortical defects.

^{99m}Tc-DMSA renal cortical imaging using dual-head SPECT offers no statistically significant diagnostic advantage over planar imaging for detection of cortical defects.

No significant difference was seen in the average number of abnormal segments detected by planar versus SPECT imaging

Planar vs SPECT

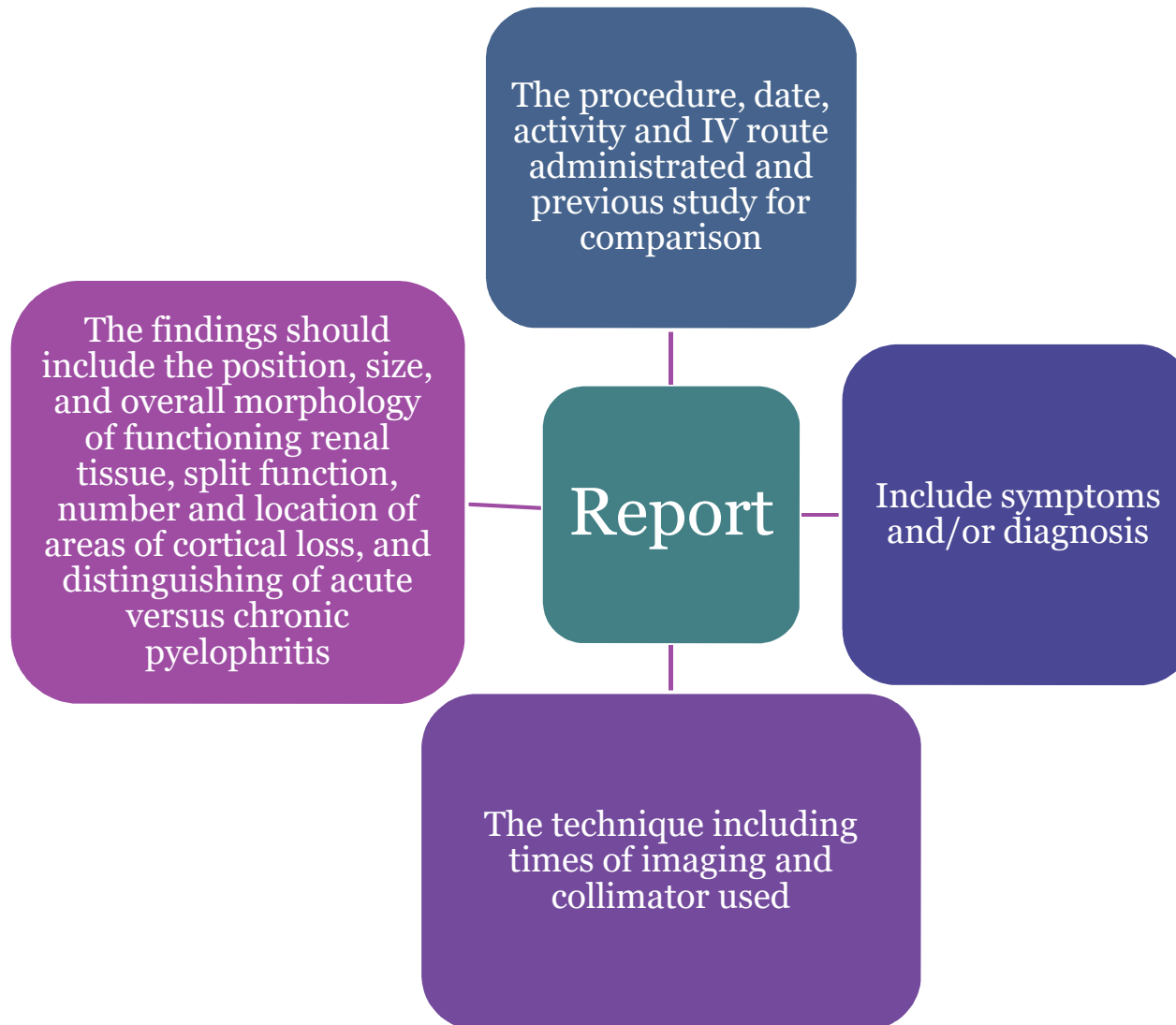
Farghaly and Sayed 2015

This study compared planar parallel-hole cortical scintigraphy and dual-head SPECT for detection of cortical defects.

Tc-99m DMSA renal cortical scanning using SPECT offers no statistically significant diagnostic advantage over multiple view planar imaging for detection of cortical defect.

From 200 DMSA scans, 100 scans were positive for scar in SPECT images, from which only 95 scans were positive for scar in planar imaging. Out of the five mismatched scans, three scans were for patients with renal impairment and high background activity and two scans were for very small scars. No significant difference was seen in the average number of abnormal segments detected by planar versus SPECT imaging.

Interpretation/Reporting



Interpretation/Reporting

- **Normal variants**

- The renal outline can be flat without suggesting a lesion;
- The lateral aspect of the upper portion of the left kidney can be flattened (splenic impression);
- A kidney may have a triangular shape, with flattened external sides;
- The transverse axis can sometimes be shorter at one pole than at the other thus giving the impression of a 'pear-shaped' kidney;
- One or both poles can sometimes show relatively reduced uptake simply because of the contrast between the hyperactive columns of Bertin in the mid-portion of the kidney and the poles;
- The number and size of the column of Bertin vary from patient from patient (variable thickness of the cortex), this may cause false interpretation of the images;
- The presence of fetal lobulation in the lateral aspect of the kidney should not be interpreted as a scar;
- The slender kidney, with a short transverse axis in the posterior view: this is often a rotated kidney.

- **Abnormal patterns:**

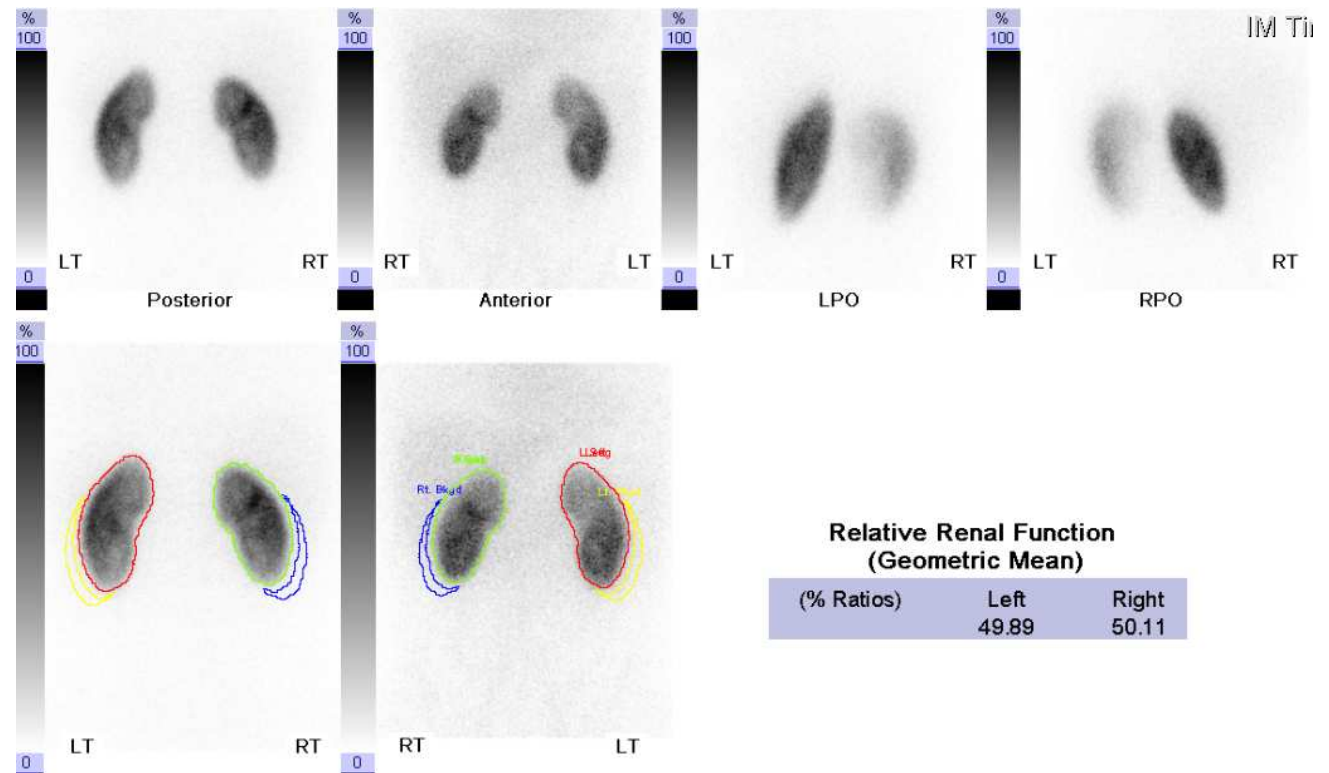
- The number, size and location of areas of cortical loss should be noted;
- Differentiation between acute lesions is not always possible
- A large polar hypoactive area, without deformity of the outlines and with indistinct margins will generally heal; marked localized deformity of the outlines or deformed outlines generally corresponds to permanent sequelae.
- Renal sequelae should anyway be best estimated on a DMSA scintigraphy performed at least 6 months after acute infection

Interesting cases

Question: Potential living donor

Patient: male adult 30-40 years old

Findings: Both kidneys are normal in size and contour. Relative split renal function: Right kidney 50%, left kidney 50%.



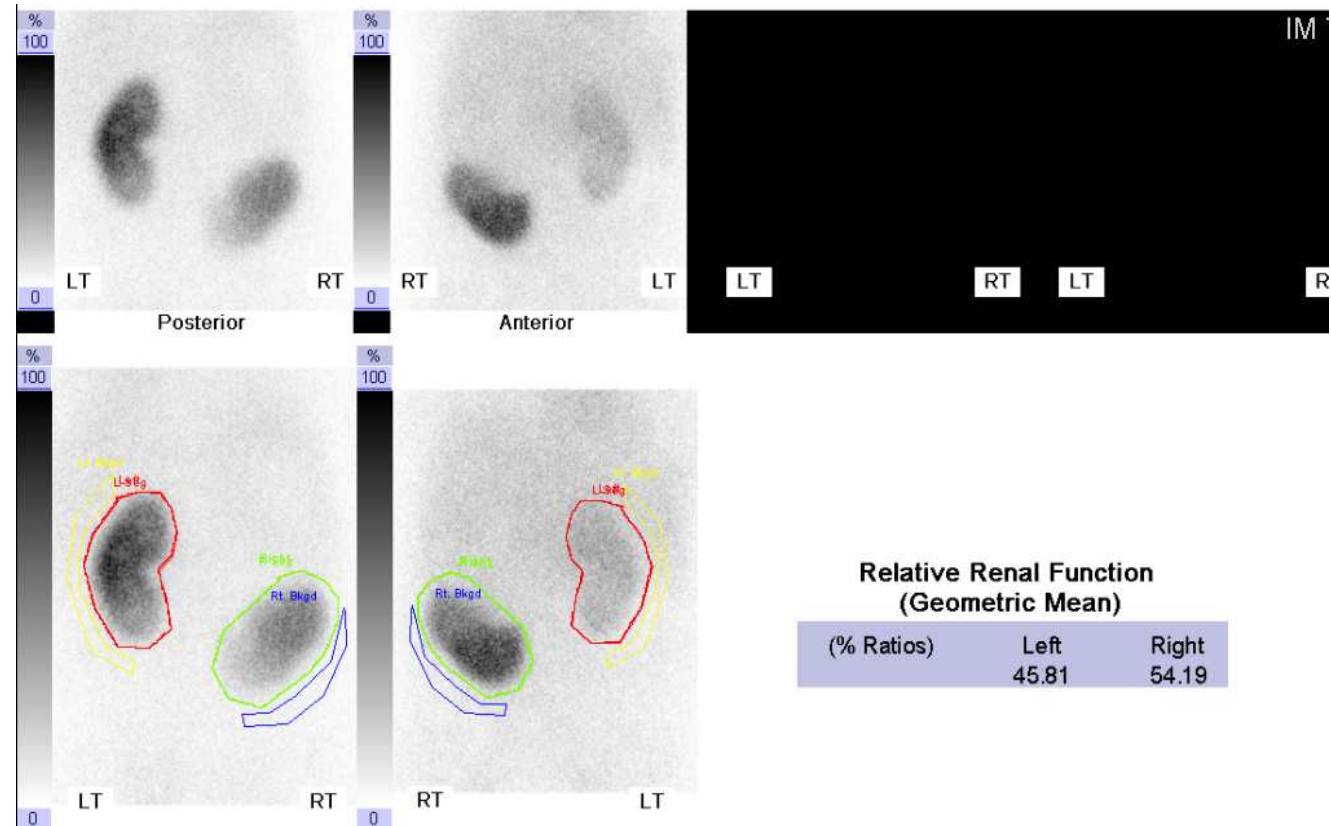
Interesting cases

Question: scheduled for right adrenalectomy +/- nephrectomy, please check left kidney function

Patient: female adult 30-40 years old

Findings: Normal outline of left kidney. Right kidney is displaced by the suprarenal mass but has normal outline.

Right Kidney - 54%
Left Kidney - 46%



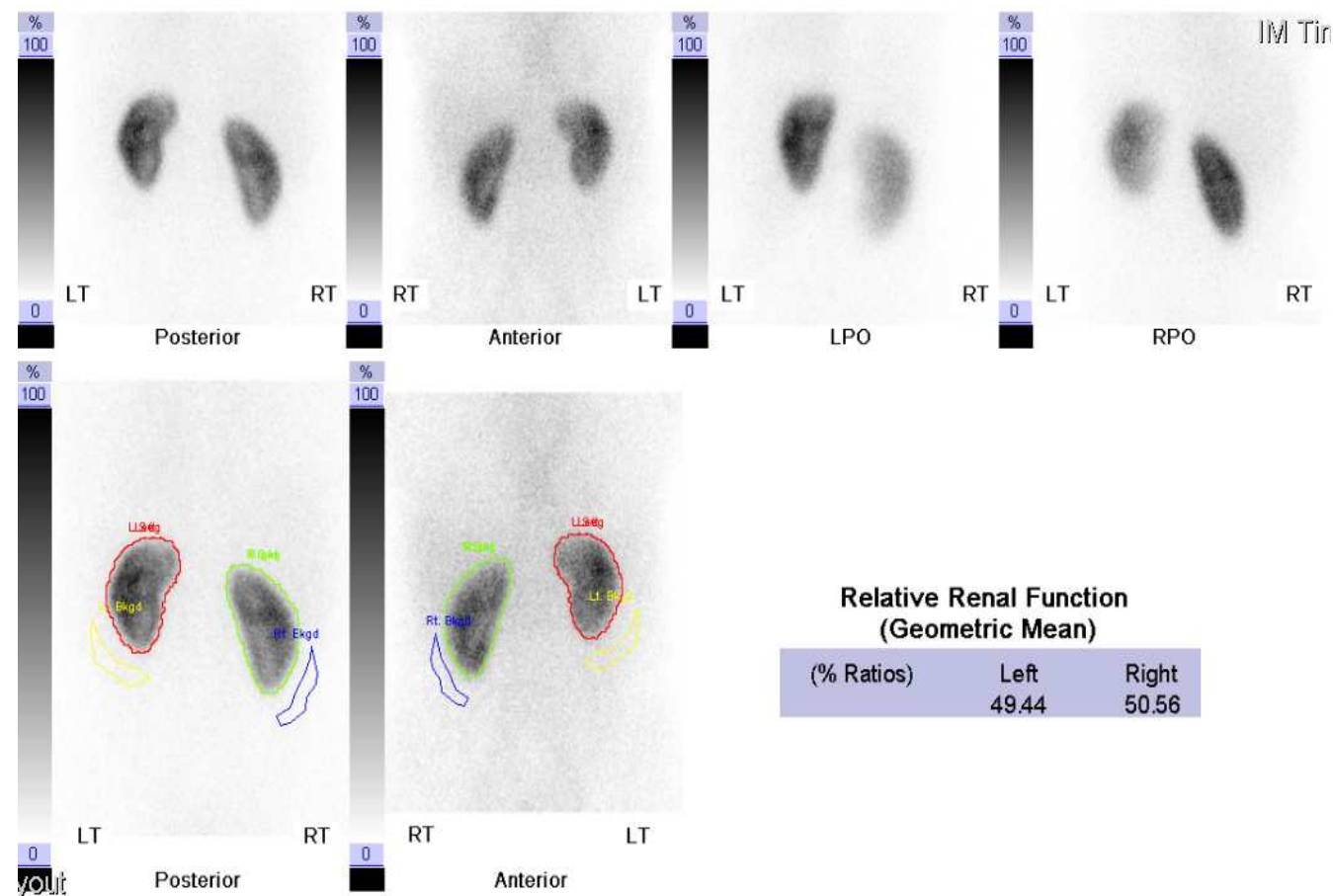
Interesting cases

Question: Previous Ct suggestive of acute infarcts but likely appearance secondary to bacteriologically proven pyelonephritis

Patient: female adult 60-70 years old

Findings: There is focal loss of functioning renal cortex within the upper pole of the left kidney suggestive of focal scarring in the upper pole. Both kidneys otherwise demonstrate normal contour.

Relative split renal function:
Right 51%, left 49%



Interesting cases

Question: Incidental finding of Left lower pole RCC
Possibly due for nephrectomy, is there equal function?

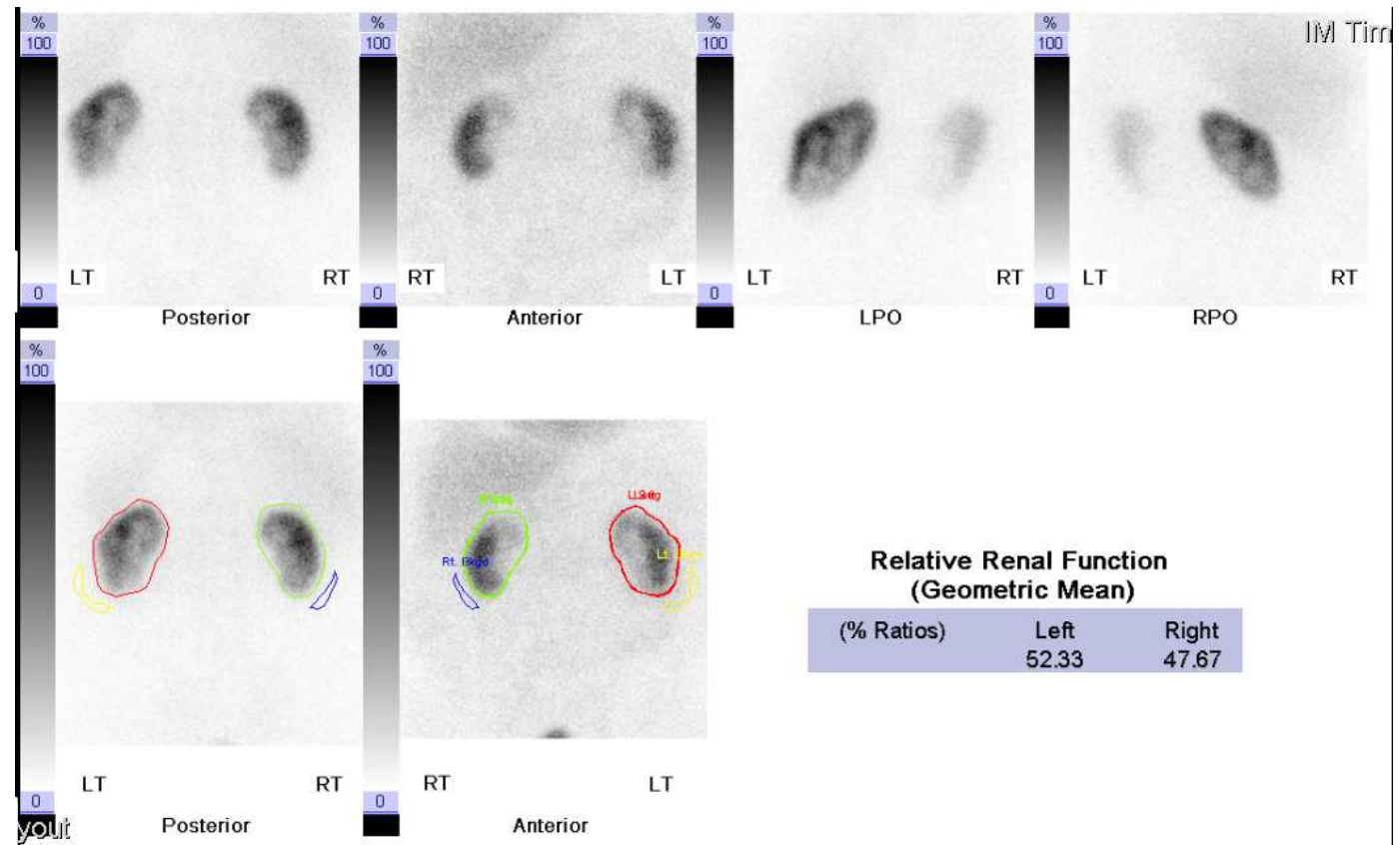
Patient: male adult 80-90 years old

Findings:

Left Kidney: There is reduced tracer uptake in the lower pole of the left kidney.

Right Kidney: Slightly smaller than the left. Normal in shape and outline.

Differential renal function: Left 52%, Right 48%



Interesting cases

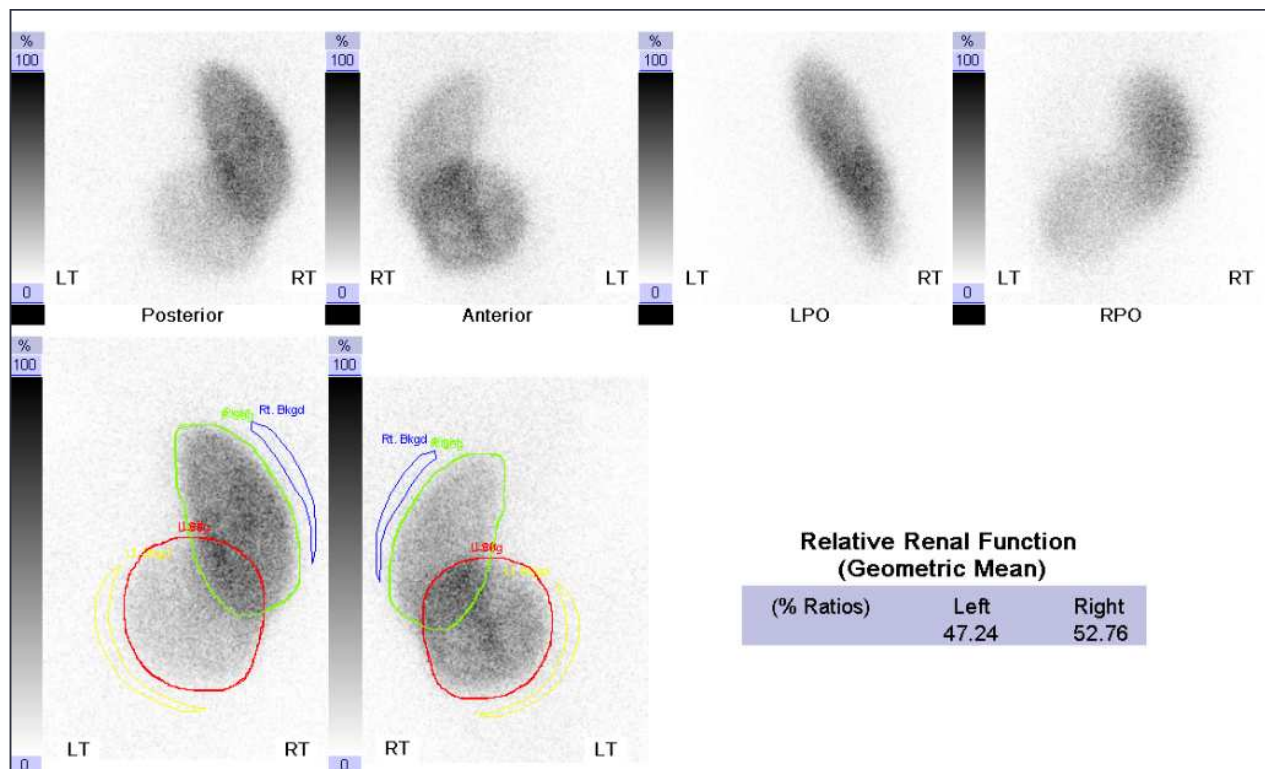
Paediatrics

Clinical details and question: Primary enuresis. Previous USS showed LT kidney on the RT side

Findings:

There is crossed fused ectopia; the left kidney is abnormally rounded in shape and in an ectopic position - located predominantly in the midline, partially fused with lower pole of the right kidney. The right kidney is in a normal position in the right flank;

Uptake figures inaccurate;
No evidence of scarring.



Interesting cases

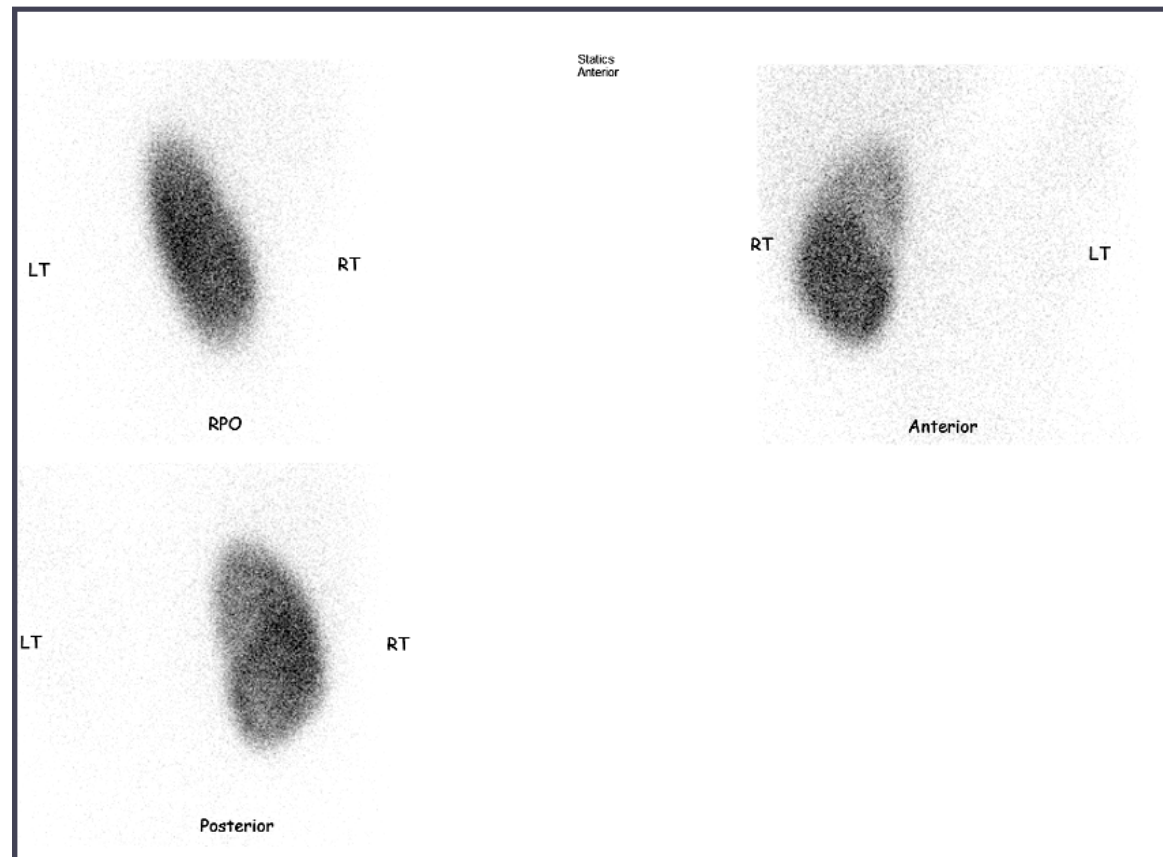
Paediatrics

Clinical details and question:
Xanthogranulomatous
pyelonephritis with staghorn
eroded through parenchyma and
urinoma in the flanks. If no renal
function will need nephrectomy.

Findings:

There is no left renal
function.

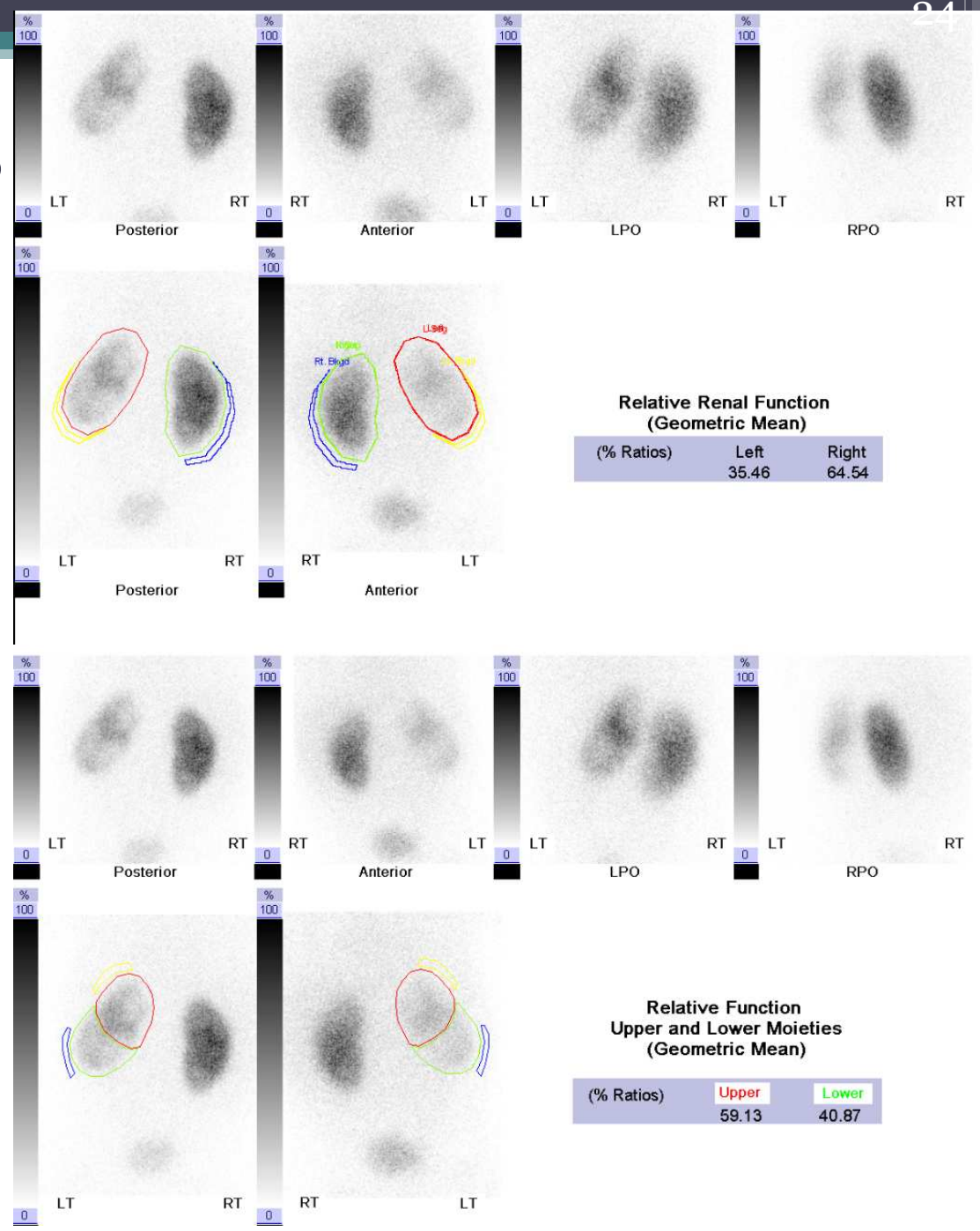
There is normal uptake in the
right kidney, with no evidence
of focal scarring



Interesting cases Paediatrics

Clinical details and question: Lt duplex with hydro ureter. Need to assess function and split.

Findings:
Relative function left 35.5% right 64.5%.
Duplex left kidney upper moiety 59.1% lower 40.9%
There are photopenic areas of the left kidney. Some scarring in the right lower pole

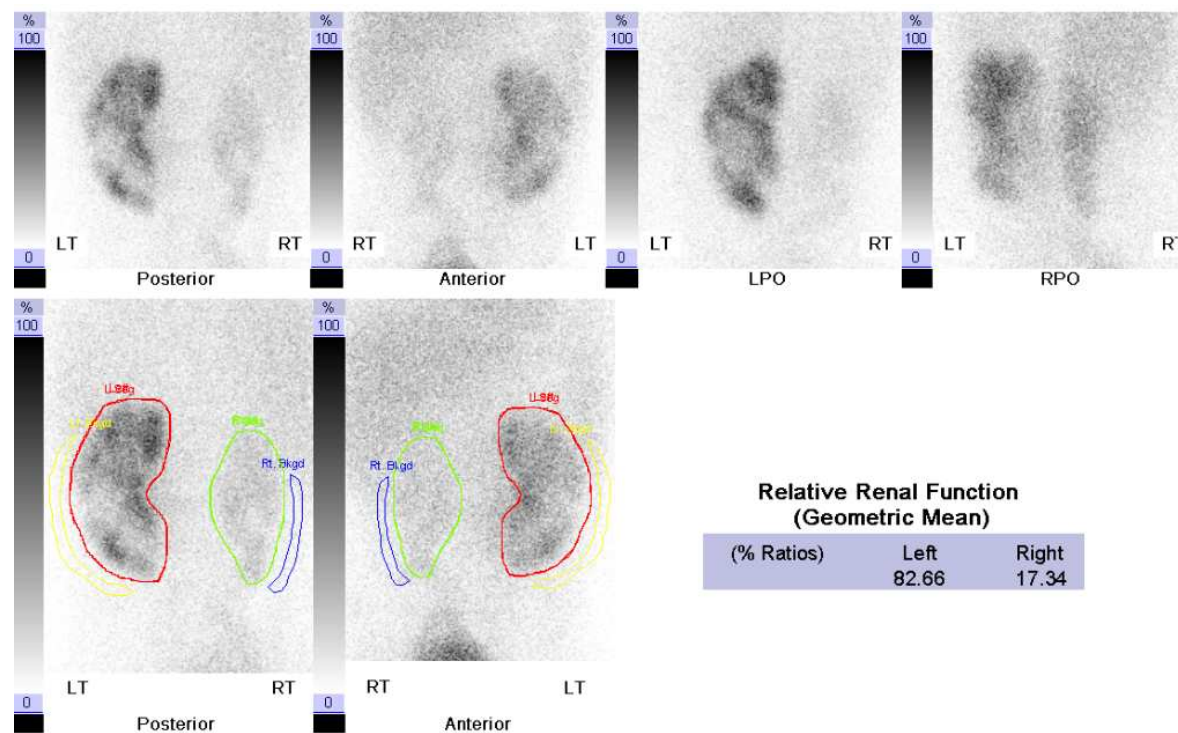


Interesting cases

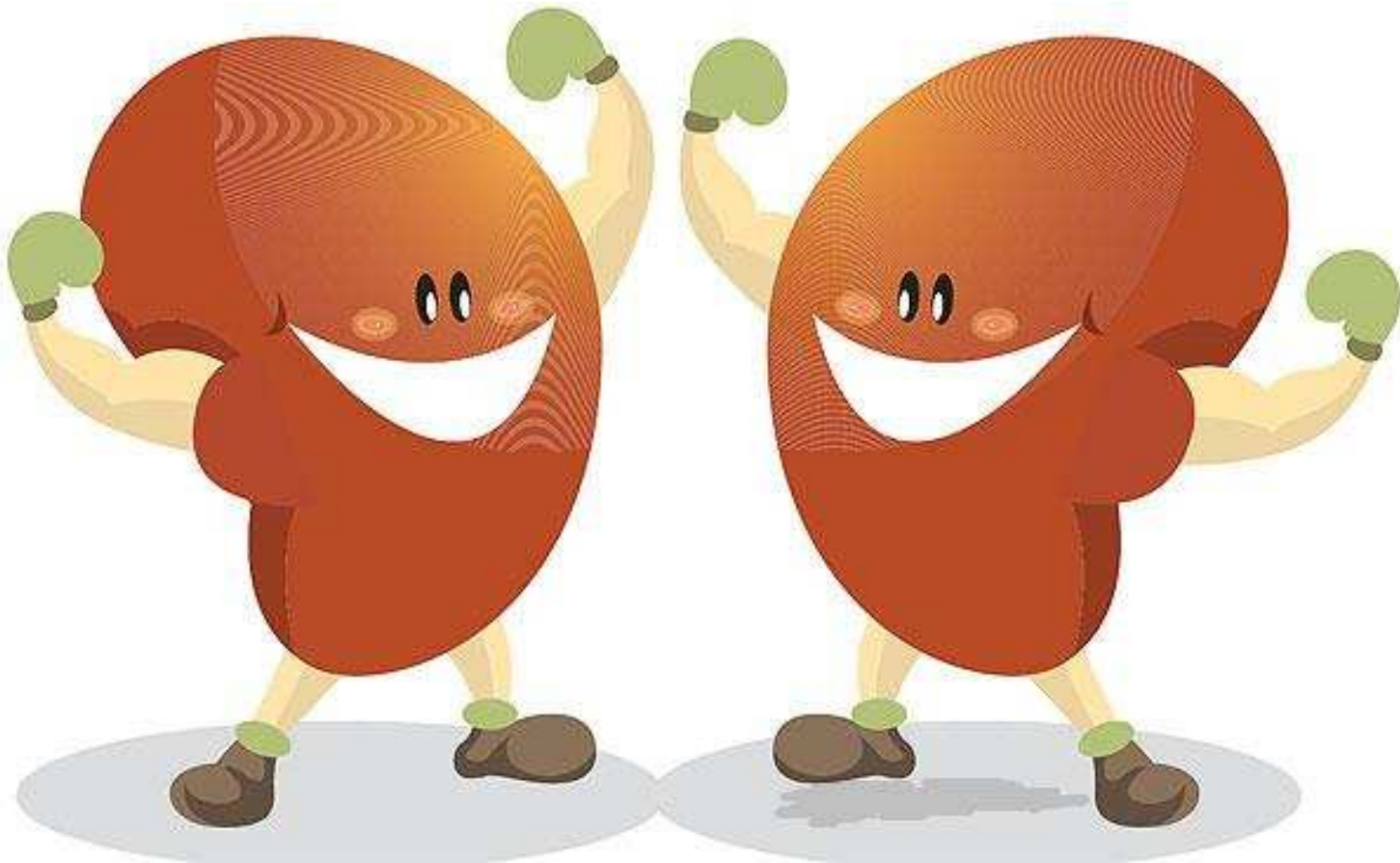
Paediatrics

Clinical details and question: Spina bifida (thoracolumbar). Recurrent UTI. Right hydronephrosis. ? Scarring

Findings:
Relative function left 83%
right 17%
Significant bilateral scarring. Small irregular right kidney.



Thank you for your attention!



References

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