Worcestershire Acute Hospitals NHS Trust

Renal Investigations (PIP)

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The following guidance is taken from the Partners In Paediatrics (PIP)

RENAL INVESTIGATIONS

PROTEIN EXCRETION

- As a diagnostic indicator in any child thought to have an underlying renal disorder
- To monitor progress in renal disorders
- Normally glomerular, rarely tubular in origin
- Investigate as below in patients with persistent proteinuria where cause is unknown
- Request protein:creatinine ratio (**must** be first urine specimen voided in the morning)

Protein:creatinine ratio

- Performed on first urine specimen voided in the morning
- Upper limit of normal 20 mg/mmol
- Significant proteinuria >100 mg/mmol
- Heavy proteinuria (nephrotic) >200 mg/mmol

Albumin:creatinine ratio

- Request albumin:creatinine ratio if need to confirm glomerular proteinuria

Timed urine collection

- Only appropriate for older patients (out of nappies)
- Night-time collection to rule out orthostatic proteinuria
  - empty bladder at bedtime and discard sample
  - collect all urine passed during the night
  - empty bladder on rising in morning and collect urine
  - record time from bladder emptying at night to bladder emptying in morning
- Calculate protein output as mg/m^2/hr (see **BNFc** for surface area)
- Upper limit of normal = 2.5 mg/m^2/hr
- Heavy proteinuria >40 mg/m^2/hr

Tubular proteinuria

- Request retinol binding protein (RBP):creatinine ratio, elevation confirms tubular proteinuria

OSMOLALITY

- Used to exclude urinary concentrating disorders
  - patients with polyuria (may present as wetting or excessive drinking)
- Test early morning urine after overnight fast, >870 mOsm/kg virtually excludes a concentrating defect
  - if concern re diabetes insipidus, do water deprivation test during the day

SODIUM EXCRETION

- Fractional sodium excretion (FE_{Na}) assesses capacity to retain sodium
  - ensure normal sodium intake (dietitian to advise)
  - stop any existing supplements 6 hr before taking samples
  - document weight loss after supplements stopped, may provide useful supporting evidence
  - random urine sample for urinary sodium (UNa) and creatinine (UCr)
  - blood sample immediately after voiding for plasma sodium (PNa) and creatinine (PCr)
  - enter results into equation (using same units for U and P; 1000 micromol = 1 mmol)
  - $$FENa = \frac{UNa \cdot PCr}{PNa \cdot UCr} \times 100$$
  - normal values for FENa aged 0–3 months <3
    aged >3 months <1

PLASMA CREATININE

- Mean and upper limit dependent on height but can be determined roughly from child's age if height not available

GLOMERULAR FILTRATION RATE (GFR)

- Serial measurements of GFR (in mL/min/1.73 m^2) predict rate of deterioration when renal function impaired

Table 1

Age	Mean GFR (mL/min/1.73 m^2)	Range (2 SD)
Up to 1 month	48	28–68
1–6 months	77	41–103
6–12 months	103	49–157
1–2 yr	127	63–191
2–12 yr	127	89–165

Plasma creatinine method

- Estimates GFR in children with reasonable accuracy from P_{Cr} and height, using following formula:

$$\text{GFR (mL/min/1.73 m}^2\text{)} = \frac{30^* \times \text{height (cm)}}{P_{Cr}\ (\mu\text{mol/L})}$$

*check local laboratory method of creatinine measurement as constant may vary

- Not suitable for children:
  - aged <3 yr
  - with muscle disease/wasting

^{51}Cr-EDTA slope clearance

- Use only when GFR needs to be determined very accurately
- Request via nuclear medicine
- Provide height and weight of child
  - 'correct' result for surface area and express as per 1.73 m^2
  - if result expressed as mL/min 'correct' for surface area

ULTRASOUND

Indications

- To indentify structural abnormalities of urinary tract or to monitor growth (e.g. in a child with a solitary kidney)

Table 2: Normal values for renal ultrasound measurement

Age	Length (mm)	Range (mm)
Up to 3 months	45	35–60
3–6 months	50	50–60
6–9 months	55	52–60
9–12 months	58	54–64
1–3 yr	65	54–72
3–6 yr	75	64–88
6–9 yr	80	73–86
9–12 yr	86	73–100

ISOTOPE SCANS

Dynamic imaging (MAG3)

Indications

- To assess obstruction in dilated system
- To assess drainage 6 months after pyeloplasty
- Indirect cystography in older children before and/or after surgical correction of reflux

Operational notes

- Request via nuclear medicine
- SHO or nurse required to insert venous cannula in young children
- Consider sedation if child has had previous problems lying still during examinations
- Maintain good hydration

- When assessing obstruction in dilated system or outcome of pyeloplasty, give furosemide 0.5 mg/kg slow IV bolus over 3–10 min (maximum rate 4 mg/min) 15 min before giving isotope. Helps to differentiate genuine obstruction from isotope pooling, provided function of affected kidney not severely impaired
- Do not use furosemide for indirect cystography

Static imaging (^{99m}Tc-DMSA)

Indications

- To assess differential function between kidneys and within duplex kidneys
- To locate an ectopic kidney
- To identify renal scars after recovery from urine infection
- atypical UTI aged <3 yr or recurrent UTI any age

Operational notes

- Request via nuclear medicine
- Scan kidney 2–6 hr after injection
- Sedation rarely required
- Delay DMSA for 4–6 months after infection to avoid false positive

X-RAY IMAGING

Micturating cystourethrogram (MCUG)

- To assess bladder for vesicoureteric reflux (VUR), to view urethra

Indications

- Atypical or recurrent UTI aged <6 months
- Recurrent or atypical UTI in children aged >6 months, but <3 yr if:
- dilatation on ultrasound
- poor urine flow
- non-*E. coli* infection
- family history of VUR

Operational notes

- **Patients already taking prophylactic antibiotics:** double dose on day before, day of the test and day after
- **Patients not on antibiotics:** give treatment dose covering day before, day of the test and day after
- Urethral catheter will be passed in X-ray department