Transplant kidney in the paediatric patient

Scanning technique and complications

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Overview

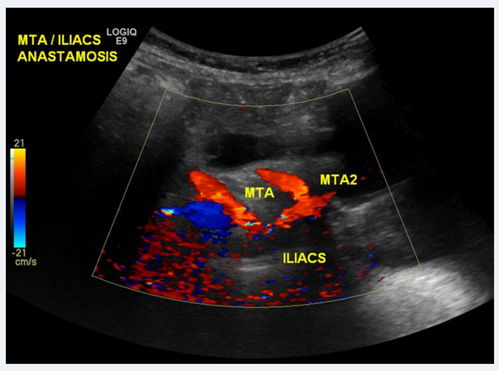
End stage renal disease is uncommon in paediatrics, accounting for only ten children in a million each year (1). Despite these figures, Great Ormond Street is the largest paediatric renal transplantation centre in the UK, undertaking on average 26 transplants each year with the figures increasing year-on-year. As a result, we perform 60-80 scans per month for renal transplant assessment (comprising pre-assessment, immediate post-operative imaging and long-term follow-up). Ultrasound is the main non-invasive imaging modality to evaluate the transplant kidney, enabling assessment of the anatomy and vasculature.

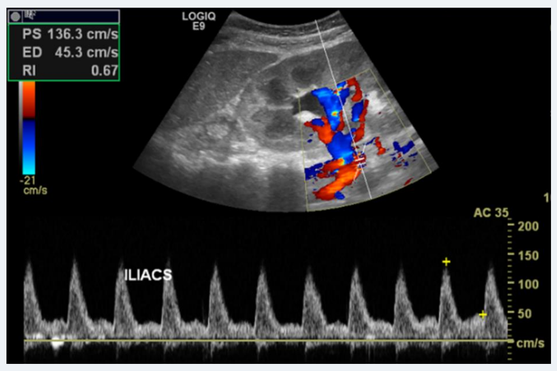
Common causes of end stage renal failure (ESRF)
Obstructive uropathy, renal dysplasia, aplasia, hypoplasia, glomerular disease, reflux uropathy, autosomal recessive polycystic kidney disease (ARPKD)

Typical Indications
Post-operative appearances, post-biopsy check, ?AV fistula, rise in creatinine, ?Perfusion, ?obstruction, stent removal- ?pelvicalyceal dilatation.

Normal anatomy
The majority of transplanted kidneys in paediatrics will be from adult donors. The kidney is located superficially and is usually situated in the right iliac fossa (unless the patient has had a mitrofanoff or previous renal allograft in this position) and anastamosed to the external iliac vessels. If the patient is a younger child, typically under 10 kg, the kidney will lie in the right flank with the renal vessels plumbed directly into the aorta and IVC.

The transplant kidney can have either one or two arteries (both of which should be assessed), and should be documented in initial post operative ultrasound report. This information can be found in the post operative notes. The figure below to the left demonstrates two transplant arteries anastamosed to an iliac vessel. The figure on the right shows a typical spectral waveform.





Ultrasound Technique

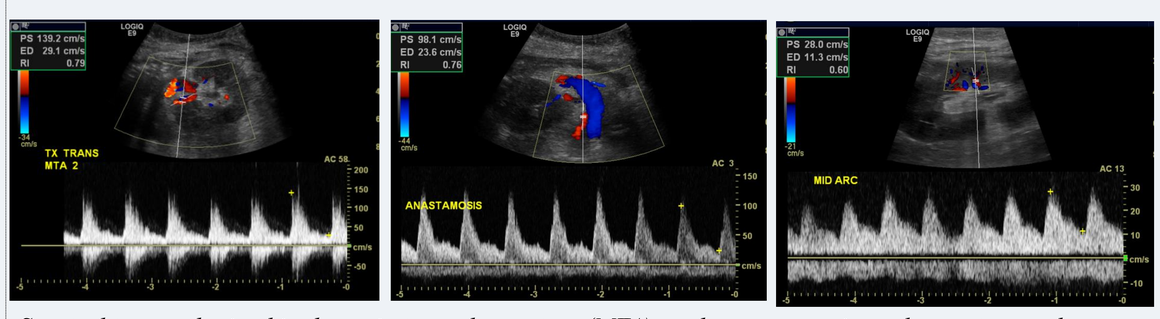
The child should be scanned in the supine position and imaging of the bladder (pre and post micturition/catheterisation), transplant ureter, transplant kidney and the native kidneys should be performed.

Preset – Renal specific parameters (ask applications specialist to optimise baseline Doppler settings)
Probe - Low frequency curvilinear probe. Followed by high frequency linear probe of the transplant kidney.

- Bladder - Volume pre & post micturition, outline & thickness
- Ureters – presence of epithelial thickening or dilatation (transplant ureters more prone to reflux)
- Transplant Kidney – Length, echotexture, echogenicity, cortico-medullary differentiation. Exclude peri-nephric collections, focal lesions, calculi or pelvicalyceal dilatation. Position of stent (if present), perfusion of transplant

Assessment should include b-mode, Doppler and pulsed wave Doppler.

Image demonstrating global perfusion using power Doppler. The colour gain should be set high and then gradually reduced until the outside ‘noise’ reduces.



Spectral traces obtained in the main transplant artery (MTA), at the anastomosis, and arcuate vessels

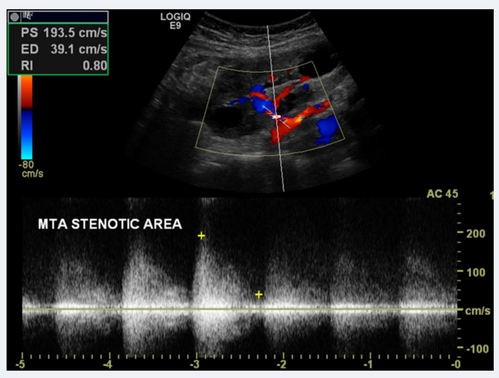
Spectral traces to be obtained from the main transplant artery (from both if two are present, including the anastomosis), the upper polar, inter-polar and lower polar arcuate arteries, the main transplant vein and the iliac arteries.

A **normal** arterial Doppler trace should have a sharp systolic upstroke with high end diastolic flow and a resistive index of < 0.8.

An **abnormal** arterial Doppler trace would have a delayed systolic upstroke giving a dampened trace.

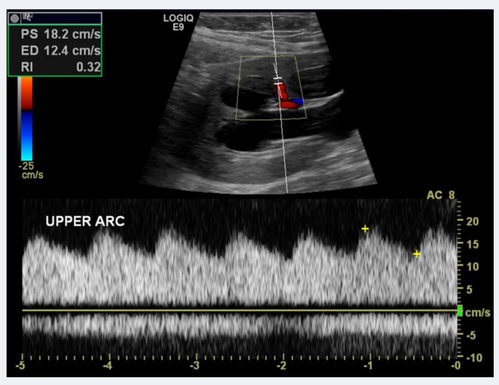
Post transplant complications

Renal artery stenosis



The main renal artery demonstrating spectral broadening. The peak systolic velocity (PSV) will be elevated higher than approximately 200 cm/s (be aware immediately after transplant the velocities may be higher to account for initial post operative swelling).

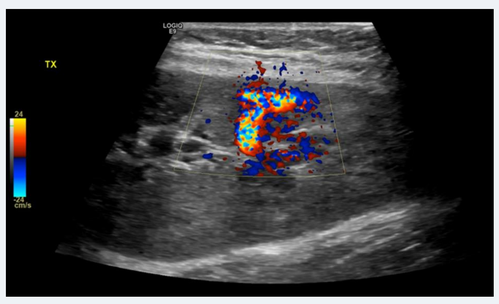
The spectral trace should be taken at the area of aliasing.



The arcuate vessels will show a delayed acceleration time with dampened traces, known as ‘tardus parvus’ waveforms.

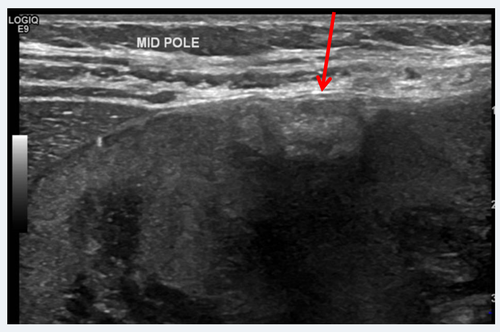
Tip – Keep the colour box small to maintain high resolution and locate a vessel as peripheral as possible.

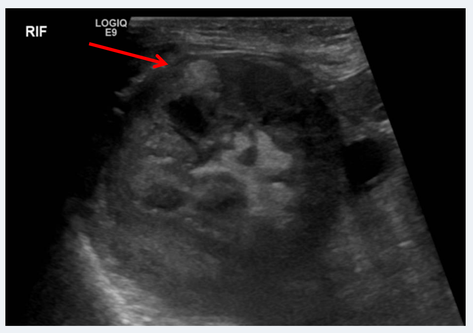
Arterio-Venous Fistula



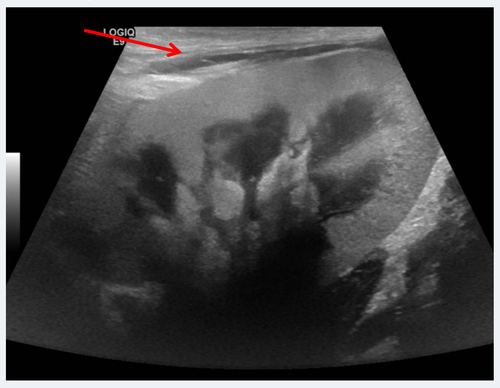
If there is a history of biopsy, then a high scale should be used which will identify areas of aliasing, a sign of arteriovenous fistula.
The scale should ideally be set at 100cm/s or higher.

Post biopsy haematoma





Perinephric collections



Post operative appearances may include a collection, more likely to be located at the upper and lower poles, however they can be subtle cresentic collections over the anterior surface.

Native kidneys

If present the native kidneys should be imaged. Assessment should include renal length, appearance (including echogenicity & cortical thinning), presence of any tumours and exclude pelvicalyceal dilatation.
Over time the native kidneys become less obvious and may be difficult to locate.

Summary
Sonographic assessment is reliable for assessment of the transplant kidney. This pictorial review provides examples of the different complications which should increase confidence for assessment of the paediatric patient and can also be applied to the adult population.

References

1. McDonald SP, Craig JC. Long-term survival of children with end-stage renal disease. N Engl J Med 2004; 350: 2654–2662