PHILIPS

Ultrasound

Clinical case study

The eL18-4 PureWave linear array with MicroFlow Imaging in the assessment of focal cortical infarction in a transplanted kidney

eL18-4 PureWave linear array transducer

Category
Renal Assessment

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Overview

Diagnostic ultrasound is commonly used to assess many renal diseases and has proven especially valuable in transplanted organs where frequent follow-up examinations are required to evaluate viability.

Patient history

A 33-year-old male patient with a complex past medical and surgical history including chronic renal disease eventually progressed to end-stage renal failure, becoming dialysis-dependent. He was subsequently the recipient of a renal transplant from a brain-death donor.

The arterial supply to the kidney consisted of three small caliber arteries and three renal veins, anastomosed to the right external iliac artery and vein respectively. During the surgery, a small upper pole infarct was noted and, despite being heparinized post-operatively, there remained ongoing concern regarding persistently raised creatinine and abnormal ultrasound findings.

As may be seen with deceased donor renal transplants, there was an initial post-operative period of delayed graft function, but of potentially more significance was the demonstration of reduced arterial flow towards the upper pole. Pulsed wave Doppler studies revealed a dampening of the inter-lobar arterial waveform but with no obvious cortical vascular abnormality demonstrated with color or power Doppler.

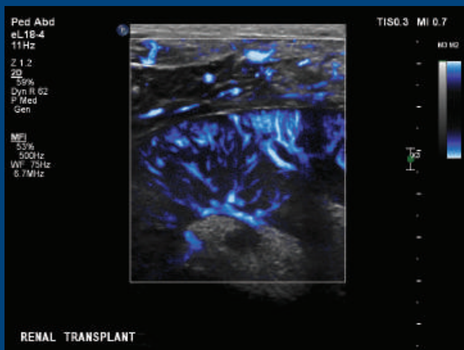
Protocol

With a BMI of 18, this patient was the ideal candidate for assessment of the right iliac fossa graft using both curved and linear transducer technology – in this case, the C9-2 and eL18-4. Structurally, the transplanted kidney appeared within normal limits, with the C9-2 B-mode images demonstrating normal cortico-medullary differentiation with no evidence of hydronephrosis. Color Power Angio (CPA) assessment initially showed no obvious areas of reduced flow in the kidney, though further interrogation with pulsed waved Doppler confirmed abnormal flow to areas in the upper pole. This was manifest in the form of reduced resistive indices (RIs) (0.37 – 0.44), compared to normal RIs in the lower pole (0.64 – 0.80), with a visibly dampened waveform, i.e., prolonged rise time and reduced peak systolic velocities.

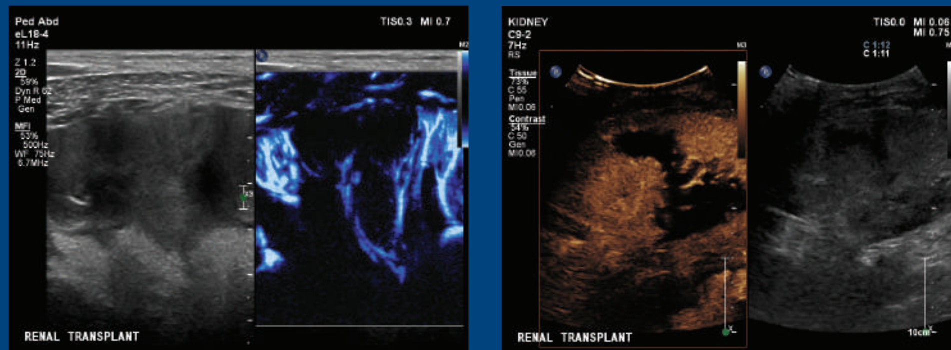
Utilizing the eL18-4 linear array transducer, MicroFlow Imaging (MFI) was used to further interrogate the renal cortex throughout the kidney. This demonstrated normal perfusion in the both poles but clear areas of cortical infarction between the equatorial region and upper pole.

The Philips eL18-4 PureWave linear array transducer is our first high-performance transducer featuring ultra-broadband PureWave crystal technology with multi-row array configuration, allowing for fine-elevation focusing capability.

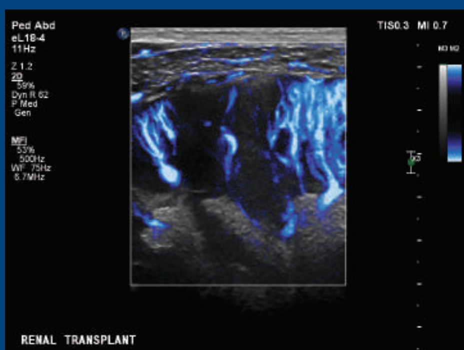
As is routine at Freeman Hospital, full organ perfusion is mapped with contrast-enhanced ultrasound (CEUS), which confirmed a thin area of infarct spanning the kidney, with the largest defect seen in the equatorial region as suspected on MFI. We estimate the total volume of renal infarct to be in the order of 10–15% of total renal volume – a useful prognostic indicator of subsequent renal function (Stenberg et al., 2017).



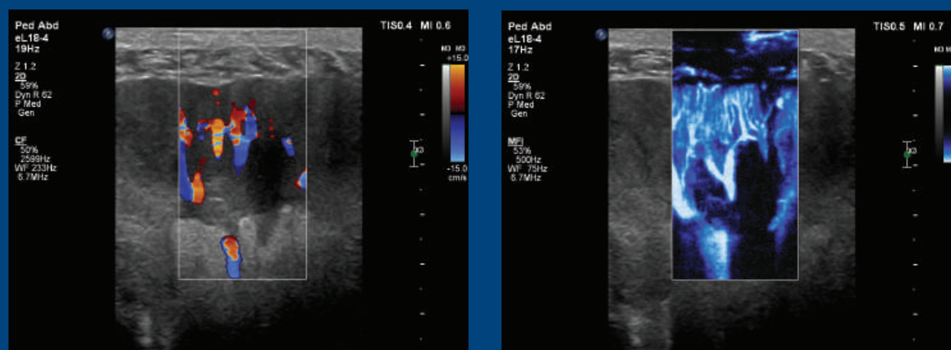
Normal perfusion in the upper pole



MFI demonstrating obvious cortical infarction, confirmed with CEUS, which mapped out the overall extent of the defect



Cortical infarction between equatorial region and upper pole



The difference between standard color Doppler and MFI, demonstrating the peripheral vasculature of the transplant kidney. MFI can visualize the arcuate and interlobular (cortical radiate) arteries, and can even identify the afferent glomerular arterioles.

Conclusion

Prior to the introduction of Doppler-based microvascular techniques in ultrasound, assessment of true organ perfusion remained the remit of contrast-enhanced ultrasound (CEUS) or other post-contrast techniques such as contrast-enhanced CT or MRI. With all of these methods, there are associated risks, not least contrast nephropathy in the case of CT and MRI, a complication with particular significance in this patient group.

This clinical case demonstrates when organ perfusion is assessed with MFI, a deeper understanding of the vascular status of the organ can be achieved, as well as increased diagnostic confidence without the need for invasive and potentially detrimental investigations. While still in the early phases of clinical discovery, the authors envisage a growing role for MFI assessment in renal transplant imaging, as well as other areas such as head and neck, MSK, and testicular ultrasound, where subtle nuances in blood flow make significant differences in diagnoses.

Reference

Stenberg B, Elliott S, Wilkinson M, Caplan N. The prevalence and significance of renal perfusion defects in early kidney transplants quantified using 3D contrast-enhanced ultrasound (CEUS). European Radiology, 2017. DOI: 10.1007/s00330-017-4871-3

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