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CT in potential live renal transplant donors-What the laparoscopic transplant surgeon wants to know

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Introduction

As the regional transplant centre, approximately 42 live kidney donor transplants are carried out a year at Southmead hospital. An increasing number of donor resections are being carried out laparoscopically where possible. MDCT (Multi-Detector Computed Tomography) is an excellent modality for the pre-operative assessment of live renal donors (1) and is now routinely used to document anatomical characteristics. It is used to convey specific information to the laparoscopic surgeon as this allows accurate intra-operative planning(2). With the advent of reconstruction software, we are also able to provide 3D representations of anatomical variants preoperatively for surgeons to view. Below is a pictorial guide with examples of these features, as well the information required by the surgeon from the radiologist.

Vascular Anatomy

Despite initial caution in the use of kidneys with multiple vessels, retrospective reports have suggested that kidneys with multiple renal arteries or veins do not carry an increased risk of complications in experienced hands(3) especially if vascular mapping is available to plan the procedure. Due to the length of the left renal vein, it is technically easier to remove and implant the left kidney. Providing there is no significant size or vascular discrepancy, the left kidney is usually preferred.

Arterial

The surgeon needs to know the number of vessels, the distance of accessory vessels from the main renal artery, and vessel length, defined by the distance from aortic wall to the first arterial bifurcation. Approximately 25% of potential donors will have multiple arteries to one kidney and around 7% will have multiple vessels to both kidneys(4).

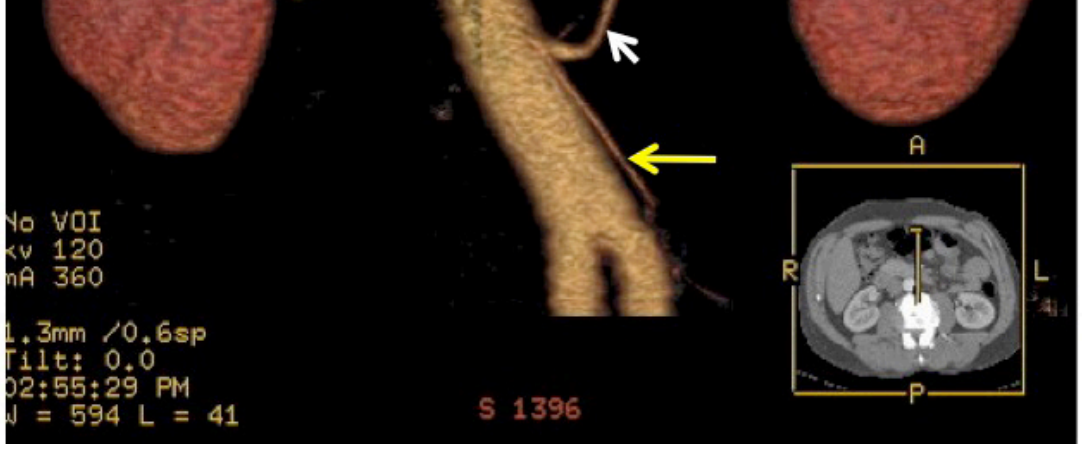
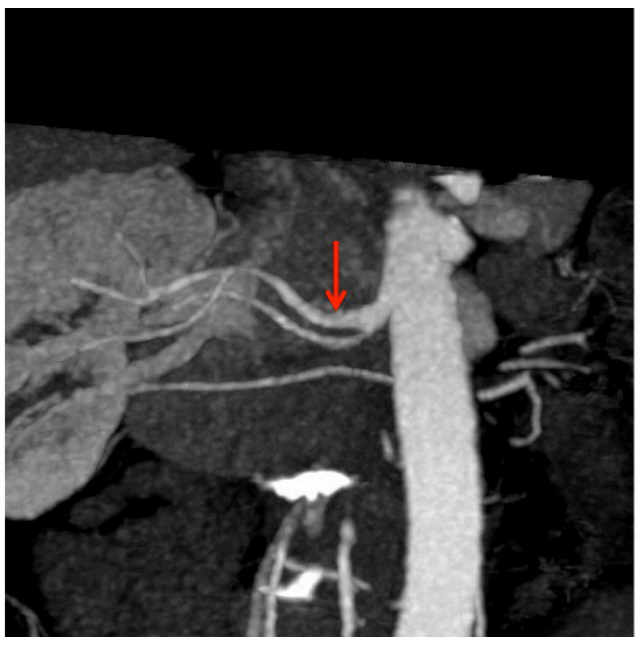


Figure 2: Demonstrating 2 right renal arteries (red arrows) and 2 left renal arteries (white arrows), the lowest originating close to the inferior mesenteric artery (yellow arrow). There is a large distance between the left renal arteries, and the small calibre of the lower pole artery along with its proximity to the inferior mesenteric artery were contraindications to performing a laparoscopic procedure.



(Above)
Figure 3: Demonstrating perihilar branching (red arrow). It is important to detect this variant if branching occurs within 2cm of the origin of the renal artery from the aorta, because most surgeons require at least 2 cm length to ensure adequate control and anastomosis.

Venous

The number of veins, their location, the length of the right renal vein and the major tributaries should be documented.

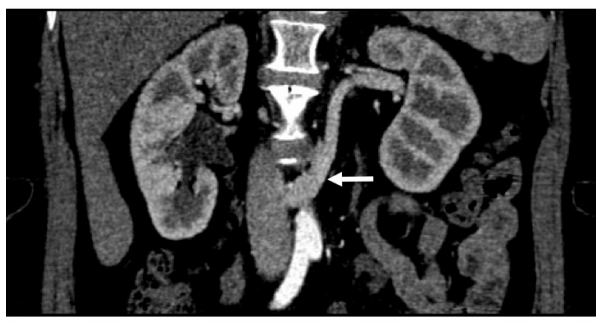
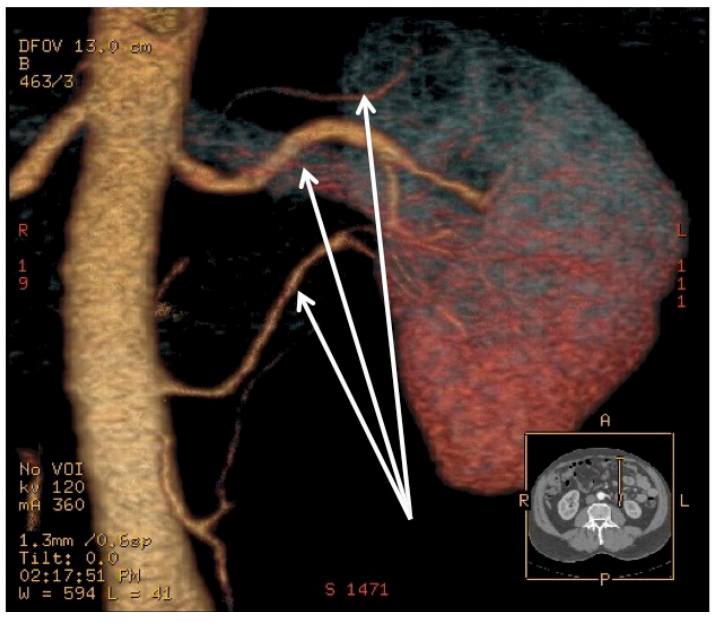


Figure 4a: Coronal CT demonstrating a second left renal vein draining low into the IVC (white arrow). Concern regarding venous hypertension, and a short right renal vein (<2cm) resulted in an open nephrectomy.



(Left)
Figure 1: 3D reconstruction of the left kidney illustrating arterial supply via 3 separate renal arteries (white arrows). Significant size discrepancy meant the left kidney was selected for donation. Laparoscopic resection was judged to be too technically difficult based on the vascular anatomy, and the patient went on to have an open procedure which failed.

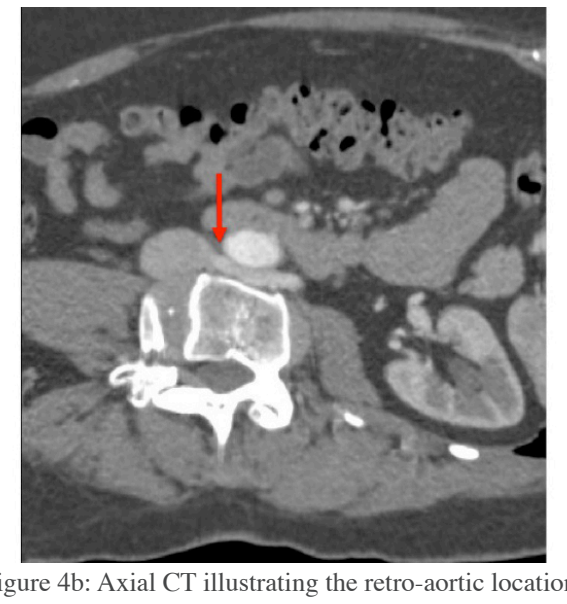


Figure 4b: Axial CT illustrating the retro-aortic location of left renal vein (red arrow). This is seen in 2%-3% of individuals .

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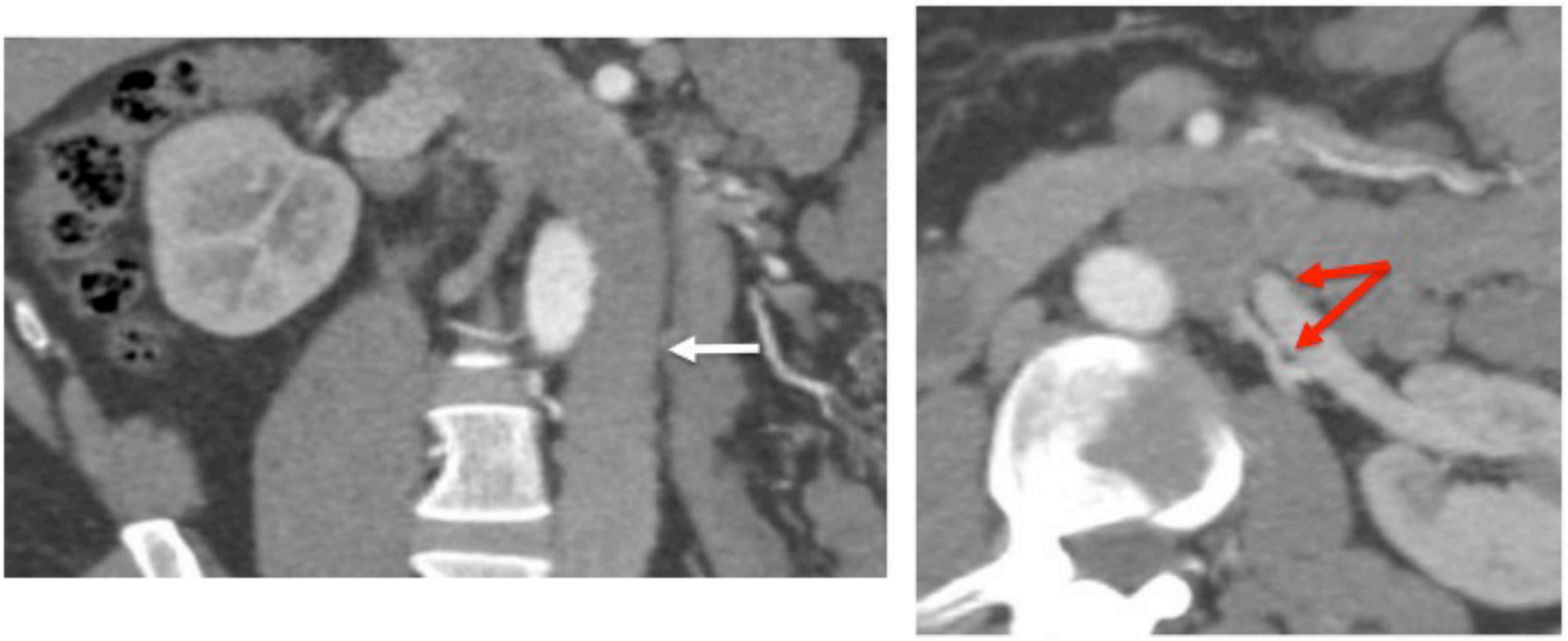

Figure 5: (a) Coronal CT demonstrating left sided IVC (white arrow) (b) axial view demonstrating two renal veins draining into the left sided IVC (red arrow). An open procedure was performed to resect the left kidney.

Incidental Findings

Non-vascular findings can also be contraindications to laparoscopic renal donation. The following can be identified using CT.

Renal size discrepancy:

Ultrasound is the first line investigation. If there is a size difference of >2cm between the two kidneys a split function isotope scan should be considered.

Ureters and pelvicaliceal tract:

The number of ureters and their structural characteristics need to be documented as well as any signs of obstruction or nephrolithiasis.

Perinephric fat density:

Although this finding is not mentioned within the BTS guidelines, local surgeons report this to be an indicator of ease for laparoscopic dissection. It is useful therefore to document the perinephric fat density in Hounsfield units.

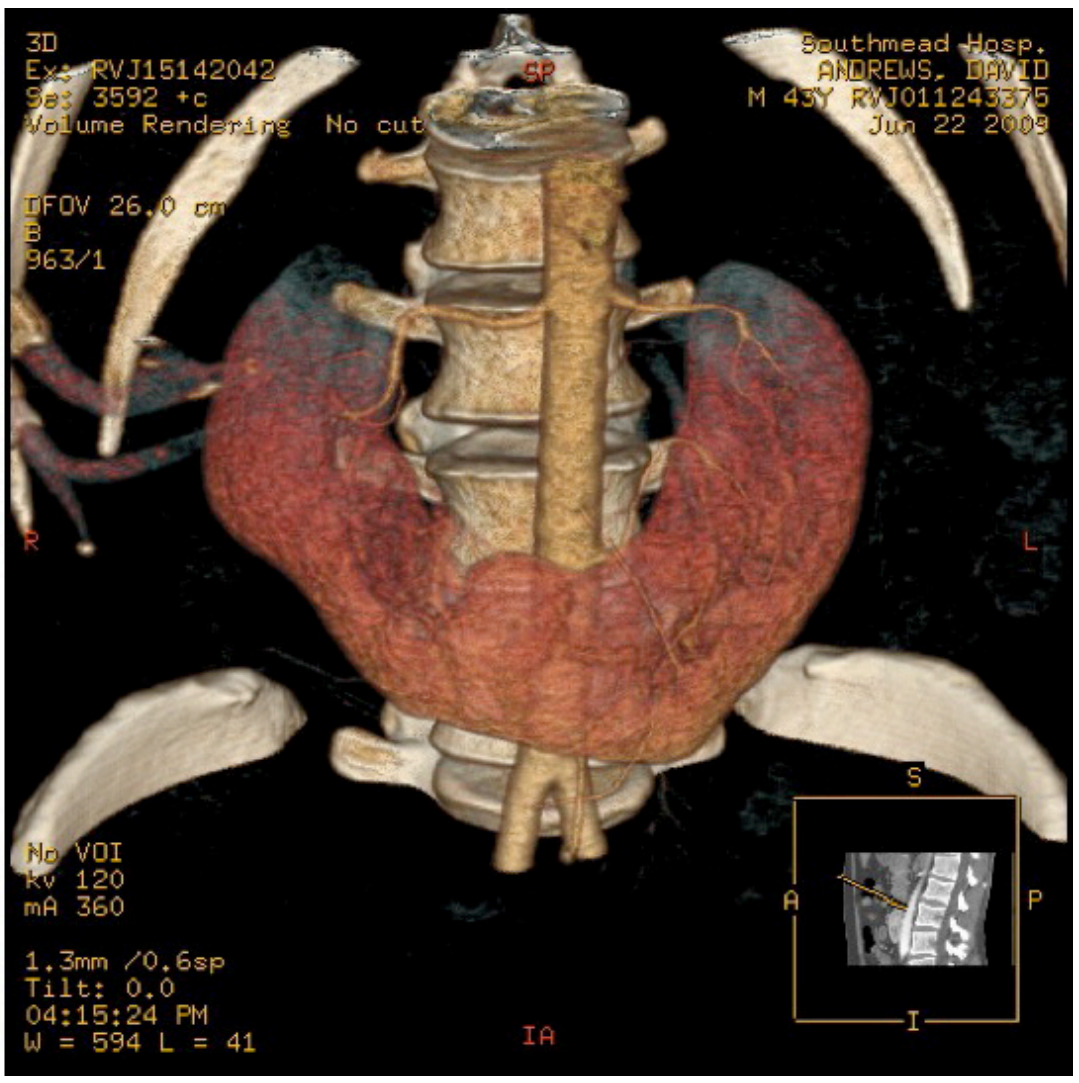

Figure 6: Structural horseshoe kidney.

Discussion

Laparoscopic nephrectomy has been shown to have comparable morbidity and mortality to open donor nephrectomy but means a significant improvement in patient recovery times(5) Due to the limited field of view in laparoscopic surgery Dual phase spiral CT and three dimensional CT angiography are useful non-invasive pre-operative procedures that can significantly aid surgical planning and help prevent surgical complications.

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