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ORIGINAL ARTICLE

Multidetector CT angiography in live donor renal transplantation: experience from 156 consecutive cases at a single centre

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Summary

The performance of multidetector computed tomography (CT) angiography was assessed in the pre-operative evaluation of live renal donors. Between July 1998 and March 2006, 156 consecutive patients underwent open donor nephrectomy following pre-operative multidetector CT angiography (MDCTA). Operative notes were compared with radiological reports and discrepancies identified. MDCTA missed five of 28 accessory arteries (four visible with hindsight), accuracy of 96%. Of 30 early-branching renal arteries, eight were missed (all visible with hindsight), accuracy 95%. MDCTA missed only one of 13 venous anomalies (accuracy 97%) and also missed the only duplicated collecting system: both were undetectable with hindsight. Following modifications to image acquisition and interpretation sensitivity, negative-predictive value and accuracy were significantly increased. The results were compared with pooled data from published studies of live donor imaging. This study and previous studies of MDCTA had improved sensitivity for arterial and venous anomalies over single detector CT angiography and MR angiography. We conclude that multidetector CT angiography is an accurate modality in the pre-operative evaluation of live renal donors. Regular communication between the transplant surgeon and the radiologist is paramount to improve reporting of surgically relevant anatomy. Mechanisms should exist for auditing and improving pre-operative imaging in any live donor programme.

Introduction

Live donors are an established and important source of organs for renal transplantation, now comprising 51% of organ donors in the USA in 2004 [1]. Graft survival from live donors have improved outcomes over cadaveric sources: 95% vs. 89% at 1 year and 80% vs. 67% at 5 years [1]. Patient survival is similarly improved in live donor recipients. Given the altruistic nature of live donation, it is mandatory that all risks to the donor are minimized. Comprehensive donor evaluation is critical and includes planning of the retrieval procedure to select the appropriate kidney and anticipate anatomical anomalies. Moreover, accurate anatomical information should minimize damage to the renal vasculature and perhaps reduce warm ischaemia. Kidneys with intact and undamaged vessels should optimize graft function in the recipient.

Traditional approaches at pre-operative evaluation have included selective renal arteriography and excretion urography. The development of single detector helical computed tomography (CT) angiography (SDCTA) offered vascular anatomical information without the morbidity and inconvenience of invasive arteriography [2,3]. SDCTA has comparable results to conventional renal angiography in the detection of accessory renal arteries and early-branching renal arteries [4–15]. At donor nephrectomy, SDCTA has been demonstrated to have accuracy for arterial anatomy in the range 80–100% [4–13,15–22]. SDCTA may miss more venous anomalies than accessory arteries at operation, but it is still more accurate than conventional angiography [6–8,12–13,15–17,22]. In the past, venous drainage has been quantitatively less important than arterial supply, but venous anatomy is of increasing importance with the advent of laparoscopic nephrectomy [22–24].

Multidetector renal CT angiography (MDCTA) has additional benefits over SDCTA including increased volume coverage, reduced movement artefact, isotropic data sets and improved *z*-axis resolution [25–27]. MDCTA has an accuracy in the range 93–97% for arterial anatomy in both open and laparoscopic live donors [28–35]. Previous studies of MDCTA have had fewer numbers than SDCTA and have not addressed the role of clinicoradiological discussions in improving the performance. Here, we present our results of a cohort of 156 consecutive donors evaluated by multidetector CT angiography at our centre. The effect of surgical feedback on changing CT angiography data acquisition and interpretation is illustrated and the results are compared with previous studies of live donor imaging.

Patients and methods

Potential renal donors underwent extensive medical and psychological evaluation with only those deemed suitable proceeding to pre-operative contrast-enhanced CT angiography. The first 25 patients were examined with an Elscint CT Twin Flash two-detector row (Elscint, Haifa, Israel) with the subsequent 131 examined by a Philips Mx 8000 with four detector rows (Philips Medical Systems, Cleveland, OH, USA). Following a scout topogram, a pre-contrast sequence was completed extending from diaphragm to mid-sacrum. A postcontrast arterial sequence was performed after a delay of 20 s following the commencement of an infusion of 120–150 ml nonionic contrast medium (4 ml/s) via an antecubital vein. The arterial sequence extended from superior to the kidneys to 2-cm distal to the aortic bifurcation with a collimated slice width of 2.5 mm in the first 62 donors, adjusted to 1 mm for the final 94 patients. A third sequence was acquired following a 90-second delay to evaluate the renal parenchyma and venous drainage. Finally, a topogram was acquired at 5 min following contrast for collecting system anatomy, although this was latterly replaced by plain film radiography at the end of the procedure (following a missed duplex system).

Images were viewed at a workstation including axial datasets, maximum intensity projection and multi-planar reconstruction by one of three consultant radiologists (LJ, EL and MT). Images were discussed with the surgeon pre-operatively in all cases and stored on magneto-optical discs for future review. Donor nephrectomy proceeded by a loin incision and extraperitoneal approach. A careful record of arterial, venous, collecting system and incidental findings was kept in all nephrectomy cases. The operation note was compared with the radiological report on the basis of arterial, venous and collecting system anatomy. Arterial anatomical data consisted of the number of main renal arteries, early-branching of the renal arteries (defined as within 20 mm from the origin) and accessory arteries (including co-dominant hilar vessels, polar and capsular arteries). Other documented findings included number of renal veins, anomalous venous drainage and collecting system abnormalities. In the light of a discrepancy between radiologist and surgeon, the surgical findings were considered definitive and the CT angiogram images retrospectively reviewed by two observers. Discrepancies were noted to be false-positive findings (a structure on CT not documented at surgery) or missed structures. Missed structures were subdivided into those visible at review but not reported originally or structures remaining undetectable at review of the CT angiogram. This was a retrospective review of our standard practice and therefore local ethics committee approval was unnecessary.

A venous anomaly missed at CT but detected at surgery instigated a clinicoradiological review of CT performance in January 2003. This review of technical and interpretative performance prompted a reduction in collimated slice width from 2.5 to 1 mm, increased attention to axial datasets (for small arteries) and the addition of plain radiography for collecting system anomalies. Patients could therefore be divided into two groups: prior to January 2003 (group 1) and subsequent to this date with the indicated refinements (group 2).

Sensitivity [test true positive/all reference positive], specificity [test true negative/all reference negative], positive predictive value [true test positive/all test positive], negative-predictive value [true test negative/all test negative] and accuracy [(true test positive + true test negative)/all patients] were calculated by using operative findings as the reference standard. Calculations were based on patient numbers and not overall number of arteries or veins. Calculations were performed on groups 1 and 2. Comparisons were performed by Fisher's exact test and considered significant at the 95% level.

Results

In the study period, there were 447 possible renal donors, of whom 159 proceeded to CT angiography (36%). Many patients were excluded from donation prior to CT

Table 1. Comparison of demographic data by groups.

Variable	Group 1	Group 2
Date of multidetector CT	July 1998 to December 2002	January 2003 to March 2006
Collimated slice width	2.5 mm	1 mm
Number of patients	62	94
Mean age (range)	47 (32–73)	48 (20–74)
Male:Female (% male)	27:35 (44%)	39:55 (41%)
Nephrectomy Left: Right (% left)	57:5 (92%)	89:5 (95%)

angiography because of precluding factors including cross-matching or ABO incompatibility, medical status of the donor, change in the status of the recipient or personal factors. Of the 159 potential donors who underwent CT angiography, one was excluded because of renal calculi, one because of complex vascular anatomy (three right renal arteries and five left renal arteries) and one due to gross asymmetry in kidney size. Between July 1998 and March 2006, 156 patients underwent open donor nephrectomy by one of two consultant transplant surgeons (DCM or PAL). Ninety (58%) of the patients were female with an age range of 20–74 years (mean 48 years). One hundred and forty-six (94%) of the nephrectomies were left sided. There were 62 patients in group 1 and 94 patients in group 2. These groups were similar save for the changes in data acquisition and interpretation aforementioned (Table 1).

At surgery, there were 28 accessory arteries in 28 patients (18% of 156 patients) of which 23 were seen at CT pre-operatively (Fig. 1). Four of the five missed accessory arteries could be visualized with hindsight at postoperative review (Fig. 2). The undetectable vessel was in group 1 with a 2.5-mm collimated slice width. There were two accessory arteries seen at CT that were not detected at surgery and these remained convincing at review (Fig. 3). MDCTA had a sensitivity of 82%, specificity 98% and accuracy 96% (Table 2). Group 2 had significantly improved sensitivity over group 1 (100% vs. 58%, $P = 0.0081$) with improvement in negative-predictive value (100% vs. 91%, $P = 0.0117$). There was an associated improvement in overall diagnostic accuracy for accessory renal arteries from 92% to 98% ($P = 0.1151$).

At nephrectomy, there were 30 renal arteries branching within 20 mm from the aorta (19% of 156 patients) of which 22 were seen at pre-operative CT (Fig. 4). All eight of the missed early-branches could be seen at postoperative review (Fig. 5). There were no early-branching arteries seen at CT that were not found at surgery. MDCTA had a sensitivity of 73%, specificity of 100% and accuracy 95% (Table 2). Group 2 had improvements in diagnostic values over group 1: sensitivity doubled from 45% to 89% ($P = 0.0275$) with an associated improvement in negative-predictive value from 89% to 97%. Overall accuracy improved from 90% to 98% ($P = 0.0593$). Combining accessory and early-branching anatomy for overall arterial anomalies, MDCTA was entirely accurate in delineating renal arterial supply in 141 of 156 patients. Group 2 had excellent sensitivity of 94% (group 1: 50%, $P < 0.001$) with a specificity of 97% and accuracy of 96% (group 1: 82%, $P = 0.0104$).

Thirteen venous anomalies were noted at surgery (8% of 156 patients) with three retroaortic (Fig. 6) and five

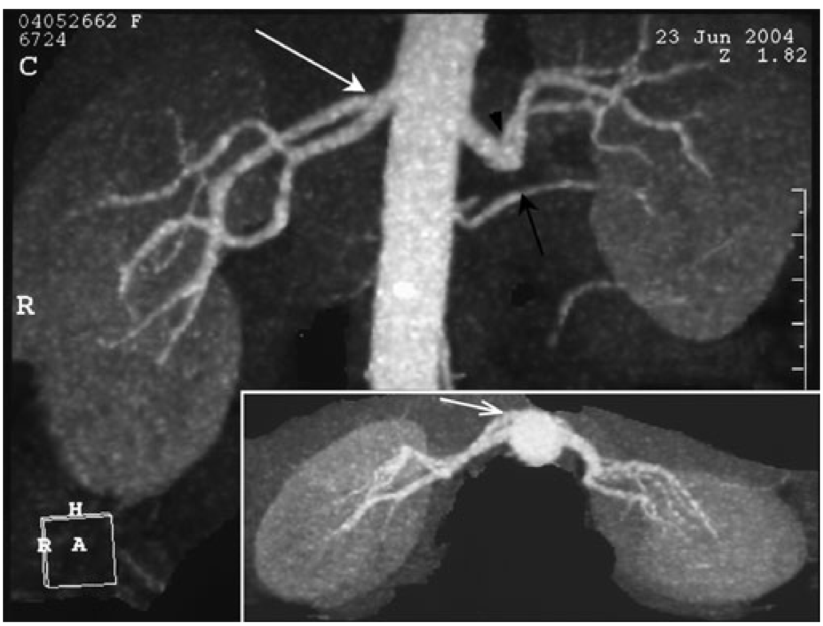

Figure 1 Bilateral multiple renal arteries. Accessory artery with distal origin on left (black arrow) and early-branching at 10 mm of left main renal artery (black arrowhead). Right renal artery appears early-branching (solid white arrow) but separate origins (open white arrow) are apparent on the axial image (inset).

Figure 2 A small accessory artery entering kidney (white arrow) that was missed at initial reporting. This was identified at surgery and subsequently visible at review of the axial dataset but not reconstructed images. This artery was sacrificed at surgery without consequence.

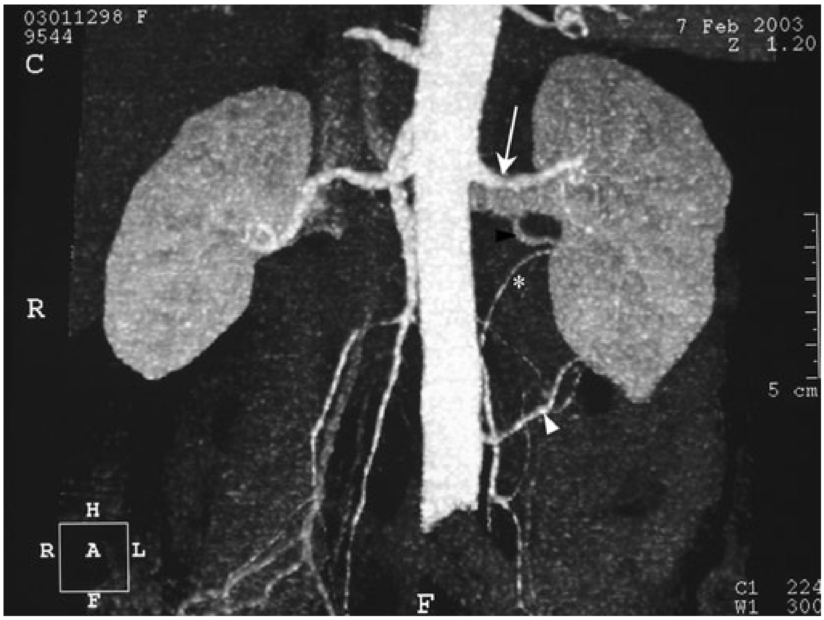

Figure 3 A false-positive accessory artery. CT angiography correctly predicted the main renal artery (white arrow) and accessory lower pole artery (white arrowhead). The further artery (asterix) in close proximity to a small venous tributary (black arrowhead) was not detected at surgery. This may represent the left colic artery.

circumaortic left renal veins. Three patients had multiple renal veins (one right and two left nephrectomies) and another two had confluence of left renal vein moieties anterior to the aorta. There was one missed pre-aortic confluence in group 1 and this was undetectable at review prompting a reduction in collimated slice width. Subsequently, there were no missed venous anomalies in group 2, but three false-positive findings: one each of retroaortic, circumaortic and multiple left renal veins (Fig. 7). Overall, MDCTA had a sensitivity of 92%, specificity of 98% and accuracy of 97% for venous anatomy. Sensitivity was increased in group 2 over group 1, but this was associated with a reduction in specificity and positive predictive value (Table 2).

There was a single missed duplicated collecting system in group 1 and this could not be detected at review. This prompted a change in policy towards plain radiology within 10 min of completing MDCTA. There were no further collecting system anomalies noted at either CT or surgery. Common parenchymal anomlies noted included simple cysts and angiomyolipomata. Miscellaneous pathology identified on CT angiography included a cystic

Diagnostic value	Group 1 (%) (n = 62)	Group 2 (%) (n = 94)	All patients (%) (n = 156)	All patients after review (%) (n = 156)
Accessory artery				
Sensitivity	58 (7/12)	100 (16/16)*	82 (23/28)	96 (27/28)
Specificity	100 (50/50)	97 (76/78)	98 (126/128)	98 (126/128)
PPV	100 (7/7)	89 (16/18)	92 (23/25)	93 (27/29)
NPV	91 (50/55)	100 (76/76)†	96 (126/131)	99 (126/127)
Accuracy	92 (57/62)	98 (92/94)	96 (149/156)	98 (153/156)
Early-branching renal artery				
Sensitivity	45 (5/11)	89 (17/19)‡	73 (22/30)	100 (30/30)
Specificity	100 (51/51)	100 (75/75)	100 (126/126)	100 (126/126)
PPV	100 (5/5)	100 (17/17)	100 (22/22)	100 (30/30)
NPV	89 (51/57)	97 (75/77)	94 (126/134)	100 (126/126)
Accuracy	90 (56/62)	98 (92/94)	95 (148/156)	100 (156/156)
Venous anomaly				
Sensitivity	86 (6/7)	100 (6/6)	92 (12/13)	92 (12/13)
Specificity	100 (55/55)	97 (85/88)	98 (140/143)	98 (140/143)
PPV	100 (6/6)	67 (6/9)	80 (12/15)	80 (12/15)
NPV	98 (55/56)	100 (85/85)	99 (140/141)	99 (140/141)
Accuracy	98 (61/62)	97 (91/94)	97 (152/156)	97 (152/156)

PPV, positive-predictive value; NPV, negative-predictive value.
*$P = 0.0081$ by Fishers' Exact method for group 2 vs. group 1.
†$P = 0.0117$ by Fishers' Exact method for group 2 vs. group 1.
‡$P = 0.0275$ by Fishers' Exact method for group 2 vs. group 1.

Table 2. Evaluation of arterial anatomy by CT angiography in comparison to operative findings: divided into groups before (group 1) and after (group 2) changes to multidetector CT angiography (MDCTA) image acquisition and interpretation in January 2003. Values relate to percentage of patients in the study period with actual numbers in parentheses. The final column relates to the technical potential of MDCTA if interpretive errors are minimized (missed anomalies detected at review included as true positives).

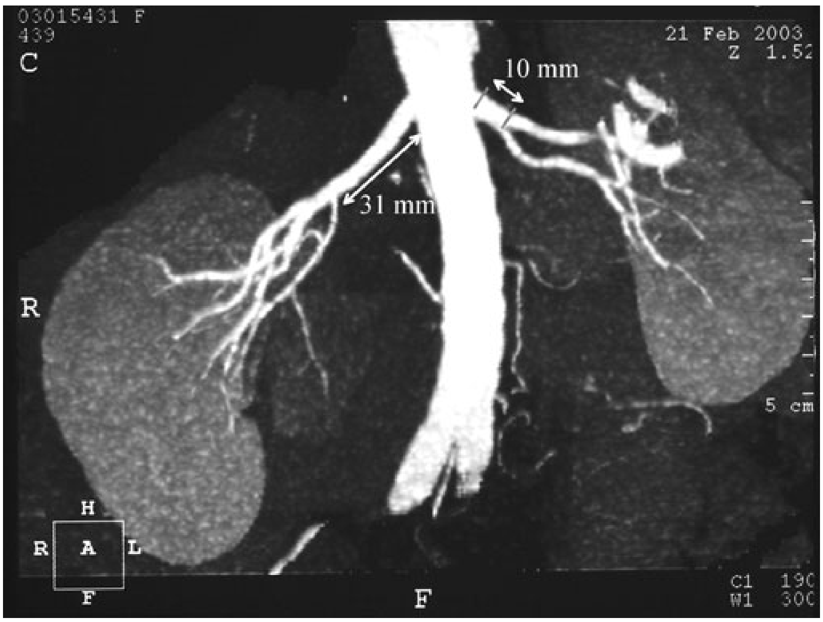

Figure 4 Early-branching renal arteries were defined as within 20 mm from the aorta. The left renal artery branched at 10 mm to the lower pole whereas the right renal artery extended for 31 mm before dividing.

perihilar mass thought to be an adrenal tumour that was revealed as a pelvic duplication cyst at nephrectomy (Fig. 8).

Discussion

To our knowledge, this is the largest series of live renal donors with multidetector CT imaging and surgical validation to date. Our study period encompasses over 7 years with changes in both imaging technology and clinician experience. We have had no problems with bolus timing in our young, fit potential donors and have not required the use of individualized patient contrast timing (smart software). The imaging potential of multidetector CT angiography was very high given that only three anatomical anomalies (one arterial, one venous and one

Figure 5 Missed early-branching of left renal artery. A tiny branch (white arrow) was visible on a single axial image at review. With hindsight, this branch was considered irrelevant as it did not affect the side of operation and it was ligated without consequence.

collecting system) could not be seen with hindsight in 156 patients. All three undetectable errors were acquired in the early part of the study using collimated slice widths of 2.5 mm. Moreover, 11 of the 13 missed arterial anomalies (total 53 arterial anomalies) were in the 62 patients in group 1 imaged with larger collimated slice widths. Reduced slice width resulted in only two arterial misses in the subsequent 94 patients. At 1 mm, all vascular anomalies could be retrospectively detected and vessels below this resolution are likely to be irrelevant and sacrificed at surgery. Discrimination of 1-mm arteries is of relevance if they supply the renal pelvis with the risk of pelvic necrosis following transplantation.

We chose surgical findings as a reference standard because ultimately the role of pre-operative donor imaging is to accurately predict operative anatomy. Surgeons used MDCTA to determine whether to proceed with surgery and, if so, which kidney to remove. It is likely that the kidney with the simplest anatomy will be removed which inevitably biases the study towards a lower prevalence of vascular anomalies. This is true of any study utilizing surgery as a reference standard but there is presently no other gold standard for arterial and venous anatomy. Given the proportion of anomalies (8% venous, 18% accessory and 19% early-branching), overall accuracy will be biased to the many cases confirming normal vascular anatomy. It is therefore important to report sensitivity and not only accuracy or concordance. For similar reasons, a high specificity may disguise false-positive findings: these are of relevance to the surgeon who may unwittingly discount a normal kidney. We have therefore calculated the positive predictive value to illustrate the confidence that may be placed in anomalous reports.

We observed accessory arteries in 18% of the kidneys chosen for nephrectomy, and this is similar to previous

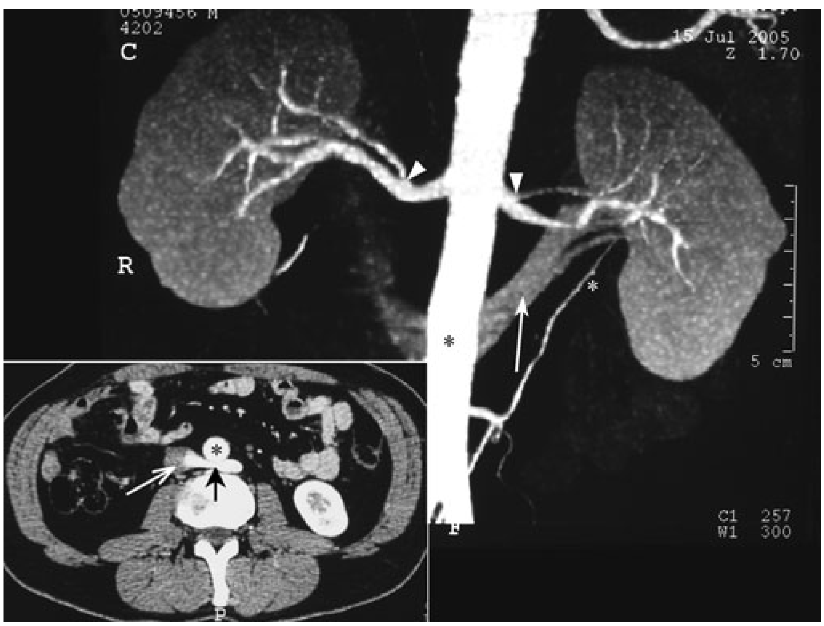

Figure 6 Retroaortic left renal vein (black arrow, inset) passing caudally (closed white arrow) before draining posterior to aorta (black asterix) into IVC (open white arrow). Note also bilateral early-branching (white arrowheads) and the left colic artery (white asterix). CT interpretation was confirmed at uncomplicated left nephrectomy.

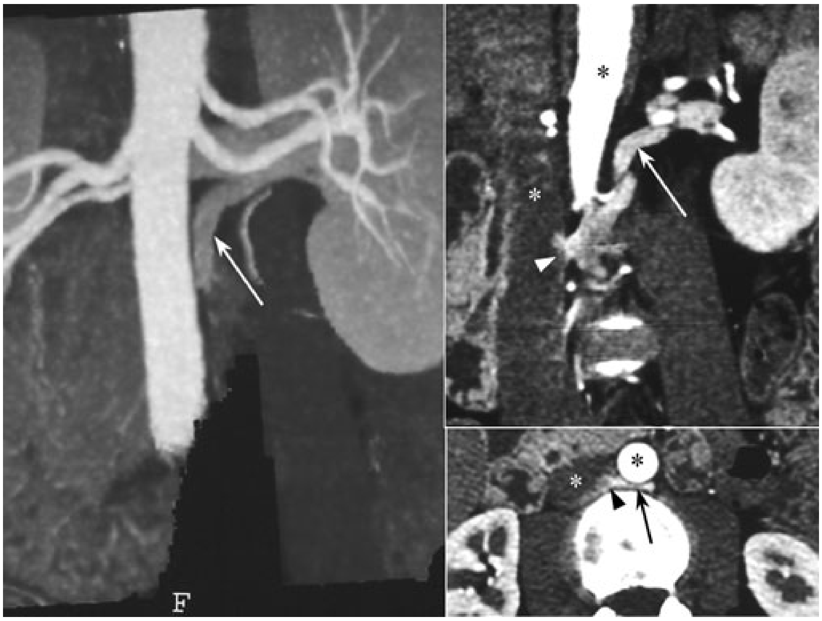

Figure 7 Left: CT angiography maximum intensity projection demonstrated branching of the left renal vein (white arrow) with an accessory left artery and early-branching right renal artery. Right: this branch had a caudal course (white arrow) passing posterior to the aorta (black asterix) before entering the IVC (white asterix, arrowheads). These findings were not confirmed at surgery although this may reflect transection of the main vein to the left of the branch.

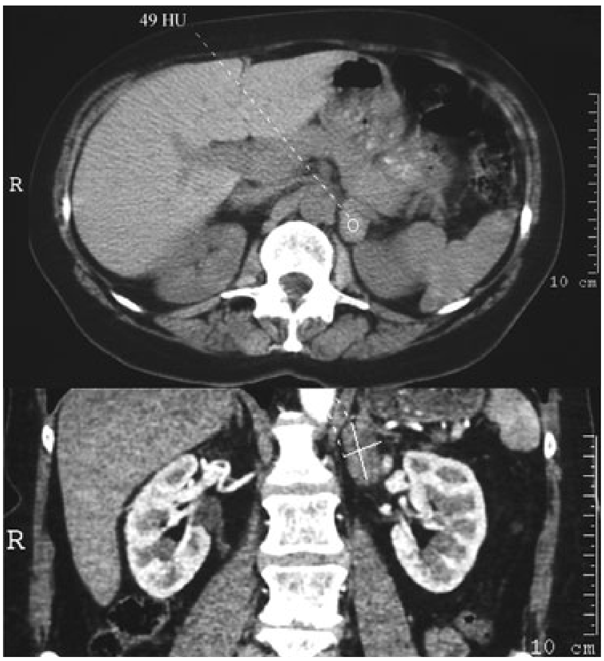

Figure 8 Incidental finding on prospective live-donor CT angiography. Top: precontrast axial images showed a 24-mm lesion in the region of the left adrenal gland (circle). Bottom: no contrast enhancement with axial dimension of 28 mm. Left nephrectomy was performed and revealed a mass separate from the adrenal; urothelium was demonstrated on frozen section and donor nephrectomy proceeded uneventfully.

observations [10,12–13,15–17,22,29,32,35]. Sensitivity for accessory artery detection was 82% with all five misses in group 1. Reduction in slice width and increased vigilance for small arteries improved sensitivity to 100% in group 2. Interestingly improved vigilance led to two false-positive cases in group 2 (Fig. 3) with a reduction in specificity and positive predictive value. It is possible that multidetector CT may detect tiny vessels of no significance that may be divided without note or consequence by the surgeon.

We defined early-branching as within 20 mm of the aorta to inform the surgical team of such vessels prior to nephrectomy. Early-branching commonly did not prejudice explanation of the kidney unless within 10 mm of the aorta. We therefore observed a high rate of early-branching (19%) in comparison with the 5–8% of previous studies in donor nephrectomies [9–10,12,34], although Watarai *et al.* and Del Pizzo *et al.* [13,17] have described similar rates of early-branching: 29% and 15%, respectively. Nephrectomy specimens may have a selection bias towards lower rates of early-branching arteries and there is indeed a higher rate of early-branching (21–28%) in conventional angiography observation studies than in donor specimens [5,7,11]. In the present study, accuracy for early-branching was 95% with a sensitivity of 73%. Similar to the findings with accessory arteries, there was an improvement in performance from groups 1 to 2 (Table 2). A doubling of sensitivity was associated with an increase in accuracy from 90% to 98% without an increase in false-positive reports.

In the present study, 8% of patients had a venous anomaly, which is comparable with previous studies [8,15,17]. Venous anatomy was accurately predicted in 97% of patients with only one of the 13 anomalies missed by MDCTA, an error that led to a change in protocol.

Reduced collimation resulted in 100% sensitivity, but there were three cases of over-diagnosis of venous anomalies (Fig. 7). It is unknown if this represents true error or an increased detection of small vessels that were considered insignificant at donor nephrectomy. Venous anatomy is poorly visualized at conventional angiography with a high miss rate of up to 100% [8,13,15]. Del Pizzo *et al.* [17] demonstrated that single detector CT had an accuracy of 96% for venous anomalies but this study still missed seven of 11 anomalies found a surgery. Moreover, Lewis *et al.* [22] demonstrated a concordance of 98% for venous anatomy but SDCTA missed the only anomaly discovered at laparoscopic nephrectomy. In the present study, MDCTA predicted 12 of 13 anomalous renal veins found at surgery and this will be of great importance in implementing a future laparoscopic donor programme.

Single CT angiography has comparable arterial accuracy to conventional angiography with improved venous accuracy [4–22]. Multidetector CT would be predicted to offer advantages over and above SDCTA [25–35]. Many of previous studies have limited numbers, a lack of surgical reference standard or have addressed only particular aspects of the full anatomical picture. Table 3 demonstrates comparisons between the present study and published series. Many studies have not included sufficient data to allow calculation of sensitivity (and other values) and have therefore been excluded. The previous data have been pooled and averaged to produce gross values. Sensitivity for accessory arteries was 71% for single-detector (919 patients) and 80% for multidetector CT (398 patients). The present study sensitivity was similar at 82% with comparable specificity and accuracy. Magnetic resonance angiography (MRA) studies have a pooled sensitivity of only 67% for accessory arteries in 377 patients. It is disappointing that in all the pooled studies one in five accessory arteries would be missed by all the modalities of pre-operative imaging. The chance finding of such an artery at surgery is of great importance and strategies to increase sensitivity are essential. We are pleased that by increasing our attention to axial datasets we have improved our sensitivity in group 2 to 100%, detecting all 16 accessory arteries in 94 patients.

Sensitivity and accuracy were higher for early-branching in SDCTA, MDCTA and MRA than accessory arteries and this contrasts with the present study. Extra vigilance in group 2 has improved our detection rates with a sensitivity of 89% superior to that of SDCTA and MRA (77% and 82%, respectively). Pooled MDCTA data demonstrate superior sensitivity (95%) to group 2 but at the expense of a reduced specificity and positive-predictive value. The increase in false-positive findings in previous multidetector studies may reflect either over-detection of adrenal branches or tiny branches unnoticed by the surgeon.

Table 3. Comparison of imaging studies in live donors with operative findings as a reference standard: present data in comparison with collated previous studies. All published studies with adequate raw data were included in the totals for each imaging modality: if insufficient data were available for contingency table analysis, then these were excluded. Only patients with surgical confirmation are included with exclusion of those with conventional arteriography as the sole gold standard.

Imaging modality	Refs.	Number of patients	Accessory arteries* (%)					Early-branching arteries† (%)					Venous anomaly (%)				
			Sensitivity	Specificity	PPV	NPV	Accuracy	Sensitivity	Specificity	PPV	NPV	Accuracy	Sensitivity	Specificity	PPV	NPV	Accuracy
Single detector CTA	[5, 8–9 10,12–13, 15–19,21–22]	919	71	98	92	93	93	77	100	98	97	97	57	100	93	96	96
Multi-detector CTA	[29–30, 32, 34–35]	398	80	99	97	94	95	95	98	87	99	98	85	99	94	98	98
MRA	[19, 36–40]	377	67	100	100	93	94	82	100	100	99	99	55	100	94	96	96
Present study (Total)	–	156	82	98	92	96	96	73	100	100	94	95	92	98	80	99	97
Present study (group 2)	–	94	100	97	89	100	98	89	100	100	97	98	100	97	67	100	97

PPV, positive-predictive value; NPV, negative-predictive value; MRA, magnetic resonance angiography; CTA, computed tomography angiography.

*All calculations reflect individual patient findings and not total number of arterial units.

†Range of criteria by different studies: from under 10 mm to under 20 mm from aorta.

Over-detection of prehilar branching may wrongly prejudice the side of surgery although we believe that in many cases early-branching does not govern the choice of kidney unless originating in very close proximity to the aorta. Missed early-branching renal vessels were not detrimental to surgical success in the eight patients, but this remains an area for ongoing improvement at our centre.

Venous anomalies are uncommon (8%) and rarely govern the side of surgery; however, their importance lies in the restricted view at laparoscopic nephrectomy [22–26]. Pooled analysis confirms that MDCTA in the present and previous studies has a sensitivity of 85–92%, which is far superior to either SDCTA or MR studies (57% and 55%, respectively). Indeed, combining the present study with pooled MDCTA studies (554 patients) demonstrated a significant improvement in sensitivity for venous anomalies over SDCTA and MRA ($P = 0.0068$ and 0.0028, respectively, Fisher's exact test). By reducing collimation, attaining isotropic datasets and using multiplanar reconstruction, we accurately detected all six venous anomalies found at surgery in group 2. We had three findings not confirmed at surgery, this may reflect true errors (particularly misclassified prominent lumbar veins) or small vessels that were not noticed at surgery. None of these errors influenced surgery or outcome.

Magnetic resonance imaging offers the advantages of radiation-free examination and safer contrast medium, but has limitations in pre-operative donor evaluation. It may miss renal calculi, small accessory arteries and reduced scan volume may limit the detection of significant abdominal pathology. In comparison with conventional invasive angiography, MR studies have at best an equivalent accuracy [41–43] or more commonly a worse sensitivity [11,44–46]. In pooled analysis (Table 3), MRA had inferior sensitivity for arterial and venous anatomy found at surgery and this was confirmed in other studies [11,47–48]. Notwithstanding, a recent study of 173 hand-assisted laparoscopic cases by Rajab *et al.* [39] demonstrated excellent results for MRA in predicting early-branching (12 of 12) and venous anomalies (eight of eight) in 173 donor nephrectomies. In two direct comparisons of MRA with single-detector CT angiography, there was general concordance between SDCTA and MRA. Rankin *et al.* [49] demonstrated similar detection rates for renal arteries but sensitivity was poor for both techniques: SDCTA missed three of four accessory arteries (36 patients) and MRA missed two of two accessory arteries (18 patients). Halpern *et al.* [19] correctly detected four out of five accessory arteries by both SDCTA and MRA. MR has significantly poorer sensitivity for venous anomalies than MDCTA ($P = 0.0028$) and this is an important deficiency in the era of laparoscopic donor nephrectomy. In summary, the role of MR imaging in the renal donor is unproved and there remains a need for comparison with modern multidetector CT angiography.

In a previous report, we outlined the importance of clinicoradiological review of errors in live donor MDCTA [50]. Following one missed accessory artery and one missed venous anomaly, collimated slice width was reduced with greater vigilance for accessory and early-branching arteries. This led to significant improvements in performance in the group 2 over group 1. Whilst this may reflect a learning curve and experience, it emphasizes the importance of close liaison with the surgical team and review of radiological errors. It is essential that in a live donor programme there are regular clinicoradiological meetings to discuss discrepancies and identify any need for improvements to image acquisition and interpretation. With close collaboration between radiologist and surgeon, multidetector CT is a highly sensitive and accurate modality in evaluating the potential kidney donors.

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Conflict of interest

None.

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