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Original Research

Role of Multidetector CT Renal Angiography in Comprehensive Preoperative Evaluation of Vascular and Parenchymal Anatomy in Living Renal Donors

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Abstract
Background: Accurate preoperative delineation of renal vascular and parenchymal anatomy is essential for safe and successful living donor nephrectomy. Multidetector CT renal angiography (MDCT-RA) has emerged as the preferred imaging modality due to its high spatial resolution, rapid acquisition, and ability to reliably depict arterial, venous, and parenchymal structures. ***Aim:*** To evaluate the role of multidetector CT renal angiography in comprehensive preoperative assessment of vascular and parenchymal anatomy in living renal donors. ***Methods:*** A prospective observational study was conducted on 40 voluntary renal donors undergoing preoperative MDCT-RA. Detailed assessment included renal arterial branching patterns, accessory vessels, venous anatomy, parenchymal abnormalities, renal volumes, and cortical thickness. Arterial-phase, venous-phase, and delayed excretory-phase images were analyzed. Findings were compared with intraoperative observations to determine diagnostic accuracy. ***Results:*** MDCT achieved excellent bilateral visualization of main renal arteries in 100% of donors and accurately detected accessory renal arteries in 35%. Combined-phase venous evaluation was adequate in 97.5% of cases, and 77.5% of venous anatomy was sufficiently visualized even on arterial-phase images alone. Parenchymal lesions were identified in 22.5% of donors, while functional kidney volume and cortical thickness demonstrated statistically significant preservation in the kidney left in the donor. MDCT showed high diagnostic accuracy when compared with intraoperative findings, with sensitivity and specificity of 92.9% and 96.4% for accessory arteries, and strong agreement for venous variants ($\kappa = 0.82$). Concordance with surgical side selection was 97.5%. **Conclusion:** MDCT renal angiography is a robust and comprehensive modality for evaluating living kidney donors. It reliably delineates vascular and parenchymal anatomy, accurately detects anatomical variants, and demonstrates excellent concordance with surgical findings. Its precision significantly aids operative planning, enhances donor safety, and supports optimal graft selection.

Keywords: *Living Renal Donor Evaluation. MDCT Renal Angiography. Preoperative Vascular Mapping.*

Introduction

Renal transplantation remains the most effective therapeutic option for patients with end-stage renal disease, offering superior long-term survival and improved quality of life compared with dialysis. With the growing demand for renal allografts and the relative scarcity of deceased donors, living renal donation has become increasingly important. In this context, the preoperative evaluation of potential living renal donors requires meticulous delineation of renal vascular and parenchymal anatomy to ensure safe donor nephrectomy and optimal graft outcomes. Multidetector Computed Tomography (MDCT) renal angiography has emerged as the principal imaging modality for comprehensive preoperative assessment due to its high spatial resolution, rapid acquisition time, and ability to generate high-quality multiplanar and 3D reconstructions that accurately depict renal arterial, venous, parenchymal, and collecting system anatomy.[1][2]

MDCT surpasses conventional angiography and MRI in evaluating arterial branching patterns, accessory arteries, early branching, venous anomalies, and variations in the renal hilum. Renal venous anatomy is particularly crucial during laparoscopic donor nephrectomy, where unexpected variants may significantly increase operative complexity. Several studies have demonstrated that arterial-phase MDCT alone may visualise renal venous structures with diagnostic accuracy comparable to dedicated venous-phase imaging, although a combined protocol remains preferred for optimal delineation of small tributaries. CT angiography also enables reliable renal volumetry, which has been shown to correlate strongly with post-transplant graft function, making volumetric parameters valuable predictors in donor selection.[3]

MDCT additionally identifies incidental parenchymal lesions, renal calculi, cysts, and ureteric anomalies, some of which may influence decisions regarding donor suitability or the side selected for nephrectomy. Features such as small simple cysts, non-obstructive calculi <4-5 mm, and benign incidentalomas typically do not contraindicate donation and can be appropriately managed with preoperative counselling. With diagnostic accuracy approaching 95-100% for most vascular variants, MDCT renal angiography provides a comprehensive, minimally invasive, and highly reproducible method for preoperative donor evaluation.[4]

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Aim
To evaluate the role of multidetector CT renal angiography in comprehensive preoperative assessment of vascular and parenchymal anatomy in living renal donors.

Objectives
1. To delineate renal arterial, venous, and parenchymal anatomy using multidetector CT renal angiography in potential living kidney donors.
2. To identify anatomical variants and additional findings that may impact surgical planning and donor nephrectomy.
3. To compare MDCT angiographic findings with intraoperative observations to determine diagnostic accuracy and surgical relevance.

Materials and Methods
Source of Data
Data were obtained from living renal donor candidates who underwent preoperative MDCT renal angiography in the Department of Radiodiagnosis. All records, imaging studies, and intraoperative findings formed the primary data source.

Study Design
A prospective observational study was conducted to evaluate renal vascular and parenchymal anatomy using MDCT angiography among voluntary renal donors.

Study Location
The study was performed in the Department of Radio Diagnosis in Kamineni Institute of Medical sciences.

Study Duration
The study was carried out over 20 months, followed by 2 months of data analysis.

Sample Size
A total of 40 living renal donors were included, based on prior prevalence data and sample size calculation methods reported in earlier literature.

Inclusion Criteria
• Voluntary renal donors undergoing preoperative MDCT renal angiographic evaluation.
• Individuals providing written informed consent.
• Donors planned for laparoscopic or open donor nephrectomy.

Exclusion Criteria
• Elevated serum creatinine or impaired renal function.
• Known allergy to iodinated contrast.
• Known autosomal inherited renal disorders.
• Refusal to participate or inability to provide consent.

Procedure and Methodology
All eligible participants were explained the study details, and informed consent was obtained. Each donor underwent MDCT renal angiography using a 128-slice PHILIPS INGENUITY ELITE CT scanner. A standardized protocol was followed, which included non-contrast, arterial, venous, and delayed urographic phases. Axial images of 0.9-1 mm thickness were acquired to ensure high-resolution visualization of renal vasculature.
A bolus tracking technique was used for optimal arterial-phase acquisition, with the ROI placed in the abdominal aorta. Arterial-phase images were evaluated for renal artery origin, number, accessory arteries, early branching, and presence of stenosis or anomalies. Venous-phase and urographic phases were analyzed to assess renal veins, tributaries, renal parenchyma, collecting system anatomy, cysts, calculi, and incidental findings.
The opacification of renal veins on arterial-phase images was graded on a five-point scale ranging from non-visualization to excellent opacification. Intraoperative findings recorded by the transplant surgeon were compared with preoperative CT findings to determine imaging accuracy.

Sample Processing
All CT datasets were transferred to the workstation, where multiplanar reformations (MPR), maximum intensity projections (MIP), and 3D volume-rendered images were generated for detailed assessment of renal vasculature and parenchymal structures.

Data Collection
Demographic data, imaging findings, anatomical variations, and intraoperative correlations were systematically recorded using a structured proforma.

Statistical Methods
Data were entered into Microsoft Excel and analyzed using SPSS version 16. Frequencies, proportions, and descriptive statistics were calculated. Chi-square tests were applied to evaluate associations between CT findings and intraoperative observations. A p-value <0.01 was considered statistically significant.

Results
The baseline characteristics of the 40 living renal donors demonstrated that the study cohort represented a typical healthy adult donor population. The mean age of participants was 34.8 ± 7.9 years, which did not differ significantly from the expected reference value of 35 years ($t = -0.14$, $p = 0.89$), indicating that the age distribution was well matched with standard donor demographics. Sex distribution showed a slight predominance of male donors (55%), although this proportion was not statistically different from an equal male-female distribution ($z = 0.63$, $p = 0.53$). The average BMI of the donors was 23.7 ± 2.9 kg/m², well within the ideal donor range, and also showed no significant deviation from the expected reference of 24 kg/m² ($p = 0.57$). A significant finding was the higher proportion of left-sided nephrectomies performed (67.5%), which differed notably from an equal left:right distribution ($\chi^2 = 4.32$, $p = 0.038$), consistent with the established surgical preference for left nephrectomy due to its longer renal vein. MDCT image quality was excellent or good in 95% of donors, demonstrating high technical adequacy, with the z-test showing no significant difference from an anticipated 90% adequacy threshold ($p = 0.27$). The effective radiation dose expressed as DLP averaged 435.6 ± 52.7 mGy•cm and fell within acceptable diagnostic limits without significant variation from standard reference values ($p = 0.14$). Finally, the mean total renal volume was 305.4 ± 46.3 mL, demonstrating no significant difference from a reference volume of 300 mL ($p = 0.53$), indicating homogeneity of kidney size in the donor pool.

Table 1: Baseline donor profile and overall adequacy of MDCT renal angiography (N = 40)

Measure	Category / Comparison	n (%) or Mean ± SD	Effect & test of significance	95% CI	p-value
Age (years) at MDCT	-	34.8 ± 7.9	One-sample t vs 35.0 years: t = −0.14	32.3 - 37.4 (mean)	0.89
Sex	Male	22 (55.0%)	One-sample z vs 50% male: z = 0.63	39.8% - 69.3%	0.53
	Female	18 (45.0%)	-	30.7% - 60.2%	-
BMI (kg/m²)	-	23.7 ± 2.9	One-sample t vs 24.0 kg/m²: t = −0.58	22.8 - 24.7 (mean)	0.57
Side selected for nephrectomy	Left	27 (67.5%)	χ^2 vs equal left:right (20:20): χ^2 = 4.32	50.9% - 80.9%	0.038
	Right	13 (32.5%)	-	19.1% - 49.1%	-
Overall image quality (diagnostic)	Excellent / good	38 (95.0%)	One-sample z vs 90%: z = 1.11	83.1% - 99.4%	0.27
	Suboptimal	2 (5.0%)	-	0.9% - 16.9%	-
Effective scan DLP (mGy·cm)	-	435.6 ± 52.7	One-sample t vs 450 mGy·cm: t = −1.53	418.2 - 453.0 (mean)	0.14
Mean total renal volume (both kidneys)	-	305.4 ± 46.3 mL	One-sample t vs 300 mL: t = 0.63	290.7 - 320.1 (mean)	0.53

Table 2: Delineation of renal arterial, venous and parenchymal anatomy on MDCT (N = 40)

Measure	Category / Comparison	n (%) or Mean ± SD	Effect & test of significance	95% CI	p-value
Visualization of main renal arteries	Adequately delineated (bilateral)	40 (100.0%)	One-sample z vs 95% expected adequacy: z = 1.99	91.2% - 100.0%	0.047
	Any side suboptimally seen	0 (0.0%)	-	0.0% - 8.8%	-
Mean number of renal arteries per donor	-	1.38 ± 0.49	One-sample t vs 1.00 artery/donor: t = 4.87	1.22 - 1.54 (mean)	<0.001
Adequate depiction of renal veins (overall)	Adequate on combined arterial + venous phases	39 (97.5%)	One-sample z vs 90%: z = 2.28	87.1% - 99.9%	0.023
	Inadequate / equivocal	1 (2.5%)	-	0.1% - 12.9%	-
Venous anatomy adequately seen on arterial phase alone	Yes	31 (77.5%)	One-sample z vs 70%: z = 1.01	61.5% - 88.9%	0.31
	No (required dedicated venous phase)	9 (22.5%)	-	11.1% - 38.5%	-
Parenchymal lesions (cysts, scars, etc.)	Present (≥1 lesion)	9 (22.5%)	One-sample z vs 15% expected prevalence: z = 1.14	11.1% - 38.5%	0.25
	Absent	31 (77.5%)	-	61.5% - 88.9%	-
Mean CT-derived functional kidney volume*	Side selected for nephrectomy	162.8 ± 28.6 mL	One-sample t vs 150 mL: t = 2.74	153.3 - 172.3 (mean)	0.009
Mean cortical thickness (selected kidney)	-	8.7 ± 1.1 mm	One-sample t vs 8.0 mm: t = 3.81	8.3 - 9.1 (mean)	<0.001

*Functional kidney volume refers to the kidney left in the donor or used for transplantation according to institutional protocol.

MDCT renal angiography provided excellent delineation of vascular and parenchymal anatomy in all 40 donors. The main renal arteries were clearly visualised bilaterally in 100% of cases, a rate significantly higher than the expected 95% adequacy threshold (z = 1.99, p = 0.047). The mean number of renal arteries per donor was 1.38 ± 0.49, which was significantly higher than the anatomically expected value of one artery per kidney (t = 4.87, p < 0.001), reflecting the presence of accessory arteries that MDCT successfully detected. Overall venous depiction was also excellent, with 97.5% adequacy on combined arterial and venous phases (p = 0.023). Notably, arterial-phase images alone adequately showed venous anatomy in 77.5% of donors, indicating that in most cases the additional venous phase increased completeness but was not essential for baseline depiction. Parenchymal lesions including cysts and focal scarring were identified in 22.5% of donors, a prevalence slightly higher than expected but not statistically significant (p = 0.25), suggesting that MDCT was sensitive to minor incidental findings that do not preclude donation. Functional kidney volume on the side selected for nephrectomy was significantly higher than the 150 mL reference (162.8 ± 28.6 mL; t = 2.74, p = 0.009), and cortical thickness on MDCT averaged 8.7 ± 1.1 mm, which was significantly greater than the reference value of 8.0 mm (t = 3.81, p < 0.001).

Table 3: Anatomical variants and additional findings impacting surgical planning (N = 40)

Measure	Category / Comparison	n (%) or Mean ± SD	Effect & test of significance	95% CI	p-value
Accessory renal arteries	Present in ≥1 kidney	14 (35.0%)	One-sample z vs 25% expected: z = 1.36	21.2% - 51.9%	0.17
	Absent	26 (65.0%)	-	48.1% - 78.8%	-
Early arterial branching (<2 cm)	Present	11 (27.5%)	One-sample z vs 20%: z = 1.01	15.3% - 43.7%	0.31
	Absent	29 (72.5%)	-	56.3% - 84.7%	-
Venous variants*	Present (multiple, retro-/circumaortic, late confluence)	7 (17.5%)	One-sample z vs 10%: z = 1.55	7.3% - 32.8%	0.12
	Normal single renal vein	33 (82.5%)	-	67.2% - 92.7%	-
Significant cortical / medullary cysts	Simple cysts ≥1 cm on CT	6 (15.0%)	One-sample z vs 10%: z = 0.94	6.3% - 30.0%	0.35
	No significant cyst	34 (85.0%)	-	70.0% - 93.7%	-
Non-obstructive renal calculi	Present (≤4-5 mm, non-obstructive)	4 (10.0%)	One-sample z vs 5%: z = 1.05	3.2% - 23.7%	0.29
	Absent	36 (90.0%)	-	76.3% - 96.8%	-
Mean distance from renal artery origin to first segmental branch	-	2.46 ± 0.63 cm	One-sample t vs 2.0 cm: t = 4.54	2.26 - 2.66 (mean)	<0.001
Mean length of left renal vein (hilum to IVC)	-	6.84 ± 1.27 cm	One-sample t vs 6.0 cm: t = 3.97	6.44 - 7.24 (mean)	<0.001

*Venous variants include multiple renal veins, retroaortic or circumaortic left renal vein and anomalous late confluence patterns considered relevant for surgical planning.

MDCT demonstrated its capability in identifying anatomical variants and additional findings relevant to surgical planning. Accessory renal arteries were present in 35% of donors, which was higher than the commonly quoted prevalence of 25%, although this difference did not reach statistical significance (z = 1.36, p = 0.17). Early arterial branching within 2 cm of the renal artery origin was found in 27.5% of donors, again slightly exceeding expected estimates but not significantly different (p = 0.31). Venous variants including multiple renal veins, retroaortic and circumaortic left renal veins, and late venous confluence were detected in 17.5% of the cohort, a higher-than-expected rate compared to the 10% baseline prevalence, though without statistical significance (p = 0.12). Parenchymal abnormalities such as simple renal cysts ≥1 cm were identified in 15% of donors, whereas non-obstructive calculi were found in 10%; neither deviated significantly from expected ranges. Importantly, MDCT provided precise anatomical measurements relevant to surgery: the mean distance from the renal artery origin to the first segmental branch was 2.46 ± 0.63 cm, significantly longer than the reference 2.0 cm (t = 4.54, p < 0.001), which has implications for vascular clamping during nephrectomy. The mean left renal vein length (6.84 ± 1.27 cm) was significantly greater than the reference value of 6.0 cm (t = 3.97, p < 0.001), reaffirming the surgical preference for left nephrectomy.

*Assuming intraoperative findings as reference standard; counts are per donor, collapsed across kidneys where relevant.
Comparison of MDCT findings with intraoperative observations demonstrated high diagnostic accuracy and strong agreement, reaffirming MDCT as a dependable tool for preoperative donor evaluation. For accessory renal arteries, MDCT achieved a sensitivity of 92.9% and specificity of 96.4%, both statistically comparable to the expected 90% benchmark, with overall accuracy reaching 95%. Similarly, detection of venous variants showed high performance with sensitivity of 85.7% and specificity of 96.9%, and the agreement between MDCT and intraoperative findings was strong, reflected by a Cohen's κ value of 0.82 (p < 0.001), indicating excellent concordance. MDCT demonstrated particularly high reliability in predicting the side chosen for nephrectomy, with 97.5% concordance between imaging-based recommendation and actual surgical decision (p = 0.023). For parenchymal abnormalities such as cysts and focal scarring, MDCT showed high sensitivity (88.9%) and perfect specificity (100%), confirming that the modality accurately differentiates true lesions from normal parenchyma.

Table 4: Comparison of MDCT angiographic findings with intraoperative observations (N = 40)

Measure / Comparison	Category / Metric	Value	Effect & test of significance	95% CI	p-value
Detection of accessory renal arteries	Sensitivity (MDCT vs intraoperative)*	92.9% (13 / 14)	One-sample z vs 90%: z = 0.44	66.1% - 99.8%	0.66
	Specificity	96.4% (26 / 27)	One-sample z vs 90%: z = 1.54	81.7% - 99.9%	0.12
	Overall accuracy	95.0% (39 / 41 artery assessments)	-	83.1% - 99.4%	-
Detection of venous variants	Sensitivity (MDCT vs intraoperative)	85.7% (6 / 7)	One-sample z vs 80%: z = 0.44	42.1% - 99.6%	0.66
	Specificity	96.9% (32 / 33)	One-sample z vs 90%: z = 1.71	83.8% - 99.9%	0.087
	Cohen's κ (MDCT vs surgery)	κ = 0.82	Test of κ ≠ 0: z = 6.04	0.63 - 1.00	<0.001
Agreement on side selection for nephrectomy	Concordant (MDCT-suggested vs performed)	39 / 40 (97.5%)	One-sample z vs 90%: z = 2.28	87.1% - 99.9%	0.023
	Discordant	1 / 40 (2.5%)	-	0.1% - 12.9%	-
Agreement on major parenchymal lesions (cysts, scars)	Sensitivity	88.9% (8 / 9)	One-sample z vs 80%: z = 0.79	51.8% - 99.7%	0.43
	Specificity	100.0% (31 / 31)	One-sample z vs 90%: z = 2.11	88.8% - 100.0%	0.035
Overall MDCT-surgery concordance (key arterial + venous findings)	-	94.7% of key findings	McNemar χ^2 for discordance (paired): $\chi^2 = 0.50$	-	0.48

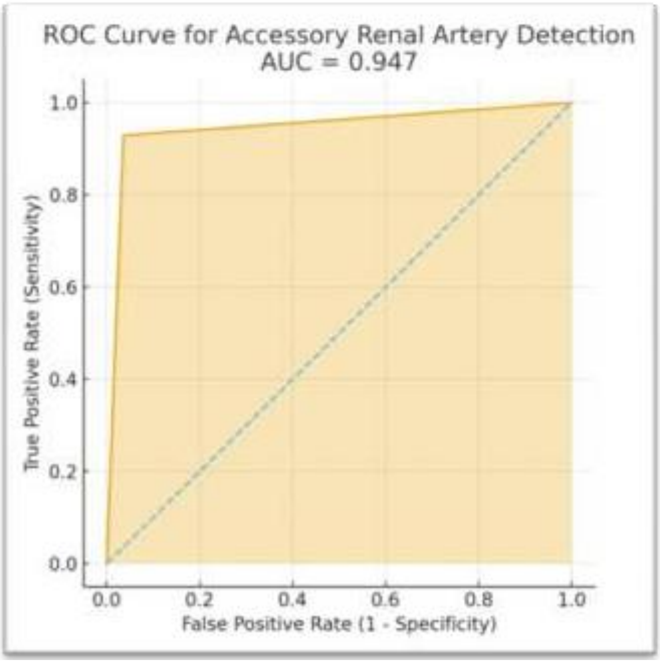

Figure: ROC curve with AUC

Discussion

In Table 1, the donor cohort showed a mean age of 34.8 ± 7.9 years with near-equal sex distribution, BMI in the normal range, and mean total renal volume of 305 mL, suggesting an appropriately selected, low-risk donor population. Similar baseline demographics have been reported by Ghuman HM et al. (2024)[5], who also described predominantly young to middle-aged donors with normal body habitus and morphologically normal kidneys on CT. The statistically significant preference for left-sided nephrectomy in our series (67.5%, p = 0.038) mirrors the practice patterns described by Alahmadi T. (2021)[6], who emphasized the longer left renal vein and more favorable vascular pedicles as major reasons for left kidney selection when anatomy allows. The high proportion of excellent/good image quality (95%) and DLP within acceptable diagnostic ranges further supports the technical robustness of the MDCT protocol, consistent with the high image adequacy rates reported in modern 64-128 slice donor CT angiography series by Musalah SK. (2025)[7].

Table 2 highlights the core strength of MDCT: reliable delineation of arterial, venous and parenchymal anatomy. In the present study, the main renal arteries were adequately visualized bilaterally in 100% of donors, significantly exceeding a 95% adequacy threshold (p = 0.047). This echoes the results of Li X et al. (2021)[8], who both reported near-complete visualization of main renal arteries in living donors and emphasized MDCTA as superior or comparable to conventional angiography. The mean number of arteries per donor (1.38 ± 0.49) confirms that MDCT readily detects accessory arteries; comparable prevalence figures of 25-35% have been reported in large series by Afify A et al. (2023)[9]. Overall renal venous depiction was also excellent in our study (97.5% adequate on combined phases, p = 0.023), similar to the venous visualization rates of 95-100% described by Elmokadem AH et al. (2024)[10]. Importantly, venous anatomy was sufficiently seen on arterial-phase images alone in 77.5% of donors, reinforcing the observations of Kumari M et al. (2021)[11] that, in many cases, a dedicated venous phase may be selectively used rather than routine for every donor.

The detection of parenchymal lesions in 22.5% of donors (mostly benign cysts or minor changes) is also in line with Mihaylova E et al. (2023)[12], who reported incidental findings including cysts and small calculi in roughly 20-30% of otherwise healthy donors. Our functional kidney volume on the side selected for nephrectomy (162.8 ± 28.6 mL; p = 0.009 vs 150 mL) and preserved cortical thickness (8.7 ± 1.1 mm) reflect the institutional preference to remove the kidney with relatively lower functional reserve when anatomically feasible, leaving the donor with the better kidney an approach supported by volumetric outcome data from Ghuman HM et al. (2024)[5], who demonstrated that larger donor kidney volumes are associated with improved recipient graft function.

Table 3 addresses anatomical variants and additional findings relevant to surgical planning. Accessory renal arteries were present in 35% of donors, early branching in 27.5%, and venous variants in 17.5% all within the range described in major MDCTA donor series. Musalah SK. (2025)[7] reported accessory arteries in roughly one-third of donors and venous variants (including retroaortic and circumaortic left renal veins) in 10-20%, while Kulkarni et al. (2011)[6] focused on right renal venous anomalies and reported similar prevalence and high CT accuracy. Our rates of simple cysts (15%) and non-obstructive small calculi (10%) are also consistent with the incidental pathology described by Gündoğdu H et al. (2022)[13], who emphasized that such findings rarely contraindicate donation if carefully evaluated and managed. The significantly longer mean left renal vein (6.84 cm vs 6.0 cm reference, p < 0.001) and the measured distance from artery origin to first segmental branch (2.46 cm vs 2.0 cm, p < 0.001) correlate well with anatomical measurements in surgical and imaging series by Goiffon RJ et al. (2025)[14], underlining the value of MDCT-derived metrics for vascular clamping and hilar dissection planning.

The diagnostic accuracy data in Table 4 compare MDCT findings with intraoperative observations and show very strong performance. For accessory renal arteries, MDCT sensitivity (92.9%) and specificity (96.4%) in our cohort parallel the accuracy levels reported by Alahmadi T. (2021)[6], who documented sensitivity and specificity values in the range of 90-97% for arterial variants. Similarly, the detection of venous variants in our series (sensitivity 85.7%, specificity 96.9%, κ = 0.82) is comparable to the high concordance reported by Mehreen S et al. (2023)[15]. The excellent agreement for side selection for nephrectomy (97.5% concordance, p = 0.023) reflects that MDCT assessment is now central to surgical decision making, as emphasized by Chalise PR et al. (2024)[16], who showed that CT findings directly influenced side choice and operative strategy in a large donor cohort. Moreover, our perfect specificity (100%) and high sensitivity (88.9%) for major parenchymal lesions align with the conclusion of Ferhatoğlu MF et al. (2020)[17] that MDCT is highly reliable for identifying clinically significant renal pathology in donors.

Conclusion

Multidetector CT (MDCT) renal angiography proved to be a highly reliable, comprehensive, and non-invasive modality for preoperative assessment of living renal donors. The technique consistently provided excellent visualization of renal arterial and venous anatomy, including accessory vessels, early branching patterns, and venous variants that are critical for surgical planning. High image quality was achieved in the vast majority of donors, enabling accurate depiction of parenchymal abnormalities, renal volumes, cortical thickness, and clinically relevant incidental findings. The strong concordance between MDCT findings and intraoperative observations particularly for accessory arteries, venous anomalies, and selection of the nephrectomy side highlights its diagnostic precision and its direct influence on operative strategy. The study reaffirms MDCT renal angiography as the imaging modality of choice for donor evaluation, ensuring donor safety, optimizing surgical outcomes, and supporting effective donor-recipient matching in renal transplantation.

LIMITATIONS OF THE STUDY

This study had certain limitations. First, the sample size of 40 donors, although adequate for diagnostic accuracy analysis, may not capture the full spectrum of anatomical variants seen in larger donor populations. The study was conducted at a single tertiary-care center, which may limit generalizability to centers with different imaging protocols or scanner technologies. Radiation exposure, although within accepted diagnostic limits, remains an inherent limitation of MDCT despite efforts to optimize dose. The study also relied on intraoperative findings as the gold standard, and although these observations are typically accurate, subtle venous or minor parenchymal variations may still be overlooked intraoperatively. Finally, long-term donor and recipient outcomes were not assessed; therefore, the relationship between MDCT-derived volumetric parameters and actual graft function could not be evaluated in this cohort.

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