

# Correlation of imaging data and intraoperative data of vascular abnormalities during kidney transplantation

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## Abstract

*ORenal transplantation from a living related donor represents an alternative for patients with end-stage chronic kidney disease. This requires a precise preoperative assessment of the donor in order to determine the side of the kidney to be removed according to the anatomical conditions, in particular the renal vascularization.*

*The presence of vascular anomalies within the couple poses a real problem at several stages:*

- Donor selection stage.
- Choice of side to be withdrawn.
- Surgical step during kidney removal and transplantation with greater operational risks compared to a donor without vascular abnormalities, which may compromise the future of the transplant.

*The objective of our work is to correlate the results of imaging, which allows the diagnosis of vascular abnormalities in renal transplantation from living related donors, and the surgical data.*

*This is a retrospective study, carried out on 259 living related donors, extended over a period of 8 years, concerning renal transplants from living related donors (DVA) performed at the Ibn Rochd University Hospital in Casablanca.*

*We report a series of 22 couples presenting vascular anomalies of different types found during the renal transplant process during the radiological assessment or during the operation, as well as the sensitivity of the imaging means to detect the various vascular anomalies.*

*Renal transplantation with vascular anomaly requires surgical expertise, both during the harvest and during the renal transplant, as well as collaboration between the various stakeholders "surgeons, radiologists, nephrologists and anesthetists" for the success of the transplant.*

**Goal:** *To assess the prevalence of vascular abnormalities in kidney transplantation from living related donors, the imaging means that allow their diagnosis, and the correlation between the imaging results and the intraoperative data.*

## Introduction

The presence of vascular abnormalities within the couple during kidney transplantation poses a real problem at several stages:

- Donor selection stage.
- Choice of side to be withdrawn.
- Surgical step during kidney removal and transplantation with greater operational risks compared to a donor without vascular abnormalities, which may compromise the future of the transplant.

We report a series of 22 couples with vascular abnormalities found during the renal transplant process performed in the urology department at Ibn Rochd University Hospital over a

period of 8 years.

## RESULTS

On angiography scanner 27 vascular anomalies were found, 20 arterial anomalies including 13 of number (9 double arteries, 2 triple arteries, 2 accessory polar arteries) and 7 of morphologies (7 early arterial bifurcations) and 7 venous including 2 supernumerary veins (2 double renal veins), 3 situations (2 retro aortic veins and a left inferior vena cava) and 2 morphology (a bifid renal vein and an early vein bifurcation).

Two patients were rejected for vascular abnormalities seen on CT angiography. The left side was chosen for sampling in 15 patients, and the right side

in 5 patients. Among these 20 living donors, the sample

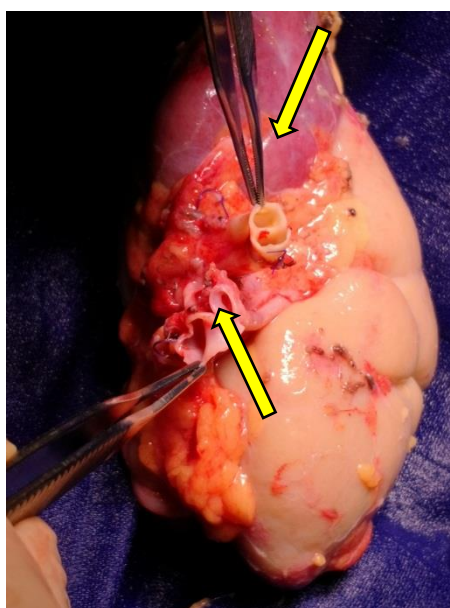
was taken from the side of the vascular abnormality in 8 cases.

of which are unrecognized by CT angiography. The various anomalies found are detailed in Table 1.

During the operation, there are 25 vascular anomalies, 13

**Table 1:** Vascular abnormalities found intraoperatively

Anomaly	Percentage	Number of cases
Early arterial bifurcation	24 %	6 cases
Double kidney vein	16 %	4 cases
Short renal vein	12 %	3 cases
Double artery	8 %	2 cases
Triple artery	8 %	2 cases
Superior polar artery	4 %	1 cases
Small artery	8 %	2 cases
Left VCI	4 %	1 cases
Retro aortic vein	4 %	1 cases
Bifid renal vein	8 %	2 cases
Early venous bifurcation	4 %	1 cases



**Figure 1:** Early bifurcation of the renal artery and vein

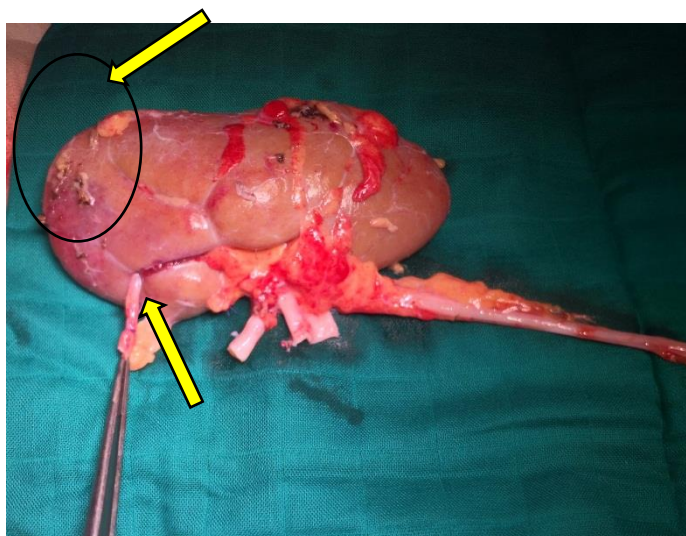


Figure 2: Ligated superior polar artery with ischemia zone <30%

Table 2: Correlation of vascular abnormalities between CT angiography data and surgical results

	Side CT	CT angiography result	Intraoperative result
Giver 1	Left	Retro aortic renal vein	Retro aortic renal vein
Giver 2	Left	Early arterial bifurcation	Early arterial bifurcation
Giver 3	Right	Early arterial bifurcation	Early arterial bifurcation
Giver 4	Left	Early bifurcation + bifid renal vein	Early bifurcation + bifid renal vein
Giver 5	Right	Double renal artery	Double renal artery
Giver 6	Left	Single artery and vein of normal morphology	Single artery and vein of normal morphology
Giver 7	Right	Single artery and vein of normal morphology	Single artery and vein of normal morphology
Giver 8	Left	Superior polar artery	Superior polar artery
Giver 9	Left	Left IVC	Double renal artery + left IVC
Giver 10	Left	Single artery and vein of normal morphology	Early left arterial bifurcation
Giver 11	Right	Main trunk (L = 35 mm; D = 6 mm) + small spindly artery upper polar accessory of the same trunk as the adrenal artery	Triple renal artery of which 2 are hailstones
Giver 12	Left	Early bifurcation of the left renal artery associated with an accessory polar artery	Triple renal artery
Giver 13	Left	Unique renal artery and vein of normal morphology	Double renal vein
Giver 14	Left	Unique renal artery and vein of normal morphology	Double renal vein
Giver 15	Left	Unique renal artery and vein of normal morphology	Double renal vein
Giver 16	Right	Unique renal artery and vein of normal morphology	Short renal vein
Giver 17	Right	Unique renal artery and vein of normal morphology	Double renal vein + vein short renal
Giver 18	Left	Early arterial bifurcation	Early arterial bifurcation + short renal vein
Giver 19	Left	Unique renal artery and vein of normal morphology	Small artery + early venous bifurcation
Giver 20	Left	Early arterial bifurcation and single renal vein of normal morphology	Early arterial bifurcation and bifidity of the renal vein

**DISCUSSION**

**Frequency of vascular abnormalities:** The overall frequency of vascular abnormalities is very diverse from one study to another. In the study by Singh and AL [1], the overall frequency was 28% for 36 living related donors, of whom 10 had vascular abnormalities.

Lim and AL [2] found an overall frequency of 17% for 109

DVA, of which 19 presented vascular anomalies.

In our study the overall frequency was 8.5%.

**Diagnostic method:** The Angioscanner is the Gold standard for the preoperative work-up, which allows a good understanding of the vascular anatomy of the graft. [3], [4]

We notice a sensitivity of 100% for Turkvatan and al. [5]

for major arterial and venous abnormalities and less sensitivity for minor venous abnormalities amounting to 79%. Rashid and al [6] also reported in their study a sensitivity of 100% all anomalies combined.

Tombul and al [7] found in his study that CT angiography has a sensitivity of around 95% for the detection of arterial anomalies and 93% for venous anomalies.

Angio MRI is not the gold standard in the pre-transplant workup, but can replace angiography as a safe and accurate modality for the evaluation of the vascular anatomy of potential living donors.

**Correlation between radiological data and surgical data:** The study by Turkvatan and al. [5] found a correlation rate between radiological and surgical data of 100%.

In the Platt and al. [8] study, we noticed a correlation rate between radiological and surgical data of 95% with 5 cases of accessory renal arteries (less than 2mm in diameter) and one case of early arterial bifurcation not seen on CT angiography.

In the literature, several authors have discussed that a weak correlation is sometimes found between radiological and surgical data when trying to point the finger at these reasons:

- Poor CT Angiography in detecting small caliber accessory branches.
- The lack of rereading of the CT images exposing the risk of overriding an anomaly, hence the interest of collaboration between radiologists for a possible rereading.
- And finally the lack of codification of the procedure for evaluating renal anatomy where the sections must be thin enough to detect certain abnormalities.

### Anomalies discovered during the operation:

**Arterial Anomalies of Number:** We notice a low rate of multiple renal arteries of all types compared to the literature, this is due to the choice of the opposite side in most patients in whom we have found an anomaly of number and this in order to improve the prognosis of the graft. Note that for the study by Platt and al. [8] 5 accessory arteries were not seen underlining the difficulty that CT Angiography finds in visualizing them.

Marcel and al [9] have demonstrated that grafts with multiple renal artery were associated with a higher risk of complication, but had comparable long-term outcomes in terms of graft and patient survival rates. For this reason, the presence of MRA should be a contributing factor in the decision regarding which kidney is best for donation.

It is the most frequently found anatomical variant with a prevalence of 32.4% of a double renal artery, and 5% of a triple renal artery. [10]

**Arterial Anomalies of Morphology:** The rate of early bifurcations of the renal arteries found during the operation in our series is similar to those found in the literature.

The results obtained on CT angiography and those reported in the intraoperative phase are consistent, thus denoting the sensitivity of CT angiography to early arterial bifurcations.

**Venous Number Anomalies:** We notice a discrepancy between the results of the CT angiography and the surgical data, which was confirmed by our study as well as the data in the literature, which is the studies of Raman and al [11], Rashid and al [6] and Platt and al [8].

**Venous Anomalies of Morphology:** In the literature, we find in Platt and Al [8] and Turkvatan [5] and al early venous bifurcation at the respective rates of 3.7% and 14.28%. In our study 2 cases of venous morphological abnormalities “An early bifurcation and a bifid renal vein” were found intraoperatively and not seen on CT angiography.

### Conclusion

Now kidney transplantation is increasingly recognized as the first choice therapeutic alternative for chronic renal failure, so surgical expertise in harvesting and transplantation is required for comparable results in the absence of vascular abnormalities.

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