Radiological study of role of multi-detector CT in the pre-operative work up of potential renal donors

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ABSTRACT

Background: Kidney Transplantation, although the most cost-effective and preferred treatment in patients with end-stage renal disease, is limited by severe shortage of cadaver kidneys. To ameliorate this limitation, use of living donors is now widely accepted, in particular because it results in better recipient and renal graft survival. It has beenshown that transplantation survival for kidneys from living donors, is higher than cadaveric sources (80% vs. 67% at 5 years). **Aim & Objective:** 1. Radiological study of role of multi-detector CT in the pre-operative work up of potential renal donors. 2.To determine the accuracy of multi-detector CT as the primary imaging technique in the evaluation of living kidney donor. **Methods: Study design:** Prospective Observational study. **Study setting:** Department of Radio-diagnosis, Bombay Hospital, Mumbai. **Study duration:** From June 2012 to May 2014 (2 years). **Study population:** A total of 30 potential donors were selected for study using consecutive type of non-probability Sampling. **Sample size:** 30. **Results:** Mean Age of the study subjects was 47.7 ± 9.9 years. Two third of the patients belonged to age group of 41 to 60 years. 70% of the donors were females while 30% were males. in Right renal artery. Out of total, 80% subjects had single artery (63.3% single while 16.7% had different variations) while remaining 20% had dual renal arteries with different variations. Out of total 83.3% subjects (63.3% single while 20% had different variations) had single artery while remaining 16.7% had dual renal arteries with different variations. Most of the subjects (96.7%) were donors of left sided Kidney while only 3.3% wereright kidney donors. **Conclusions:** Most of donors were female, Most subjects were left Kidney donors, Compared with arteriography and urography, MDCT is less invasive. More important, for pre-surgical planning, MDCT provides highly accurate imaging of the renal collecting and vascular systems, especially in revealingvascular variations.

Keywords: MDCT, Kidney donors, potential renal donors.

INTRODUCTION:

Kidney Transplantation, although the most cost-effective and preferred treatment in patients with end-stage renal disease, is limited by severe shortage of cadaver kidneys[1]. To ameliorate this limitation, use of living donors is now widely accepted, in particular because it results in better recipient and renal graft survival [2,3]. It has beenshown that transplantation survival for kidneys from living donors, is higher than cadaveric sources (80% vs. 67% at 5 years) [4].

Increasing success in the harvest of donor kidneys and development of less invasive laparoscopic nephrectomy have alsocontributed to substantial growth in living-donor kidney transplantation [2,3,5].

The number of living donors has increased dramatically in the last few years. To minimize donor risk and preserve maximum graft function, precise evaluation ofthe donor is a major focus during preoperative preparation [6–9]. Laparoscopic surgery has definite advantages over the open approach. However, conversion to the open approach is not infrequent, with vascular injury the most common reason [9–11].

Therefore, special attention must be paid to preharvest assessment of donor renal vessels in surgery planning. Anatomical evaluation of the donor kidneys is essentialto select the kidney to be used and to choose the appropriate surgical approach [12].

Multidetector Computed Tomography (MDCT) is now considered an appealing and less invasive technique with advantages over conventional catheter angiographyand excretory urography for assessment of potential renal donors [13].

AIM AND OBJECTIVE

OBJECTIVE:

1. Radiological study of role of multi-detector CT in the pre-operative work up of potential renal donors.
2. To determine the accuracy of multi-detector CT as the primary imagingtechnique in the evaluation of living kidney donor.

MATERIAL AND METHODS

Type of Study: Prospective Observational study

Duration of study: June 2012 to May 2014 (two years)

Place of Study: Department of Radio-diagnosis, Bombay Hospital, Mumbai

Sample Size and Technique: A total of 30 potential donors were selected for study using consecutive type of non-probability Sampling.

Between June 2012 to May 2014, 30 consecutive potential donors underwent MDCT at our hospital. All candidates were evaluated using an MDCT scanner(Somatom Sensation 64; Siemens Medical Solutions; Forchheim, Germany).

Selection Criteria:

1. Age > 18 years
2. Candidate should be tobacco free since eight weeks prior to donation.
3. Normal Kidney function tests.
4. Non-reactive for HIV/AIDS, Hepatitis B and C.
5. Not a known case of Hypertension, Diabetes, Coronary heart disease, Valvular heart disease or Peripheral vascular disease.

Exclusion Criteria:

1. ABO Incompatibility with potential recipient.
2. Known case of Diabetic or Hypertensive Nephropathy.
3. BMI > 35 Kg/m^2
4. Donors with family history of polycystic kidney disease.
5. Patients on Nephrotoxic drugs like Aspirin, Ibuprofen, Valdecoxib, etc.

Prior Informed consent from each patient was taken. A plain scan of the kidneys was first acquired. Subsequently, using a mechanical injector, 70 to 80 ml of nonionic iodinated contrast material containing 300 mg/mL of iodine (Ultravist; Schering AG, Berlin-Wedding, Germany) was administered intravenously at 4 to 5 mL/sec via a 18-gauge cannula placed in an antecubital vein. Bolus tracking method was used to obtain arterial phase images followed by venous phase at about 60 seconds after contrast injection.

Delayed images were then acquired after about 5 to 10 minutes. All images were transferred to a workstation (CE Advantage Windows 4.2; CE Healthcare) and reconstructed for CT angiography and CT urography using maximum intensity projection, a volume-rendering technique, and multiplanar re-formation. The respective reconstruction increments were 2.5 mm (unenhanced phase), 1 mm (vascular phases), and 1 mm (excretory phase). The images were reviewed for anatomical details including renal system and its vascular anatomy.

Nephrectomy was then performed in donors. Intra-operatively, the surgeon noted the number, location, and course of renal arteries and veins, and the presence of early arterial branching. The surgical findings at each donor nephrectomy constituted the standard of reference for the imaging findings.

Statistical Analysis:

All the collected data was entered in Microsoft Excel sheet and then transferred to SPSS software ver. 17 for statistical analysis. Qualitative data were presented as frequency and percentages while quantitative data were presented as means and standard deviation.

Result and observation

Table 1. Age Distribution

Age Distribution	Frequency	Percent
20-30	1	3.3
31-40	6	20
41-50	11	36.7
51-60	9	30
> 60	3	10
Total	30	100
Mean Age - 47.7 ± 9.9 years		

Mean Age of the study subjects was 47.7 ± 9.9 years. Two third of the patients belonged to age group of 41 to 60 years.

Table 2. Gender Distribution

Gender	Frequency	Percent
Female	21	70
Male	9	30
Total	30	100

Out of the total, 70% of the donors were females while 30% were males.

Table 3. Distribution based on patterns of right renal artery

Right Renal Artery	Frequency	Percent
Single	19	63.3
Main Artery prehilar		

branching pattern & Accessory artery	2	6.7
Single artery with early branching pattern	2	6.7
Two arteries of different caliber	1	3.3
Single main artery with accessory artery	1	3.3
Single artery showing prehilar branching pattern	2	3.3
Single artery with narrowingin mid segment	1	3.3
Two arteries of same caliber	1	3.3
Two arteries, proximal one with plaque	1	3.3
Total	30	100.0

The above table shows the variations in Right renal artery. Out of total, 80% subjects had single artery (63.3% single while 16.7% had different variations) while remaining 20% had dual renal arteries with different variations.

Table 4. Distribution based on patterns of Left Renal artery

Left Renal Artery	Frequency	Percent
Single artery	19	63.3
Single artery with prehilar branching pattern	5	16.7
Main Artery prehilar branching pattern & Accessory artery	2	6.7
Dual Artery	1	3.3
Dual artery with accessory Upper polar artery	1	3.3
Single main artery with accessory artery	1	3.3
Single artery with proximal plaque	1	3.3
Total	30	100

The above table shows the variations in Left renal artery. Out of total 83.3% subjects (63.3% single while 20% had different variations) had single artery while remaining 16.7% had dual renal arteries with different variations.Out of the 30 subjects, 19 had a single renal artery while 6 had different variations of single artery.

Single artery with prehilar branching pattern was observedin 5 subjects while 1 subject had a Single artery with proximal plaque.Dual arteries and its variations were observed in 5 patients. Main Artery with prehilar branching pattern & Accessory artery was observed in 2 subjects, 2 had dualarteries including 1 accessory artery while 1 had 2 arteries with same caliber.

Table 5. Distribution based on side of Kidney transplant

Kidney For Transplant	Frequency	Percent
Left	29	96.7
Right	1	3.3
Total	30	100

Most of the subjects (96.7%) were donors of left sided Kidney while only 3.3% wereright kidney donors.

DISCUSSION:

A Prospective Observational study was conducted with the aim of evaluating the role of Multi-detector CT in the pre-operative work up of potential renal donors.Detection of the anatomy of renal arteries and confirmation of the absence of any parenchymal critical disease or tumors is essential for preoperative evaluation ofpotential renal donors. In a healthy donor the left kidney is usually harvested becauseof its longer pedicle.

Digital subtraction angiography (DSA) has been used to recognize the number and length of renal arteries and assessment of unsuspected renal artery diseases such as atherosclerosis, aneurysm or fibromuscular dysplasia and renal parenchymal diseases such as cyst, scar or tumor.Although DSA is an accurate technique for this proposes, it is invasive, expensive and accompanies with more major complications such as arterial perforation thrombosis and hematoma.

Development of CT technology currently allows faster scanning and MDCT scanners have provided more detailed data sets them single detector spiral CT. Anatomic information of renal artery is critical for donor nephrectomy. Mean Age of the subjects in our study was 47.7 ± 9.9 years. Two third of the patients belonged to age group of 41 to 60 years. Out of the total, 70% of the donors were females while 30% were males.

Our findings are in accordance with a study conducted by Asghari et al. to compare the accuracy of the use of multidetector computed tomography (MDCT) to evaluate vascular anatomy in living kidney donors with traditional angiography.

Out of the 30 subjects, 19 (63.3%) had a single right renal artery while 5 (16.7%) had different variations of single artery. Single artery with early and prehilar branching pattern was observed in 2 subjects each while 1 had a single artery with narrowing inmid segment. Dual right renal arteries and its variations were observed in 6 (20%) patients. A main artery with prehilar branching pattern and one accessory artery observed in 3 subjects while daul arteries were found in 3 subjects, one each with same calibre, different calibre and with plaque.

Out of the total, 63.3% subjects had a single left renal artery while 16.7% had a single artery with prehilar branching pattern. Main Artery with an accessory artery was observed in 3 subjects while dual arteries were found in 2 subjects.Our results are similar to a study done by okzan et al. who observe renal artery variations on 855 consecutive patients. They observed that there was only one renal artery feeding both of the kidneys in 76% of the patients compared to 80% in our study.

More than one renal artery was found in 202 (24%) patients while dual arteries were observed in 20% subjects in present study. More than one renal artery was observed on the right side in 135 (16%) patients and on the left side in 113 (13%) patients. In 46(5%) patients, there was more than one renal artery on both sides. Of all the observedERA, 16% were on the right and 13% were on the left. There were early divisions in 67 (8%) patients, 32% of which occurred on the

right side, 25% on the left, and 22% on the both sides [14].

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