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# MULTIDETECTOR COMPUTED TOMOGRAPHY (MDCT) ANGIOGRAPHY OF THE RENAL ARTERIES ANATOMY AND ITS VARIATIONS WITH LOW KV TECHNIQUES

**Radio-Diagnosis**

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## ABSTRACT

CT renal angiography is an excellent diagnostic test used to demonstrate the anatomy and patency of blood within the arteries. Reasons for a renal angiogram embrace renal artery stricture, renal artery aneurysm, and Pre-operative assessment for renal transplant. Radiologists investigate the aneurysm and stricture of a blood vessel, or thrombosis in a lumen and also see blood flow in the kidneys region. The patient study was done in our department on 128 slice (Wipro GE) OPTIMA CT machine. In our case study of 572 patients, 152 cases (26.5 %) show variations in the variations of the renal arteries. In 99 cases ( 17.3 %) renal artery is bifurcating early (<1.5mm) and in 53 cases (9.2 %) accessory renal artery is present bilaterally. MDCT renal angiography allows us to provide precise information about the anatomy of the renal vasculature and the possible variants and diseases before surgery. The valuable anatomical information has drastically reduced the risks and complications during and after renal transplant improving the chances for a successful outcome. Knowledge of the surgical techniques performed and exclusion criteria allows radiologists to write an accurate radiological report. There is no significant difference in image quality on the low KV technique but it helps to reduce radiation exposure to patients.

## KEYWORDS

## INTRODUCTION

Kidney transplantation is the treatment of choice for end-stage renal disease [1,2,3]. Live kidney donors have increased over the past 10 years. Advances in imaging have allowed a quick and relatively non-invasive evaluation of the donors´ renal anatomy.

CT renal angiography is an excellent diagnostic test used to demonstrate the anatomy and patency of blood within the arteries. Reasons for a renal angiogram embrace renal artery stricture, renal artery aneurysm, and Pre-operative assessment for renal transplant. Radiologists investigate the aneurysm and stricture of a blood vessel, or thrombosis in a lumen and also see blood flow in the kidneys region. CT angiography has become a standard imaging technique since the advent of CT scans. CTA has been suggested for living renal donor transplant for pre-operative evaluation. CTA is minimally invasive angiography with lower complication rates. CT has high spatial resolution images of each arterial wall and lumen. Availability of multiplanar reconstruction (MPR) and three-dimensional (3D) reconstruction, take a shorter time. The radiation exposure with minimum radiation dose by reducing tube voltage. In the current study, patients underwent CT angiography and then analyzed the image of renal arterial branches report findings & analysis with CTA protocols before renal transplantation.

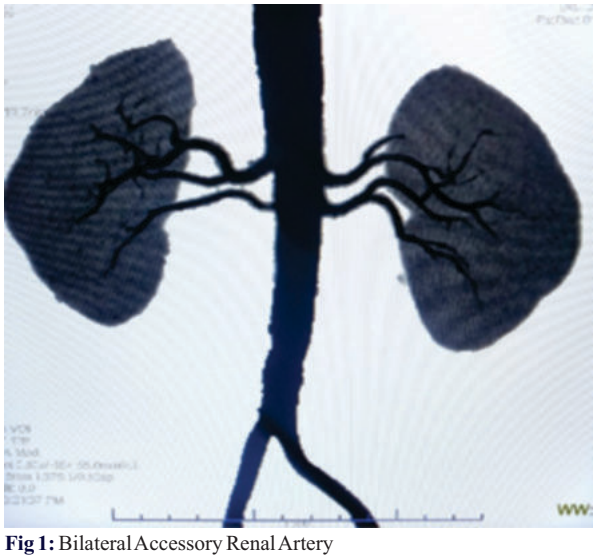


**Fig 1:** Bilateral Accessory Renal Artery

**Fig 2** Normal Bilateral Renal Arteries

## MATERIALS AND METHODS :

It is a retrospective and prospective study. The data of 572 living renal donors collected from January 2020 to till date were included retrospectively. Who underwent CT angiography in the Department of Radiology of our institute Informed consent was signed by each patient before the CT angiography. All images were obtained by 128 slice (Wipro GE) OPTIMA CT machine.

**Fig 3** Early Bifurcation In Bilateraal Renal Arteries

CT angiography was performed by injecting IV contrast with the help of a dual syringe injector unit (Medred Stellant). Two types of scouts are to be taken in a supine position that is one coronal and another lateral plane and planning for a plain non-contrast scan is performed. After that angiography scan is performed with bolus tracking ROI ( region of interest) system at the level of the abdominal aorta.

**CT- Technique**

Scout is taken in supine position including area from dome of diaphragm up to pubic symphysis.The scan direction is Caudo-cranial with breath hold inspiration phase during scan.

We use the following parameters: Slice thickness 5mm; Detector coverage 40mm; pitch, 1.375:1 rotation time, 0.6 s field of view, 350 mm matrix, 512 X 512, threshold 100 HU. The study was done using a low-dose-radiation protocol, with 80 to 100 kV & mA range 350-550.

**A Plain** - CT is performed from the dome of the diaphragm to the iliac crest. This phase is used to locate the kidneys, nephrolithiasis, and provide baseline attenuation measurements of renal masses.

**An Arterial Phase-** 80-120 ml of non-ionic contrast medium is administered in an antecubital fossa vein containing 350 mg of iodine per milliliter with a velocity of 5 ml/sec. The ROI is placed in the center of descending aorta at the level of the celiac artery with an attenuation threshold of 100 HU.

**Venous Phase-** The acquisition begins 70 seconds after the commencement of the contrast material injection.

**Excretory Phase-** This phase begins 7-10 mins after the arterial phase. In this phase, we can study the excretory system and the kidneys. Data are transferred to an imaging workstation to obtain multiplanar reconstruction ( MPR), maximum intensity projection (MIP) images and 3D volume-rendered images for evaluation of vasculature and renal parenchyma. 0.625 mm reconstructed axial , coronal and sagittal images are reviewed for all phases.

The scan were reported by experienced abdominal radiologists on dedicated workstations. The anatomy and structure of the renal arteries, veins, and their tributaries were documented. A artery (apart from the main renal artery) originating from the aorta towards the renal hilum was noted as an accessory artery.

**Fig 4** Accessory Renal Artery On Right Side

**Observations**

There are mainly three variants of renal arteries, depending on the location at which the renal arteries, depending on location at which renal artery enters the kidney. They are:

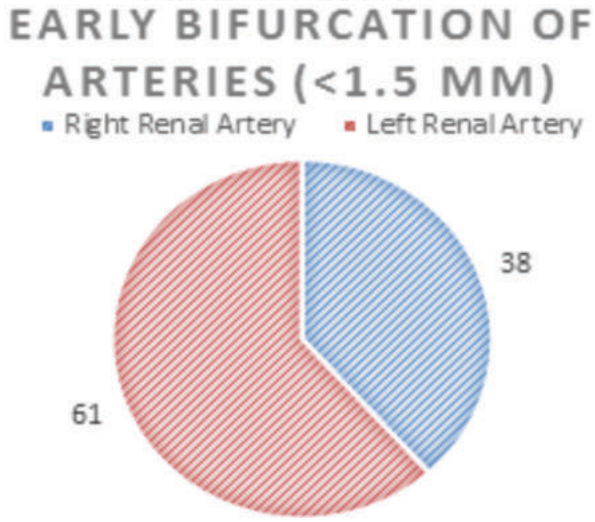
1. Hilar- in which case, the renal artery enters the kidney at the hilum.
2. Polar- in which case, the renal artery enters the kidney at the renal pole. Polar renal arteries can be further subdivided into superior polar (in which the renal artery enters the kidney at the superior pole) and inferior polar (in which the renal artery enters the kidney at the inferior pole)
3. Capsular- in which case, the renal artery surrounds the kidney.

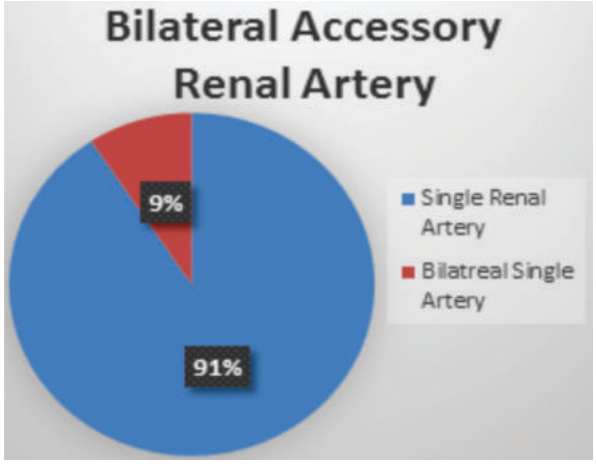
According to Bojsen et al, approximately 70 % of the kidneys have single renal arteries bilaterally, and 24 % have two arteries. A relative contraindication to a kidney transplant is only possible if, one out of the three arteries, is a small superior polar artery with a diameter measuring less than 2 mm. The surgeon usually clamps these vessels whilst operating and observes the underlying renal parenchyma for any evidence of ischemia. If there is ischemia, or if the ischemic area is small, the artery can be ligated.

Three renal artery measurements have to be reported:

1. The real orthogonal diameter of all renal arteries: It must be at least 3 mm, because in arteries with a diameter less than 3 mm, anastomosis is difficult, and there is a higher risk of thrombosis.
2. The lengths of the arteries from their origins to the first bifurcation.
3. The distance between the right inferior vena cava and the first segmental bifurcation: A distance less than 1.5 cm to the first bifurcation of the renal arteries or a retrocaval branching hinders the surgical anastomosis.

572 living donor patients were evaluated 151 males and 421 females mean as of donor.

## DISCUSSION

In our case study of 572 patients, 152 cases (26.5 %) show variations in the variations of the renal arteries. In 99 cases ( 17.3 %) renal artery is bifurcating early (<1.5mm) and in 53 cases (9.2 %) accessory renal artery is present bilaterally.

The developing mesonephros, metanephros, suprarenal glands, and gonads of an 18-mm foetus are supplied by nine pairs of lateral mesonephric arteries arising from the dorsal aorta. The first and second arteries were categorised as the cranial, the third to fifth arteries as the middle, and the sixth to ninth arteries as the caudal group by Felix [4]. The renal arteries emerge from the middle group. Multiple renal arteries continue to exist as a result of the middle group's lateral mesonephric arteries continuing to exist.

The extra renal arteries are very significant from a surgical standpoint. In contrast to supernumerary renal arteries that take their origin from the aorta, upper polar and lower polar supernumerary renal arteries that originate from the renal arteries and are directed towards the superior or inferior pole have a vertical trajectory. These arteries can sustain damage from mobilisation and other surgical procedures as well as polar infarction due to their vertical trajectory [5]. The ureteropelvic junction may be blocked by lower polar supernumerary renal arteries of aortic or renal origin [6].

Before performing any transplantation surgeries where micro-vascular techniques are used to reconstruct the renal arteries, anatomical knowledge of supernumerary renal arteries is required [7]. Theoretically, transplanting a kidney with accessory renal arteries has several drawbacks, including acute tubular necrosis, episodes of rejection, and reduced graft function. For surgical management during renal transplantation, abdominal aortic aneurysm repair, urological procedures, and angiographic interventions, we believe that knowledge of variations is essential.

**Fig 5** Bilateral Accessory Renal Artery

## CONCLUSION

MDCT renal angiography allows us to provide precise information about the anatomy of the renal vasculature and the possible variants and diseases before surgery. The valuable anatomical information has drastically reduced the risks and complications during and after renal transplant improving the chances for a successful outcome. Knowledge of the surgical techniques performed and exclusion criteria allows radiologists to write an accurate radiological report. There is no significant difference in image quality on the low KV technique but it helps to reduce radiation exposure to patients.

**Foot Notes**

**Sources of support:** Nil

**Conflict of Interest:** Nil

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