



Anatomic variations of the renal arteries from a local study population using 3D computed tomography angiography reconstruction images from a reference hospital in Cali, Colombia

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Abstract *Purpose:* With the advances in the new image techniques and 3D modeling, angiography computed tomography (A-CT) has become a very useful image for studying vessels. Renal artery (RA) variations are common, and have a clinical relevance in pre-operative planning. There are several descriptive studies made in high income countries, but there are not many in middle and low income countries. Our objective was to describe prevalence of RA variations in a study population in Cali, Colombia.

Methods: A database was made from a selection of A-CT 3D images from January 1, 2012 to September 30, 2014, from which the RA could be; visualized. Patients under 18 were excluded, also with no 3D A-CT, or not of; Colombian nationality. Frequencies, percentages were calculated using; Excel.

Results: A total of 560 patients were selected, from which 296 fulfilled all criteria. The most common causes of performing the A-CT were pathologies of the Aorta. Variations of the RA were present in 52% of the patients, 54% were man, 77% had unilateral variation and 33% had bilateral variations, 58% in the right side. The two most common variations were extra Renal arteries (hiliar and polar) seen in 70% of the patients.

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Conclusions: Prevalence of RA can be as normal as the usual anatomy, more commonly found in men, unilateral and in the right side. The most common variations are accessories arteries to the polar zone and the renal hilum, but early division (double and triple) arteries are also common.

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Introduction

Knowledge of the Renal artery (RA) variations is not only important for academic purposes, but also has clinical implications.^{1,2} Studies has shown the importance the study of RA for the treatment of patients that are going to surgeries as kidney transplantation, renal artery stenosis, open or endovascular treatment for abdominal aortic aneurysm.³

The study of the renal vessels in the past was performed using invasive methods as catheter angiography.⁴ Nowadays new diagnostic techniques such as angiography Computed tomography (A-CT) has become in many reference centers the gold standard because is noninvasive, fast, and reliable.⁵ Three-dimensional image reconstruction is additionally easily interpreted for non radiologist physicians and has a sensitivity of 100% for detecting variations.^{6,7}

The number of minimally interventional procedures has increased worldwide, and the use of A-CT has shown a positive impact in the surgical planning in surgeries as in kidney transplantation surgery.⁸ Our institution is a Latin American reference hospital for advanced surgical procedures such as kidney, pancreas, and liver transplant.^{9,10} Although prevalence and characterization of RA variations has been well described in studies in population from high-income countries, in which studies report a prevalence ranging from 30 to 60%, there are few studies in middle and low-income countries.^{11,12} The purpose of this study was to determine the prevalence of RA variations and the presence of Fibromuscular dysplasia (FMD) in a cohort of patients using 3D A-CT images from a reference hospital located in Cali, Colombia.

Methods

Patients

The institutional ethics committee approved this study, and all patients gave consent. All abdominal A-CT with 3D reconstruction from January 1st of 2012 to September 30 of 2014 were included to create a database of the anatomical RA variations, from which we exclude patients with less than 18 years at the time of the study, without 3D reconstruction A-CT, or not Colombian origin.

Image technique: angiographic computed tomography

A medical-surgical specialist (vascular surgeon, transplant surgeon or oncologist) ordered A-CT to determine several

characteristics of the relationship between the vessels and the organs related to diagnostic and/or treatment.

The images were obtained using a 64-row MDCT scanner (LightSpeed VCT, GE Healthcare) with a symmetrical matrix of 64 detector rows, and slice thickness of 0.625 mm. A dual head injector was used for the administration of contrast material, which allows the simultaneous injection of a compact iodine bolus followed by a normal saline bolus, both of them at the same injection rate of 4.5–5.0 ml/s.

Analyses of the images were performed on a computer with a Siemens console equipped with Syngo software and GE centricity RIS/PACS-IW Solution. A multiplane reconstruction (MPRs) in the three spatial planes and three-dimensional reconstructions (3D) using maximum intensity projection (MIP) and volume rendering (VR) was performed. Selection of the CTA images to analyze were based on those ordered as Thoracic and abdominal Aorta, renal, splenic and hepatic arteries, and contrasted total abdominal CT.

Image interpretation

All images were evaluated by two different physicians of different levels of expertise. First a resident in radiology evaluated the CT 2D axial images obtained by MDCT angiography as well as the post-processed 3D VRT, MIP and MPR images, in order to make a diagnosis. Then all images were reviewed by a former radiologist with more than 10 years of practice in corporal image A-CT.

For image interpretation RA was defined as any artery arising from the abdominal aorta or direct branches and ending in the kidney, regardless of the location and the course,¹³ and any other anatomical different course were considered as a variation.

Statistical analyses

Frequencies and percentages were calculated using Excel® for the prevalence of RA and FMD across sex and age, and location of the anatomical variation. It was considered statistical significant a level of significance lower of 5% ($p < 0.05$).

Results

There were 560 patients that fulfilled the criteria for the study, after exclusion criteria 296 were included, and from them 154 (52%) were men and 142 (48%) were women. The mean age was 55, the median age was 58, with minimum age was 19 and the maximum age was 96 (Table 1).

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