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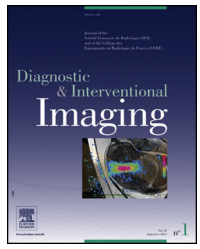

ORIGINAL ARTICLE / *Cardiovascular imaging*

Accuracy of multi-detector computed tomographic angiography assisted by post-processing software for diagnosis atheromatous renal artery stenosis

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KEYWORDS
Renal artery stenosis;
Multidetector computed tomography angiography;
Arteriography;
Accuracy

Abstract
Purpose: To compare the diagnostic performance of MDCTA versus renal angiography in the detection of > 50% renal artery stenosis in patients suspected of reno-vascular hypertension.
Materials and methods: Between January 2005 and January 2010, 92 MDCTA and renal arteriographies were retrospectively analysed. Renal angiographies were read by one interventional radiologist. Three blinded independent readers (two senior radiologists and one technician) scored MDCTA images using three different approaches. Reader 1 scored stenosis using only MPR and MIP. Reader 2 (technician) used only proprietary automatic arterial segmentation software. Reader 3 used the cited software, using manual diameter measurements.
Results: A total of 92 patients, (235 renal arteries) were assessed in which 48 significant stenosis were found by arteriography. Sensitivity, specificity, of MDCTA compared to renal arteriography were respectively per patient for reader 1: (88%; 80%); for reader 2: (58%; 80%); for reader 3: (96%; 90%) ($P < .02$).
Conclusion: When using automated vessel analysis software edited by a radiologist, MDCTA studies had a Sensibility/Specificity of 96%/90% to detect > 50% renal artery stenosis.

Abbreviations: RAS, Renal artery stenosis; HT, Hypertension; DSA, Digital subtraction angiography; MDCTA, Multi-detector CTA; EPR, Electronic patient record; LR, Likelihood ratios; CI, Confidence intervals; AVA II, Advance vessel analysis version 2; HU, Hounsfield units.

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Introduction

The causal relationship between renal artery stenosis (RAS) and some cases of hypertension (HT) has been firmly established for several years. Despite the persisting controversy regarding the benefit of angioplasty for > 50% stenosis in atheromatous lesion, a search for RAS is recommended in patients suspected of reno-vascular HT or acute deterioration of renal function. Based on recent guidelines, either Doppler ultrasonography, computed tomography angiography or magnetic resonance angiography can be proposed as a screening test to establish the diagnosis of RAS [1—3]. Different authors have addressed the performance of CTA in the diagnosis of RAS, and in 2001, a meta-analysis by Vasbinder et al. [4] demonstrated satisfactory diagnosis accuracy supporting these guidelines.

In the Dutch RADISH trial [5], the unique largest prospective study published to date, 356 patients suspected of renal vascular hypertension were evaluated with computed tomography angiography, MRA, and compared to digital subtraction angiography (DSA), with the latter used as the reference standard [5]. They found that computed tomography angiography had an overall sensitivity of only 69%, with a specificity of 91% in a population were a prevalence of RAS was 20%. However, in this study, the vast majority of examinations were performed with a single-detector-row CT at 2.5- to 3.0-mm collimation.

Since the introduction of the multi-detector computed tomography, the diagnostic accuracy of computed tomography angiography for the diagnosis of RAS with the help of automatic arteries segmentation software has never been studied. One may hypothesize, however, that the technological progress allowed by the use of sub-milimetric thickness, high acquisition speed and high isotropic resolution, and post-processing imaging workstations equipped with arterial segmentation software, have increased both the sensibility (Se) and specificity (Sp) of these tests.

We undertook this retrospective cohort study to assess the accuracy of computed tomography angiography using state of the art multi-detector computed tomography unit and post-processing software. The aim of our study was to compare the diagnostic performance of multi-detector computed tomography angiography (MDCTA) versus renal DSA in the detection of RAS in patients suspected of reno-vascular HT.

Patient population and methods

Because of a retrospective data analysis, and in accordance to our national law, the Institutional Review Board approval was waived. The design of this work was performed in accordance with the recommendations of the Standards for Reporting of Diagnostic Accuracy initiative [6].

Study design

Between January 2005 and January 2010, all consecutive abdominal MDCTA and renal DSA of patients presenting reno-vascular hypertension available on our electronic patient record (EPR) were retrospectively reviewed at our institution. Only patient fulfilling the exclusion and inclusion criteria were selected (Boxed text 1). All previous reports and patient data information were blinded to readers involved in the present study before imaging reanalysis. Because the most frequent clinical problem of renal artery stenosis are those related to atheromatous disease, we excluded fibro-dysplasia stenosis, radiation-induced stenosis, Takayasu's disease, vasculitis and surgical graft and patients with a renal stent in place. In addition, to assess the accuracy of MDCTA against arteriography, only cases in which an appropriate technique of image acquisition had been used within a short period of time (i.e. less than 6 months) were selected.

All renal arteriography were performed, using a Siemens Multistar system (Siemens AG, Medical Solutions, Erlangen, Germany), with a 5F pigtail catheter, using 30 mL of iobitridol (Xenetix® 350 Guerbet, Roissy France) contrast material, injected in 17 mL/s global, or 10 mL of contrast material in 10 mL/s for selective injections. Total contrast load to patients was approximately 60 mL. Selective arteriography was performed, using a 5F Shepherd hook catheter only in cases where the global angiogram was not able to depict appropriately the stenosis. The images were acquired at 3/s over a $\leq$ 30 cm field using both anterior posterior and 30° left anterior oblique projections. CTA protocol is described in Table 1.

During this period, 1078 patients had undergone both MDCTA and renal arteriography, of which 92 fulfilled the study inclusion/exclusion criteria as listed in Boxed text 1.

Image interpretation and analyses

All selected radiological records were transferred and anonymized from the EPR onto an ADW 4.4 image processing workstation (General Electric Healthcare, Waukesha, WI) in a DICOM format. To ensure that all readers would analyze the

Boxed text 1 Study inclusion and exclusion criteria.

Inclusion
- Clinical suspicion of reno-vascular HT
- Renal arteriography performed according to the protocol
- MDCTA performed according to the protocol (Table 2)
- MDCTA $\leq$ 6 months before arteriography
- Atheromatous stenosis

Exclusion
- Age < 20 years
- Pregnancy
- Non-atheromatous renal artery stenosis
- Surgical bypass graft
- Renal artery stent
- Images unavailable
- Poor technical quality of arteriography
- Poor technical quality of MDCTA according MDCTA setting (Table 2)
- Arterial attenuation < 250 UH*

*Arterial attenuation was measured in the aorta just upon renal artery ostia.