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Original Article

Role of MDCT renal angiography in determining the anatomical eligibility for renal sympathetic denervation in resistant hypertensive patients

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ABSTRACT

Objective: Aim of this study was to assess role of Multidetector computed tomography (MDCT) Renal Angiography in determining the anatomical eligibility for renal sympathetic denervation in resistant hypertensive patients.
Subjects and methods: This study included 30 patients, referred from hypertension unit in Zagazig University Hospital, with refractory systemic hypertension [an office blood pressure (BP) > 140/90 mmHg despite treatment with at least three drugs, including a diuretic in adequate doses]. All cases were performed using a 128-slice MDCT scanner. All data were transferred to an imaging workstation for reconstruction and analysis. Axial source images were post-processed to produce multiplanar reformation, curved planar reformation, maximum intensity projection and volume rendering images.
Results: Most patients (46.7%) had an A1/A1 type renal artery (RA). 66.7% were completely eligible (CE), 23.3% were partially eligible (PE), and 10% were non eligible (NE). Regarding intraobserver agreement; concordance between two readings by the same radiologist was in 96.7%, while discordance was in 3.3%. Regarding interobserver agreement; concordance between two radiologists was in 93.3% while discordance was in 6.7%.
Conclusion: MDCT renal angiography gives valuable knowledge to the interventional radiologist and cardiologist before renal artery denervation (RDN) to increase the success rate.

1. Introduction

Resistant hypertension is an uncontrolled blood pressure in spite of using optimum doses of 3 antihypertensive drugs of different classes [1].

Recently, Catheter-based endovascular renal artery denervation (RDN) using the Simplicity Flex Catheter System (Medtronic, CA) appears to be valuable in treatment of resistant hypertensive patients, as it decreases renal sympathetic nerve over activity (Figs. 1 and 2) [2–4].

Ablation procedures of organs have emphasized the need for both preprocedure imaging of the ablation target, and optimal catheter design [5].

Multidetector computed tomography (MDCT) renal angiography, therefore needs to fulfill multiple important goals in RDN: First, it needs to detect renovascular diseases, in particular renal artery stenosis [6]. Second, it has to describe the morphology of the renal arteries such as caliber, length, plaque location, branching patterns and presence of accessory or polar arteries [7]. Third, the correct choice of catheter can be made before the procedure because the size and angle of the renal arteries affect the type and size of renal catheter system [8]. Fourth, a preprocedure MDCT avoids the need for aortography to depict the renal vessels at the time of the procedure, this reduces the amount of intravenous (IV) contrast material required during RDN and shortens the procedure time. Finally, MDCT is useful in assessing the tortuosity of the iliac vessels before RDN, which influences the side to choose for catheter delivery [9].

MDCT renal angiography has a superior spatial resolution obtained with optimal enhancement of the renal arteries during the arterial phase, this provides application of multiple post-processing techniques such as maximum intensity projection (MIP), curved planar reformation (CPR) and volume rendering technique (VRT) [10].

As unsuitable renal arterial anatomy represented 17% between other causes of ineligibility to RDN according to the European Network Coordinating Research on Renal Denervation criteria [11] and 16% according to Simplicity Hypertension (HTN) -Two Trial [12], so the aim of this study was to analyze the detailed anatomy of renal arteries using MDCT renal angiography and determine the anatomical eligibility to RDN in patients with resistant systemic hypertension based on Symplicity HTN trials [12,13].

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Nomenclature

List of abbreviations

aRAs	accessory renal arteries
BP	blood pressure
CE	completely eligible
cm	centimeter
CPR	curved planar reformation
CT	computed tomography
CTDI vol	volume CT dose index
DLP	dose-length product
HTN	hypertension
HU	hounsfield unit
IMA	inferior mesenteric artery
IV	intravenous
IVC	inferior vena cava
kg	kilogram
kVp	kilovoltage peak
mAs	milliamperes
MDCT	multidetector computed tomography
mGy	milligray
MIP	maximum intensity projection
ml	millilitre
mm	millimeter
mmHg	millimeter of mercury
MPR	multiplanar reformation
mRA	main renal artery
mSv	millisievert
NE	non eligible
PE	partially eligible
RA	renal artery
RAs	renal arteries
RDN	renal artery denervation
ROI	region of interest
s	second
SMA	superior mesenteric artery
VRT	volume rendering technique
vs	versus

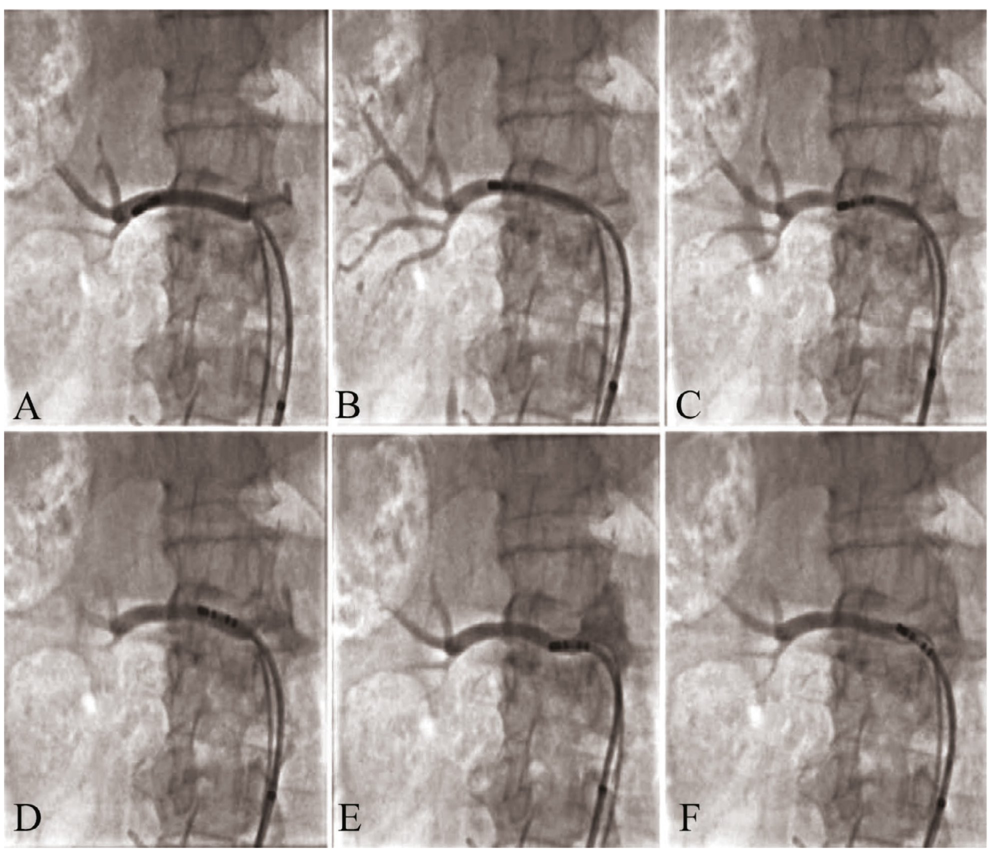

Fig. 1. Sequential radiofrequency applications in the right renal artery. The catheter is pulled and rotated after each application, making sequential lesions in a helical configuration (A to F) [3].

2. Patients and methods

This study was a prospective study, done in Radio-diagnosis department of Zagazig University Hospital, included 30 patients referred from hypertension unit in Zagazig University Hospital during the period from January 2016 to January 2017. 30 patients with refractory systemic hypertension [an office blood pressure (BP) > 140/90 mmHg despite treatment with at least three drugs, including a diuretic in adequate doses] were included in this study. Patients with hemodynamically significant renal artery stenosis (> 75% stenosis), fibromuscular dysplasia, history of allergy to iodine contrast, congenital anomaly of the kidney, renal neoplasm and hydronephrosis were excluded from the study. All patients underwent Doppler ultrasound of the renal arteries and MDCT renal angiography. The included patients gave their written informed consent and the protocol of this study was approved by the Committee of Ethics.

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