Role of MDCT Angiography in Diagnosis and Evaluation of Anatomical Variations and Anomalies of the Coronary Arteries

Thesis

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List of Abbreviations

Abbr.	Full-term
AIVS	**:** Anterior Inter Ventricular Septum
AO	**:** Aortic Root
AV	**:** Atrioventricular
CA	**:** Coronary Artery
CAA	**:** Coronary Artery Anomalies
CABG	**:** Coronary Artery Bypass Graft
CAD	**:** Coronary Artery Disease
CAF	**:** Coronary Artery Fistula
CPR	**:** Curved Planar Reformation
CT	**:** Computed Tomography
DSCT	**:** Dual-Source CT
EBCT	**:** Electron Beam Computed Tomography
ECG	**:** Electrocardiogram
ED	**:** Effective Dose
EMT	**:** Epithelial Mesenchymal Transition
EPDC	**:** Epicardial Derived Cells
HU	**:** Hounsfield Unit
IQR	**:** Interquartile Range
IVC	**:** Inferior Vena Cava
LA	**:** Left Atrium
LAD	**:** Left Anterior Descending Artery
LCA	**:** Left Coronary Artery
LCX	**:** Left Circumflex Coronary Artery
LM	**:** Left Main Coronary
LMCA	**:** Left Main Coronary Artery

LMS : Left Main Stem
LMT : Left Main Trunk
LSV : Left Sinus of Valsalva
LV : Left Ventricle
MDCT : Multi-Detector Computed Tomography
MIP : Maximum Intensity Projection
MPR : Multiplanar Reformation
MRI : Magnetic Resonance Imaging
OM : Obtuse Marginal
PDA : Posterior Descending Artery
PL : Posterolateral
PLB : Posterolateral Branch
RA : Right Atrium
RCA : Right Coronary Artery
RI : Ramus Intermedius
RSV : Right Sinus of Valsalva
RV : Right Ventricle
RVOT : Right Ventricular Outflow Tract
SA : Sinoatrial
Scx : Scleraxis
Sema 3D : Semaphorin 3D
SPSS : Statistical Package for the Social Sciences
SSCT : Single Slice Computed Tomography
SSD : Surface Shaded Display
SVC : Superior Vena Cava
UD : Undetected
VEGF-C : Vascular Endothelial Growth Factor C
VR : Volume Rendering

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ABSTRACT

Background: Coronary anomalies are often asymptomatic and may be accidentally discovered. With the increase of interventional coronary procedures, the detection of coronary anomalies is becoming of major clinical importance, the coronary anomalies cannot be considered just rare aspects because they may often lead to relevant clinical consequences. That is reason why the diagnosis of coronary anomalies should be a healthcare priority. **Aim of the Study:** This study was designed to identify the MDCTA appearance of the anatomic variations and anomalies of the coronary arteries and determine their prevalence. **Patients and Methods:** This study was conducted as a cross-sectional study in Radio-Diagnosis Department, Faculty of Medicine, Ain Shams University and other specialized private radiology centers, during the period between December 2017 and June 2018. All patients gave their written informed consent for taking part in this study. Patients inclusive of 70 males and 50 females with their ages ranged between 4-82 years. The study was approved by Ethical Committee of Faculty of medicine, Ain Shams University. It included 120 patients that were referred for MDCTA for coronary arteries study, Patients were referred for coronary CTA because of known or suspected coronary artery disease (CAD). **Results:** The total number of studies population were 100. 60 (60%) were males ages ranging 4-82 years and 49.5± 11.3 years mean age, and 40 (40%) were females with 25-77 age group and 52.75 years mean age. In 79 patient out of 100 (79%), the RCA was dominant giving off PDA and PLB, in 11 patient (11%) the left coronary artery were dominant and in the remaining patients 10 (10%) were Co-dominant. in 2% the LMCA originated from right sinus of valsalva with interarterial course. In 23.46 % the LMCA trifurcated to LAD, LCx and an intermediate ramus artery. The LAD showed myocardial bridging 16% more than other coronary arteries. One coronary aneurysm seen in the LAD. The LCx had abnormal origin from Rt. coronary sinus in two patients (2%) with retro aortic course. The myocardial bridging is very rare in LCX, present in 1% only. LCx fistula also rare detected in 1 patient (1%), no aneurysm was detected in the LCx. The origin of RCA was from right sinus of valsalva in 99 patients (99%) while one patient had abnormal origin from left coronary sinus (1%), in this case the RCA course was inter-arterial. In general, the normal variations and anomalies of coronary arteries were more common in LMCA 27%, in LAD 19%, LCx was 9 % and least 3% in RCA. **Conclusion:** Complex anatomy of the coronary artery system can accurately be depicted by MDCTA because of the improved isotropic spatial resolution and flexible post-processing tool. This noninvasive modality is useful in detecting coronary artery variants and anomalies and is a valid alternative to conventional coronary angiography in their diagnosis. Recommendations: Further studies are needed with large sample volume and correlate clinical presentation of patients with coronary anomalies & variant.

Keywords: Coronary artery, Anatomical variant, Multi detector cardiac Computed Tomography.

Introduction

In 1998, multi-detector computed tomography (MDCT) was introduced and since then, cardiac CT has played a major role in the evaluation of the coronary arteries. Before the introduction of this new technique, electron beam computed tomography (EBCT) had already been used to evaluate the heart, but because of the inferior spatial resolution compared with MDCT and the fact that it is not widely available, EBCT does not play a major role in cardiac imaging today ***(Ropers et al., 2001)***.

With the advent of newer generations of CT scanners, the 64-slice MDCT, and more recently, the dual-source CT (DSCT), temporal and spatial resolution have improved dramatically, due to a higher gantry rotation speed. Consequently, image quality has improved and the number of motion artifacts have substantially decreased compared to earlier scanner generations. As a result of these developments, evaluation of the coronary artery tree is increasingly performed with CT ***(Ropers et al., 2001).***

In MDCT, the coronary anatomy is shown in axial slices, as in all other radiological studies. But besides these axial slices, coronary anatomy can also be evaluated using a three-dimensional visualization derived from these axial slices. With current software, oblique multiplanar reconstructions, curved

multiplanar reconstructions, three- and four-dimensional volume rendering can be achieved without extensive manual manipulation necessary **(Schmid *et al.*, 2006).**

The occurrence of coronary artery abnormalities in the general population is reported to be approximately 0.2% to 1.3% based on the adult population **(Ghersin *et al.*, 2004).** These anomalies are usually not symptomatic and have no clinical significance. However, certain types of coronary artery abnormalities were related to sudden death, particularly in young athletes. According to the report of the Sudden Death Committee of the American Heart Association, approximately 19% of sudden death in athletes may be related to these anomalies **(Maron *et al.*, 1996).**

Other studies also report that sudden cardiac death due to coronary anomalies, especially those which course between the root of the aorta and the pulmonary artery (range from 19% to 33% in healthy young individuals) **(Pelliccia *et al.*, 2001 and Eckart *et al.*, 2004).** Coronary angiography and autopsy were used to detect coronary artery anomalies, but these procedures have limitations because of their invasiveness. The new device, Multidetector Computed Tomography (MDCT), now replaces the catheter angiography for detecting coronary anomalies.

Aim of the Study

This study was designed to identify the MDCTA appearance of the anatomic variations and anomalies of the coronary arteries and determine their prevalence.