ROLE OF MDCT CORONARY ANGIOGRAPHY IN DETECTION AND EVALUATION THE DEGREE OF CORONARY STENTS RESTENOSIS

Essay

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List of Abbreviations

BMS..... Bare metal stent
CAD..... Coronary artery disease
DES..... Drug eluting stent
ECM..... Extracellular matrix
EEL..... External elastic lamina
GP..... Glycoprotein
HU..... Hounsfield unit
IEL..... Internal elastic lamina
IGF..... Insulin- like growth factor
ISR..... In stent restenosis
LAD..... Left anterior descending
LCA..... Left coronary artery
LCX..... Left circumflex
MDCT..... Multi-detector row computed tomography
MPR..... Multi-planer reformat
MIP..... Maximum intensity projection
NI..... Neo-intima
NIH..... Neo-intimal hyperplasia
PCI..... Percutaneous coronary intervention
PDA..... Posterior descending branch
PLB..... Postro-lateral branch
RCA..... Right coronary artery
SAPK..... Surface activating protein kinase
VRT..... Volume rendering technique
VSMCs..... Vascular smooth muscle cells

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Chapter (1)

INTRODUCTION AND AIM OF WORK

Percutaneous coronary intervention (PCI) has gained widespread acceptance as the treatment of choice for managing symptomatic coronary disease. The most important advance in the field of PCI was the introduction of coronary stent implantation in the 1990s because this lead to a reduction in both the risk of acute major complications and the incidence of restenosis, as compared with the risks after balloon angioplasty (**Serruys PW et al., 1994)**, While its technical success rate exceeds 95%, stent restenosis remains a clinical problem. The introduction of drug eluting stents into clinical practice has dramatically reduced the occurrence of restenosis compared with the use of bare metal stents (**Whang Y, et al., 2006)**, Yet even at this low rate, stent restenosis remains an important problem **(Lee CW, Park S. et al, 2007),** And so an efficient diagnostic tool for follow up after stent placement is needed. Conventional Coronary angiography is presently the standard procedure for assessing the vessel lumen after stent placement. However, this method may involve major complications due to its invasiveness **(Scanlon PJ et al., 1999).**

The development of noninvasive and less expensive imaging modalities to assess the patency of coronary artery stents is of great clinical interest. Magnetic resonance (MR) angiography also can depict the coronary anatomy and it can help to detect stenosis in the proximal segments of coronary arteries (**Kim WY et al., 2001)**. However, metallic stents cause magnetic susceptibility artifacts that may prevent visualization of the lumen **(Hug J et al., 2000).**

Electron-beam computed tomography (CT) has been used to assess stent patency, yet assessment with this modality depends on indirect time-attenuation analysis in the vessel segments distal to the stent, but there is no actual visualization of the in-stent lumen. (**Pump H et al., 2000) / Knollmann FD, et al., 2004).**

Since its introduction, the multi-detector row CT (MDCT) technology for cardiac applications has continuously evolved. With increasing the number of detector rows, CT scanners can provide markedly improved temporal and spatial resolution on coronary imaging which also allows the imaging of coronary stents and patency of their lumen. There has been a dramatic increase in the number of recent investigations that have evaluated coronary stents by MDCT, and it is now valid to ask: Is this method ready for real world clinical use?, can this method

replaces all the previous mentioned methods ?, can this method play a definitive role in clinical / surgical management interference?

AIM OF WORK

To evaluate the role and efficacy of MDCT coronary angiography in the ability of detection of coronary stent restenosis and assessment of its degree and it's definitive role in clinical / surgical management interpretation & decision.

Chapter (2)

ANATOMY OF CORONARY ARTERIES AND THEIR NORMAL VARIANTS

The right and left coronary arteries originate from the right and left sinuses of Valsalva of the aortic root, respectively. The posterior sinus rarely gives rise to a coronary artery and is referred to as the "non coronary sinus." The locations of the sinuses are anatomic misnomers: The right sinus is actually anterior in location and the left sinus is posterior. The myocardial distribution of the coronary arteries is somewhat variable, but the right coronary artery (RCA) almost always supplies the right ventricle (RV), and the left coronary artery (LCA) supplies the anterior portion of the ventricular septum and anterior wall of the left ventricle (LV). The vessels that supply the remainder of the LV vary depending on the coronary dominance, The RCA arises from the right coronary sinus somewhat inferior to the origin of the LCA. After its origin from the aorta, the RCA passes to the right of and posterior to the pulmonary artery and then emerges from under the right atrial appendage to travel in the anterior (right) atrioventricular (AV) groove (Figs. 1, 2, 3 and 4). In about half of the cases, the ***conus*** branch is the first branch of the RCA. In the other half, the conus branch has an origin that is separate from the aorta. The conus

branch always courses anteriorly to supply the pulmonary outflow tract. Occasionally ‹the conus branch can be a branch of the LCA, have a common origin with the RCA, or have dual or multiple branches. In 55% of cases, the **sinoatrial nodal** artery is the next branch of the RCA, arising within a few millimeters of the RCA origin. In the remaining 45% of cases, the sinoatrial nodal artery arises from the proximal left circumflex (LCx).In either case, the sinoatrial nodal artery always courses toward the superior vena cava inflow near the cephalad aspect of the interatrial septum. As the RCA travels within the anterior AV groove, it courses downward toward the posterior (inferior) interventricular septum. As it does this, the RCA gives off branches that supply the RV myocardium; these branches are called "**RV marginals**" or "**acute marginals**", They supply the RV anterior wall. The distal RCA divides into the PDA and the posterior left ventricular branches. The PDA runs in the posterior interventricular groove. If the LAD artery, which usually supplies the apex of the heart, is small, the PDA can extend around the apex to supply one-third of the anterior interventricular septum **(Kini et al., 2007).**

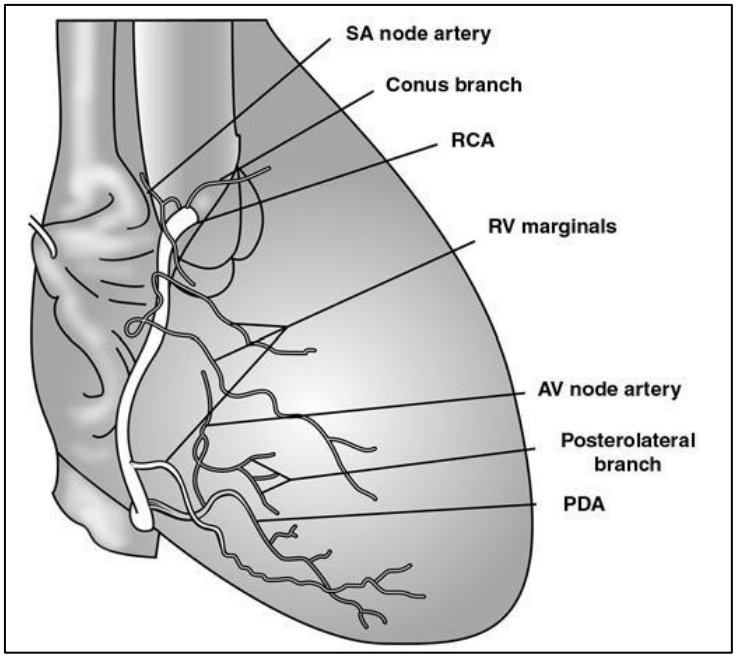


Fig. (1): Anterior schematic diagram of heart shows course of dominant right coronary artery and its tributaries. AV = atrioventricular, PDA = posterior descending artery, RCA = right coronary artery, RV = right ventricular, SA = sinoatrial **(Kini et al., 2007).**

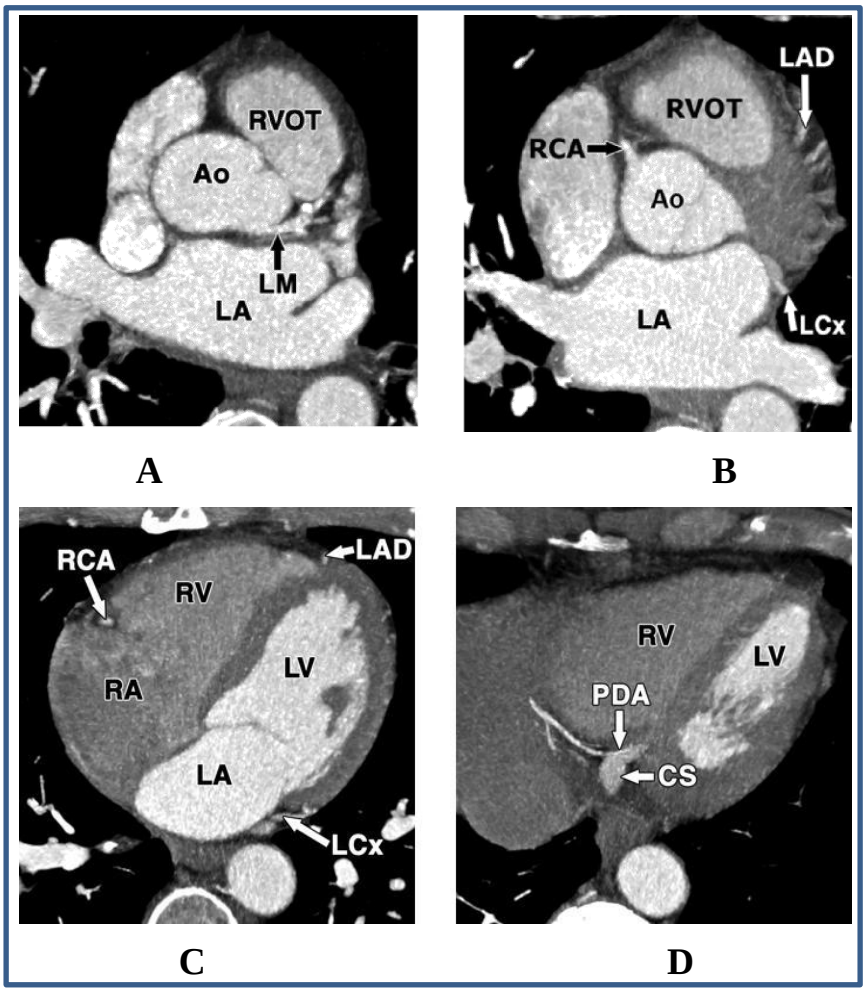


Fig. (2): CT images of normal heart in 53-year-old man. Ao = aortic root, CS = coronary sinus, LA = left atrium, LAD = left anterior descending artery, LCx = left circumflex artery, LM = left main coronary artery, LV = left ventricle, PDA = posterior descending artery, RA = right atrium, RCA = right coronary artery, RV = right ventricle, RVOT = right ventricular outflow tract. A, Axial 5-mm maximum-intensity-projection (MIP) image shows left main coronary artery as it arises from left coronary cusp. B, Axial 5-mm MIP image shows right coronary artery as it arises from right coronary cusp inferior to level of beginning of left main coronary artery. C, Axial 5-mm MIP image shows course of right coronary artery within anterior atrioventricular groove. and Left anterior descending artery is shown within anterior interventricular groove, and left circumflex artery is shown in posterior atrioventricular groove. D, Axial 5-mm MIP image shows origin of posterior descending artery from distal right coronary artery (**Kini et al., 2007**).

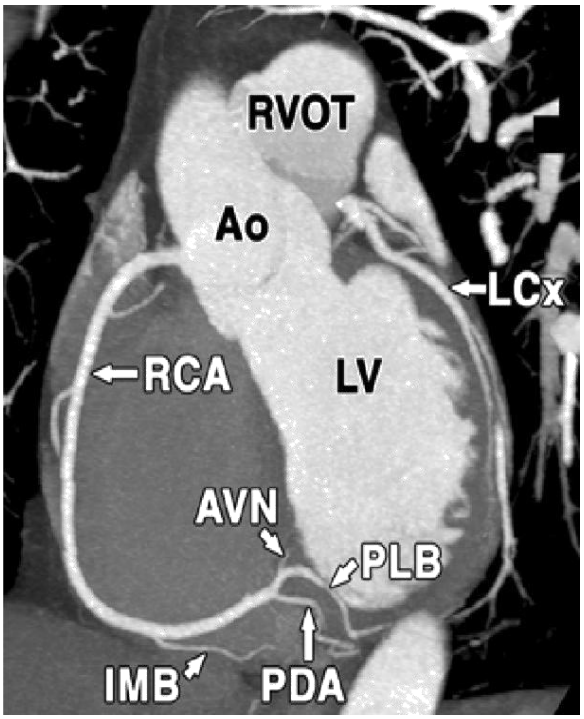
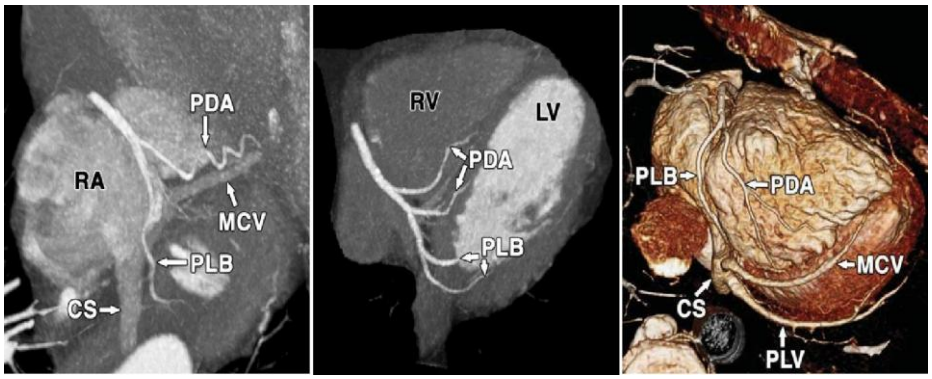


Fig. (3): Distal right coronary artery anatomy in 34-year-old man. Left anterior oblique20-mm maximum intensity- projection. image shows course of entire right coronary artery. Distally, posterior descending artery and posterior lateral branch are shown, as is atrioventricular node branch. Ao = aortic root AVN = atrioventricular node, IMB = inferior marginal branch, LCx = left circumflex artery, LV = left ventricle ،PDA = posterior descending artery, PLB = posterior lateral branch, RCA = right coronary artery RVOT = right ventricular outflow.



A **B** **C**

Fig. (4): Distal dominant right coronary artery variation on axial projections. CS = coronary sinus, LV = left ventricle, MCV = middle cardiac vein, PDA = posterior descending artery, PLB = posterior lateral branch, PLV = poster lateral vein, RA = right atrium, RCA = right coronary artery, RV = right ventricle. A, Axial 10-mm maximum-intensity-projection (MIP) image in 51-year-old man shows typical tortuous course of posterior descending artery as it arises from distal right coronary artery. Posterior descending artery as it travels in inferior interventricular groove along side middle cardiac vein. Posterior lateral branch continues along distal coronary sinus to supply inferior wall.B, Axial 10-mm MIP image shows dual posterior descending arteries and dual posterior lateral branches in 44-year-old man. C, Axial 3D volume-rendered projection image shows origin of posterior descending artery, Which still courses toward middle cardiac vein, is higher than normal in 49-year-old woman. (**Kini et al., 2007**).

The LCA normally emerges from the left coronary sinus as the left main (LM) coronary artery (Fig. 5). The LM coronary artery is short (5–10 mm), passes to the left of and posterior to the pulmonary trunk, and bifurcates into the left anterior descending (LAD) and LCx arteries.Occasionally, the LM coronary artery trifurcates into the LAD artery ،the LCx artery, and the ramus intermedius artery.The LAD artery runs in the anterior interventricular sulcus along the ventricular septum.,