

Introduction

Coronary artery stenting is now the predominant method of non-surgical myocardial revascularisation, with an estimated 475,000 coronary artery stents having been implanted in 2011 in the United States of America (***Zhang et al., 2012***).

Inhibition of neointimal proliferation by local pharmacological interventions (sirolimus, rapamycin) is a recent technical development. That clinical experience with sirolimus-eluting coronary stents has shown excellent results in patients with long lesions in small-diameter native vessels, with 3.2% restenosis within the stent versus 34.5% with bare-metal stents at angiographic follow up at 240 days (***Zhang et al., 2012***).

The use of conventional coronary angiography for early detection of stent complications is considered a gold standard but this technique carries a lot of morbidity and mortality, choosing a noninvasive method like stress testing lacks sensitivity and specificity so there has been growing interest in using the multi-detector computed tomography (MDCT) which offers a noninvasive option for assessment of coronary in-stent restenosis. However, due to metal-related artifacts the in-stent lumen may be obscure in CT angiography (CTA) (***Syed, 2010***).

Introduction

With the introduction of 16-slice CT, it became possible to visualize the in-stent lumen, and 64-slice CT has been proven highly accurate for assessment. Theoretically, 128 dual-source computed tomography (DSCT) has the same spatial resolution and better temporal resolution than single-source 64-slice MDCT systems. Thus, it can reduce artifacts which are aggravated by cardiac motion and provide better image quality. Besides the stent-related factors, a variety of patient-specific factors may also affect visualization, and the image quality and diagnostic accuracy are not always completely accordant (*Mahnken, 2012*).

Aim of the Study

To assess the role of multi detector computed tomography (mdct) in evaluation of coronary artery stent patency and to find correlation between risk factors of coronary artery disease and stent complications.

Radiological Anatomy of Coronary Arteries

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 (*Kini et al. 2009*).

LCA Anatomy:

The LCA normally emerges from the left coronary sinus as the left main (LM) coronary artery (**Figure. 1**). 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 (**Figure.2**). Occasionally, the LM coronary artery trifurcates into the LAD artery, the LCx artery, and the ramus intermedius artery (*O’Brien et al., 2009*).

Ramus Intermedius Artery:

The most common variation in LCA anatomy is the presence of a trifurcation of the LM coronary artery. In this instance, the LM coronary artery trifurcates into the LAD artery, LCx arteries, and an artery between them called the “ramus intermedius” artery (**Figure. 3**). The ramus intermedius artery itself has variable branching. The ramus intermedius can be distributed as a diagonal branch or as an obtuse marginal branch depending on whether it supplies the anterior or the lateral wall, respectively (*Kini et al., 2009*).

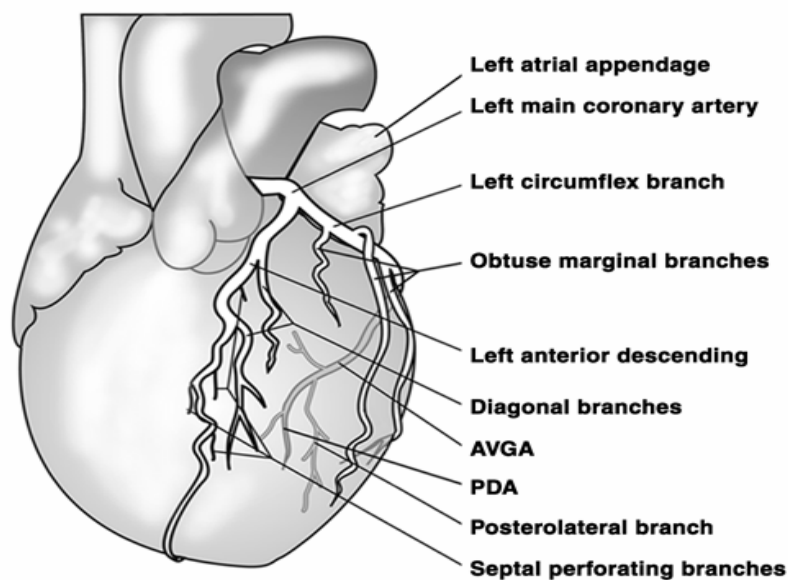


Figure (1): Dominant left coronary artery anatomy. Left anterior oblique schematic diagram of dominant left coronary artery anatomy, including left anterior descending artery and left circumflex artery tributaries, is shown. AVGA = atrioventricular groove artery, PDA = posterior descending artery (*Kini et al., 2009*).

LAD Artery:

The LAD artery runs in the anterior interventricular sulcus along the ventricular septum., the LAD artery may be embedded within the anterior myocardium forming an overlying myocardial bridge. The LAD artery has branches called “septal perforators” that supply the anterior ventricular septum, diagonal arteries that course over and supply the anterior wall of the LV. The diagonals and septal perforators are numbered sequentially from proximal to distal (i.e., D1, D2, S1, S2) (*Goo et al., 2009*).

LCx Artery:

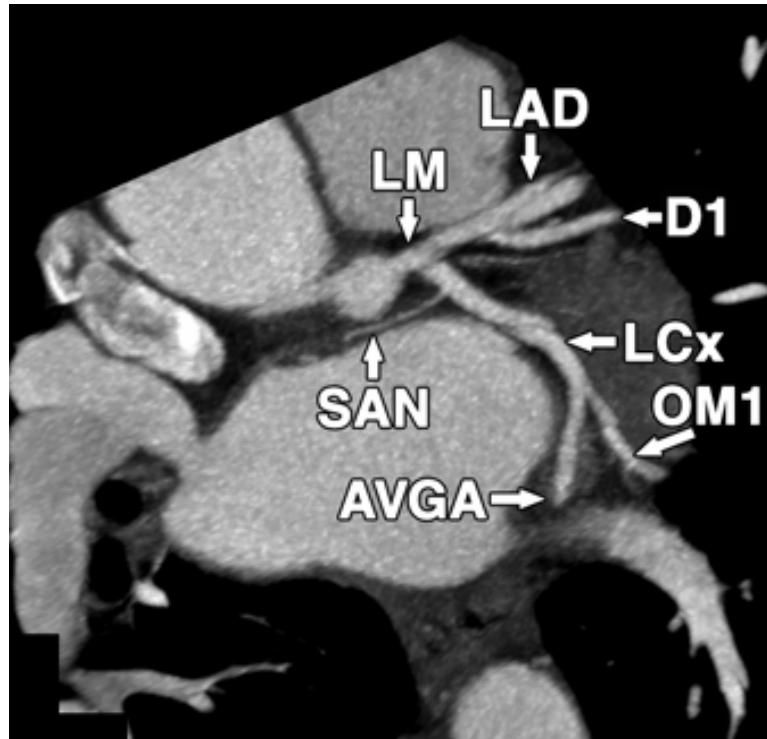


Figure (2): Left main coronary artery bifurcation. Anterior caudal 10-mm maximum-intensity-projection image displays typical bifurcation of left main coronary artery into left anterior descending and left circumflex arteries in 47-year-old man. AVGA = atrioventricular groove artery, D1 = first diagonal, LAD = left anterior LM = left main coronary artery, OM1 = first obtuse marginal, SAN = sinoatrial node branch (*Kini et al., 2009*).

The LCx artery (**Figures.4, 5**) runs in the posterior AV groove analogous to the course of the RCA on the opposite side. The major branches of the LCx artery consist of obtuse marginals (OM) branches supply the lateral wall of the LV.

They are numbered sequentially from proximal to distal (i.e., OM1, OM2, OM3 (Kini *et al.*, 2007).

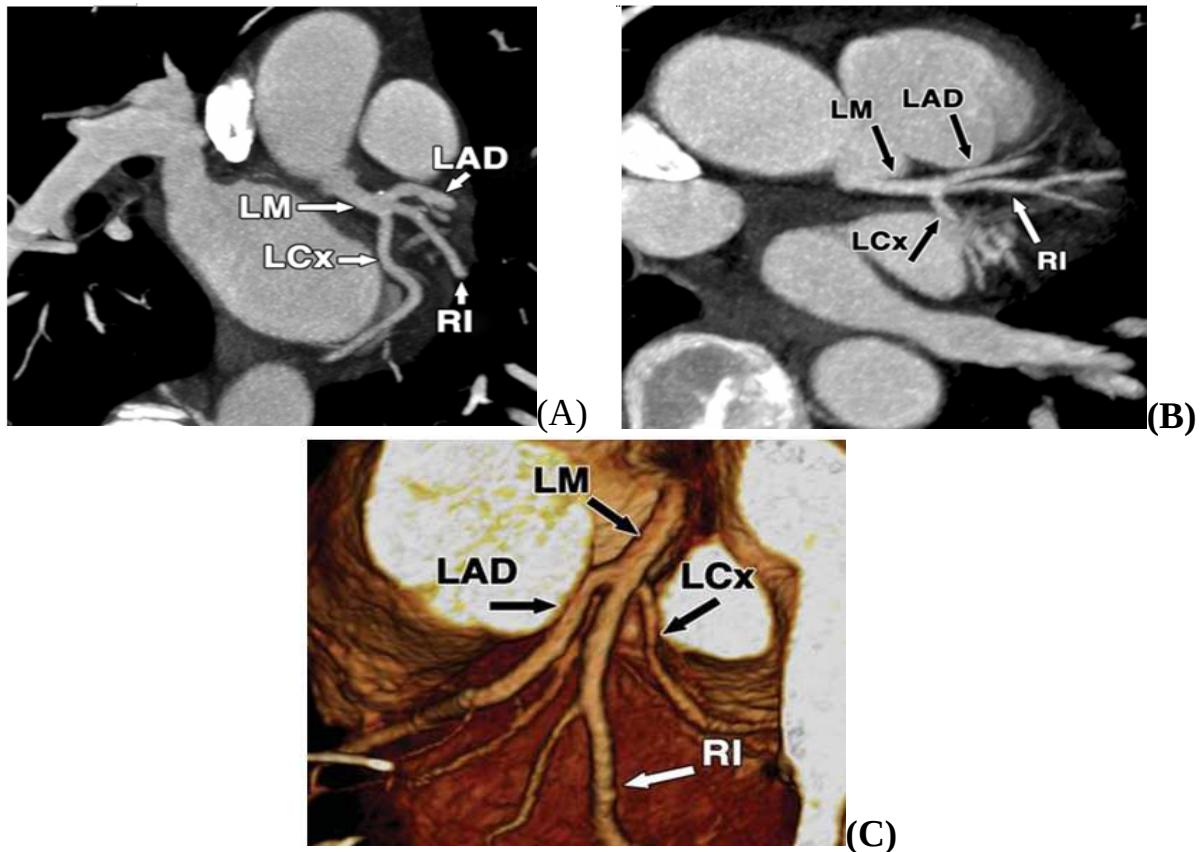


Figure (3): Ramus intermedius anatomy. LAD = left anterior Descending artery, LCx = left circumflex artery, LM = left main coronary artery, RI = ramus intermedius artery. **(A)** Right anterior oblique caudal 10-mm maximum-intensity-projection (MIP) image displays trifurcation of left main coronary artery into left anterior descending artery, ramus intermedius artery, and left circumflex artery in 49-year-old man. **(B)** Axial 10-mm MIP image shows left main coronary artery dividing into left anterior descending artery, left circumflex artery, and ramus intermedius branches in 42-year-old woman. **(C)** Left posterior cranial 3D volume-rendered

projection image shows branching ramus intermedius artery, which is mostly distributed as obtuse marginal branch to lateral wall, in 52-year-old man (*Kini et al., 2009*).

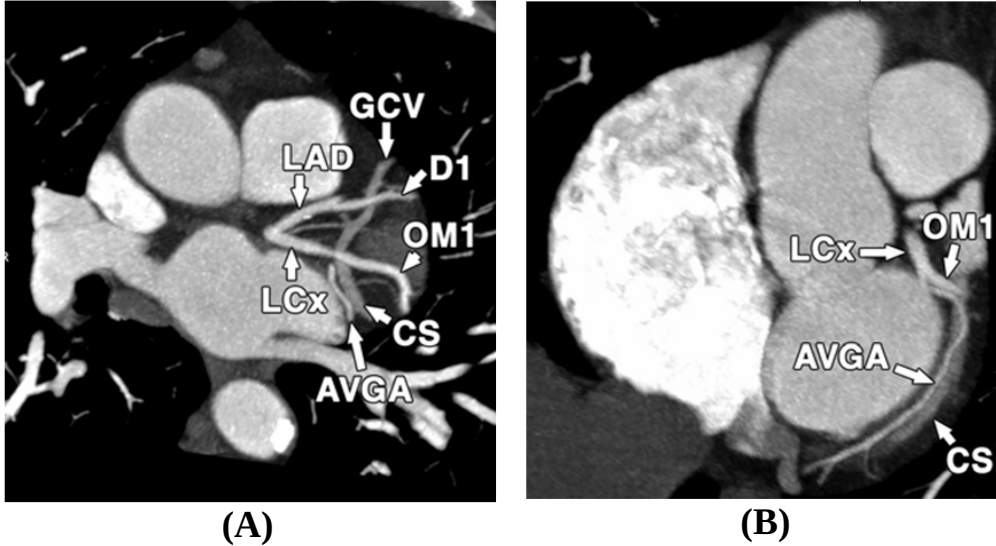


Figure (4): Nondominant left circumflex artery anatomy in 36-year-old man. AVGA = atrioventricular groove artery, CS = coronary sinus, D1 = first diagonal, GCV = great cardiac vein, LAD = left anterior descending artery, LCx = left circumflex artery, OM1 = first obtuse marginal. **(A)**, Axial 10-mm maximum-intensity-projection (MIP) image shows left circumflex artery and left anterior descending artery with large first obtuse marginal arising from proximal left circumflex artery. Small left circumflex artery descends in posterior atrioventricular groove as atrioventricular groove artery. **(B)**, Left anterior oblique 10-mm MIP image displays left circumflex artery anatomy with its descent as atrioventricular groove artery (*Kini et al., 2009*).

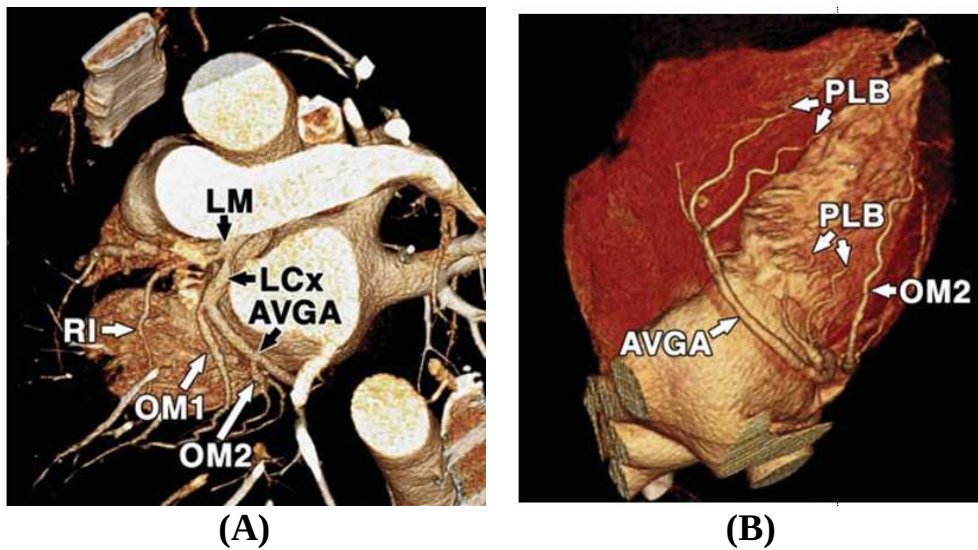


Figure (5): Dominant left circumflex artery anatomy in year-old man. AVGA = atrioventricular groove artery, LCx = left circumflex artery, LM = left main coronary artery, OM1 = first obtuse marginal, OM2 = second obtuse marginal, PDA = posterior descending artery, PLB = posterior lateral branch, RI = ramus intermedius artery. **(A)** Left anterior oblique cranial 3D volume-rendered image shows dominant left circumflex artery anatomy with two obtuse marginal branches. **(B)** Axial 3D volume-rendered image reveals dual posterior descending artery and posterior lateral branch arising from atrioventricular groove artery (*Kini et al., 2009*).

RCA Anatomy:

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)

Figures. 6 and 7). 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 (*Standring et al., 2009*).

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 (*Standring et al., 2009*).

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 right ventricular (RV) myocardium; these branches are called “RV marginals” or “acute marginals”. They supply the RV anterior wall. After it gives off the RV marginals, the RCA continues around the perimeter of the right heart in the anterior AV groove and courses toward the diaphragmatic aspect of the heart (*Standring et al., 2009*).

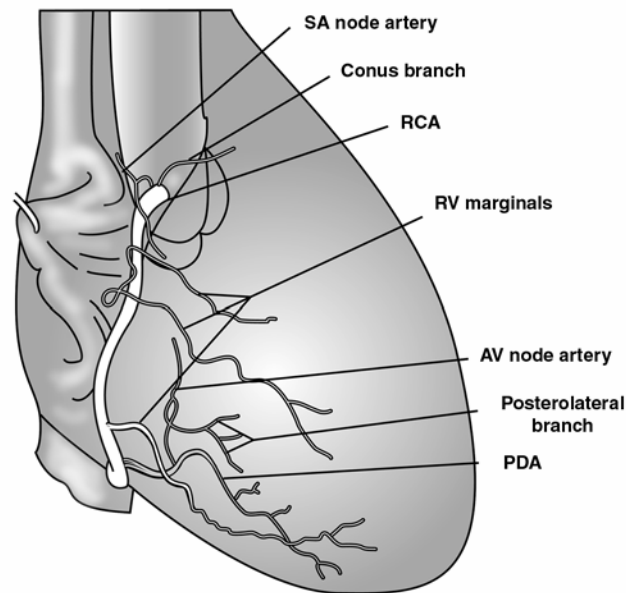


Figure (6): Anterior schematic diagram of heart shows course of dominant right coronary artery and its tributaries. AV = atrioventricular, PDA = posterior descending artery, RCA = right coronary artery, RV = right ventricular, SA = sinoatrial.

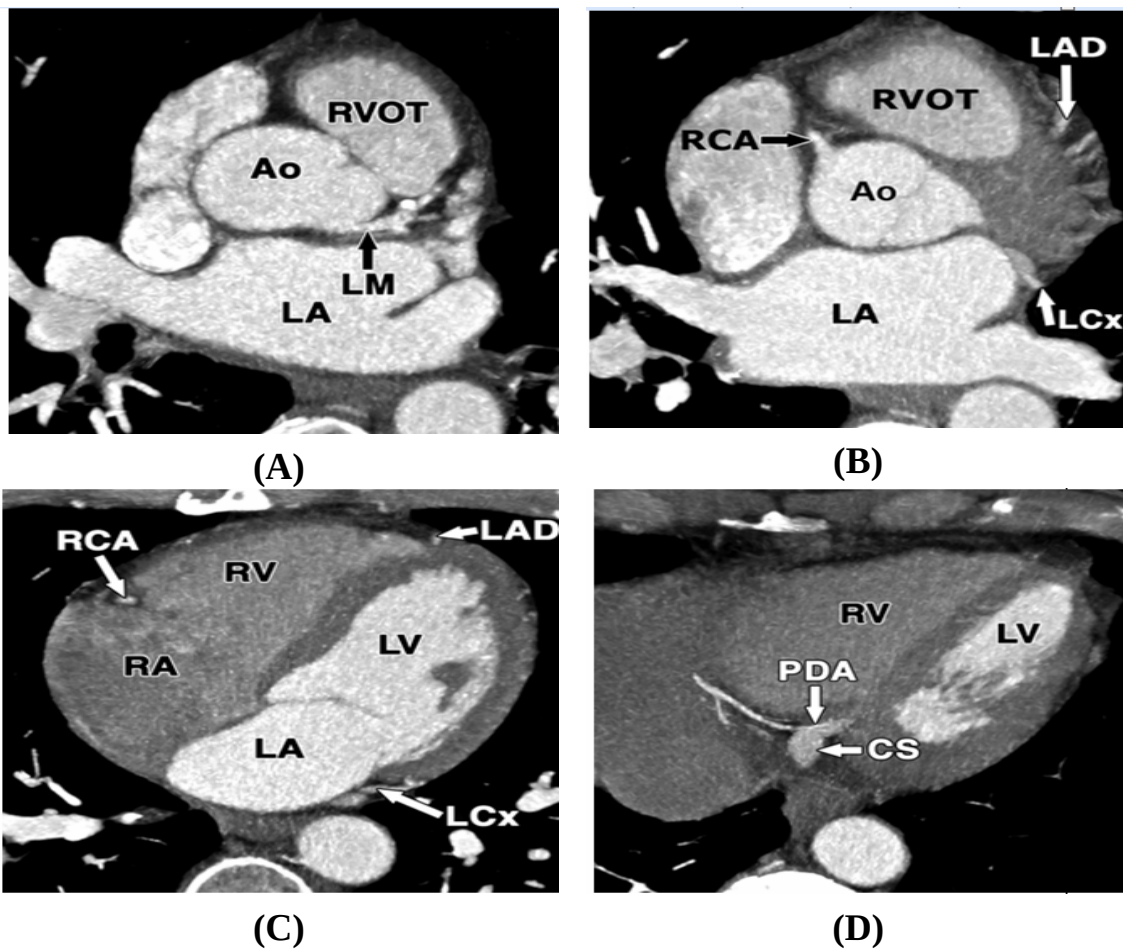


Figure (7): CT images of normal heart in 53-year-old man. Ao = aortic root, CS = coronary sinus, LA = left atrium, LAD = left anterior descending artery, LCx = left circumflex artery, LM = left main coronary artery, LV = left ventricle, PDA = posterior descending artery, RA = right atrium, RCA = right 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

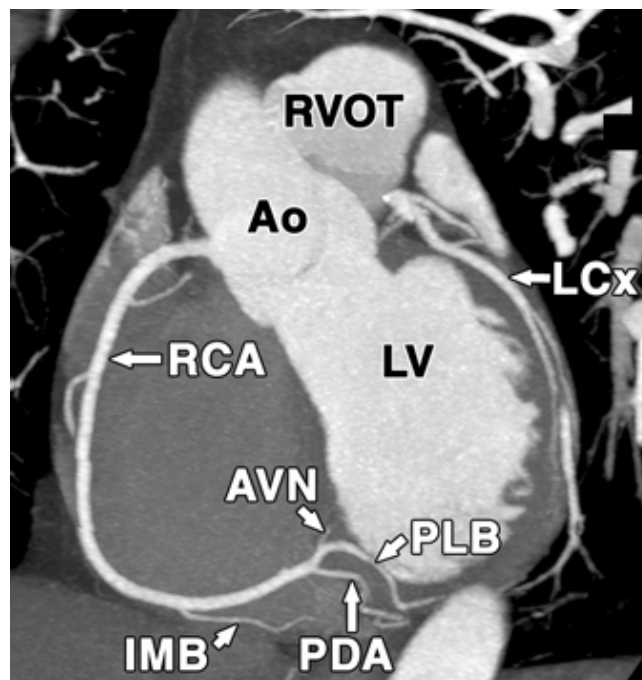


Figure (8): Distal right coronary artery anatomy in 34-year-old man. Left anterior oblique 20-mm maximum intensity-projection image shows course of entire right coronary artery. Distally, posterior descending artery and posterior lateral branch are shown, as is atrioventricular node branch. Ao = aortic 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.

Coronary Dominance:

Right dominant circulation.

The RCA gives rise to the conus branch (which supplies the right ventricular outflow tract) and one or more acute atrial and ventricular rami, whether or not the circulation is right-dominant. In the 85% of patients who have a right dominant circulation, it goes on to form the AV nodal artery, the posterior descending artery (PDA), the posterolateral (PL) and left ventricular branches which supply the inferior surface of the left ventricle and inter-ventricular septum **(Figure 9)**. **(Cerqueira et al., 2009)**.

Left-dominant circulation.

In 8% of patients, the coronary circulation is left-dominant; that is, the postero-lateral, left ventricular remi, PDA and AV nodal arteries are all supplied by the terminal portion of the LCX artery. In such patients, the RCA is quite small and supplies only the right atrium and right ventricle **(Figure 10)**. **(Cerqueira et al., 2009)**.

Balanced (co-dominant) circulation.

In about 7% of hearts, there is a co-dominant or balanced system, in which the RCA gives rise to the PDA and then terminates while the LCX gives rise to the PL left ventricular branches and perhaps also to a parallel posterior descending