

REVIEW ARTICLES

Clinical Correlation with Coronary Circulation

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Heart is supplied mostly by two coronary arteries-right and left. Only inner 75-100mm of endothelial surface gets nutrition directly from the blood in the cardiac chamber. Anatomically coronary arteries are not end-arteries because they anastomosis with each other by their trunk branches and sub-branches- mostly at the pre-capillary level. So they are functional end arteries. Right coronary artery supplies whole of the right atrium, most of the right ventricle except a strip along the anterior inter ventricular groove, post-inferior one third of ventricular septum and S-A node and A.V. node in the majority of subjects, left coronary artery supplies most of the left atrium and left ventricle except a strip along the posterior and inferior surface of the heart and also supplies anterior-superior two third of the ventricular septum.

The most common cause of death in affluent society across the world is ischemic heart disease which results from occlusion of coronary artery or its major branches; clinically the occlusion of coronary arteries and their major branches may be within the fast 2-5 cm of left anterior descending and circumflex branches and proximal and distal third of right coronary artery. Average frequencies of critical narrowing of the three major arterial trunk are- anterior interventricular (LAD)-40-50%, right coronary artery (RCA), 30-40% and circumflex branch of left coronary artery (LCX), 15-20%.

Description

The coronary arteries, the first branches of aorta, supply the myocardium and epicardium.² The right and left coronary arteries arise from the corresponding aortic sinuses at the proximal part of the ascending aorta just superior to the aortic valve, and pass around opposite side of the pulmonary trunk.⁵ The coronary arteries supply both the atria and the ventricles, however the atrial branches are usually small and not radiating apparent in the cadaveric heart.^{2,5} The ventricular distribution of each coronary artery is not sharply demarcated.

The right coronary artery arises from the right aortic sinuses of the ascending aorta and passes to the right

side of the pulmonary trunk, running in the coronary groove.^{1,2} Near its origin the RCA usually gives off an ascending S.A. nodal branch, which supplies the S.A. node. The RCA then descends in the coronary groove and gives off the right marginal branch which supplies the right border of the heart as it turns toward the apex of the heart.^{1,2} After giving off this branch, the RCA turns to the left and continues in the coronary groove to the posterior aspect of the heart. At the crux of the heart the function of the septa and walls of the four heart chambers. The RCA gives rise to the AV nodal branch, which supplies the AV node. The SA node and AV node are part of the conducting system of the heart (Fig. A & B).

Dominance of the coronary arterial system defined by which artery gives rise to posterior interventricular branch of posterior descending artery. Dominance of the right coronary artery is typical approximately 67%.² The right coronary artery give rise to the large posterior interventricular branch which descend in the posterior interventricular groove towards the apex of the heart.² This branch supplies adjacent areas of the both ventricles and sends perforating septal branch into the IV-septum. The terminal branch of right coronary artery then continues for a short distance in the coronary groove. The right coronary artery supplies the diaphragmatic surface of the heart. The right coronary artery supplies.^{1,2} (Fig.-D)

1. the right atrium
2. most of the right ventricle, part of the IV septum
3. part of the left ventricle(diaphragmatic surface)
4. the S.A node 60% of people
5. the A.V node 80% of people.

The left coronary artery (LCA) arises from the left aortic sinus of the ascending aorta passes between the left auricle and the left side of the pulmonary trunk and runs in the coronary groove. In approximately 40% of the people the S.A nodal branch arise from the circumflex branch of the LCA and ascends on the posterior surface of the left atrium to the S.A node.² As it enters the coronary groove, at the superior end of the anterior IV groove, the LCA divides into

two branches, anterior IV branch or left anterior descending (LAD) (Fig.- A) and circumflex. The anterior IV branch passes along the IV groove of the apex of heart. Here it turns around the inferior border of the heart and commonly anastomosis with the posterior IV branch of right coronary artery. The anterior IV branch supplies the adjacent parts of the both ventricles and via IV septal branches the anterior 2/3rds IVS.^{2,5} (Fig.-C) In many people the anterior IV branch gives rise to a lateral (diagonal) branch which descends on the anterior surface of the heart.^{1,2,5}

The smaller circumflex branch of LCA follows the coronary groove around the left border to the posterior surface of the heart. The left marginal artery a branch of the circumflex artery follows left margin of the heart and supplies the left ventricle most commonly the circumflex branch of the LCA terminates in the coronary groove on posterior aspect of heart before reaching the crux, but in approximately one third of heart it continues to supply a branch that runs in or adjacent to the posterior IV groove.

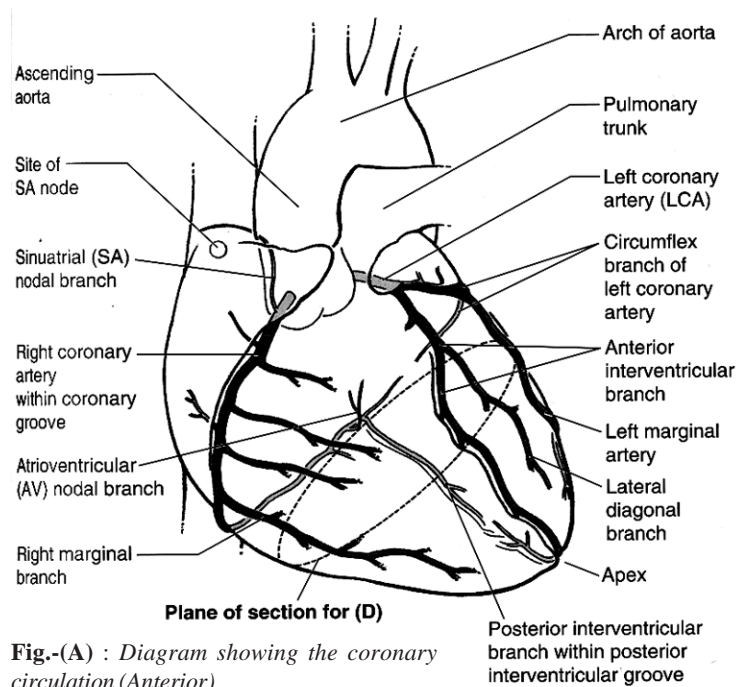


Fig.-(A) : Diagram showing the coronary circulation (Anterior)

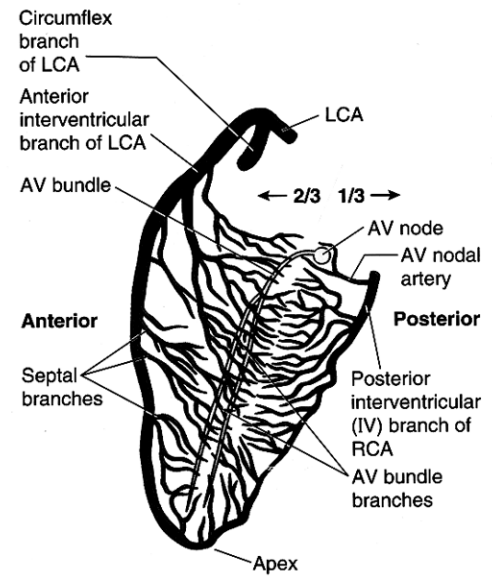


Fig.-(C) : Diagram showing the coronary circulation (Interventricular septum)

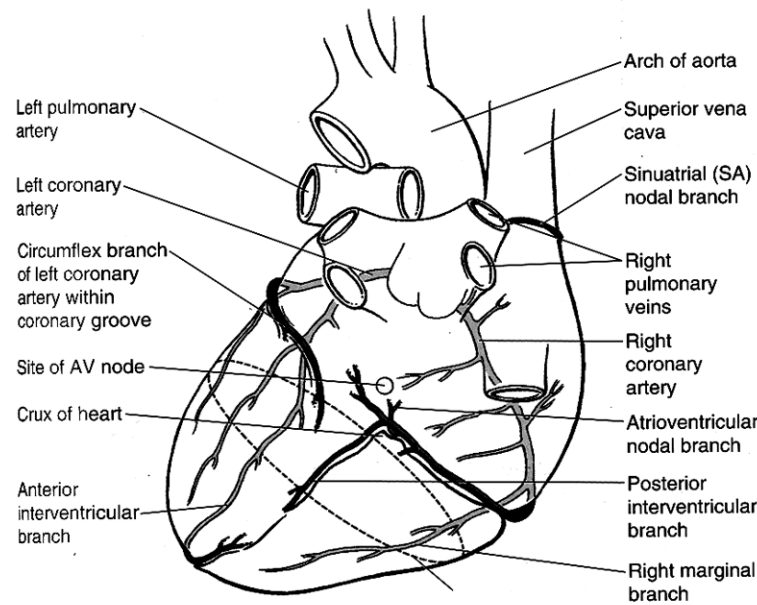


Fig.-(B) : Diagram showing the coronary circulation (Posterior)

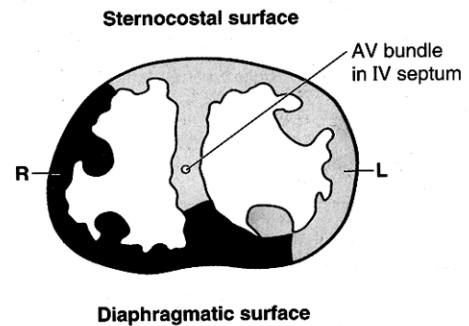


Fig.-(D) : Diagram showing the coronary circulation (Sectional view)

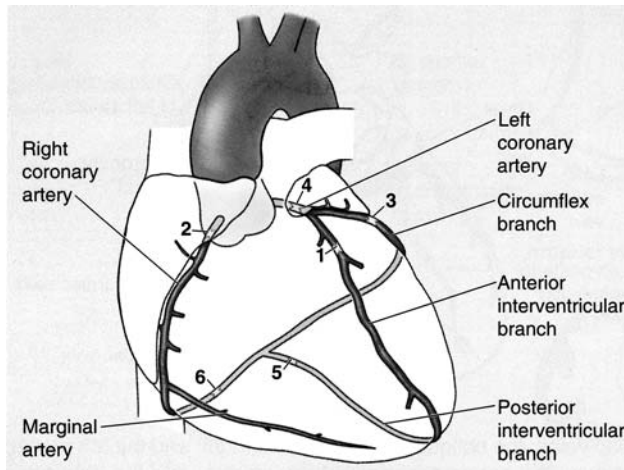


Fig.-(E) : Diagram showing the coronary bypass grafting (Anterior view)

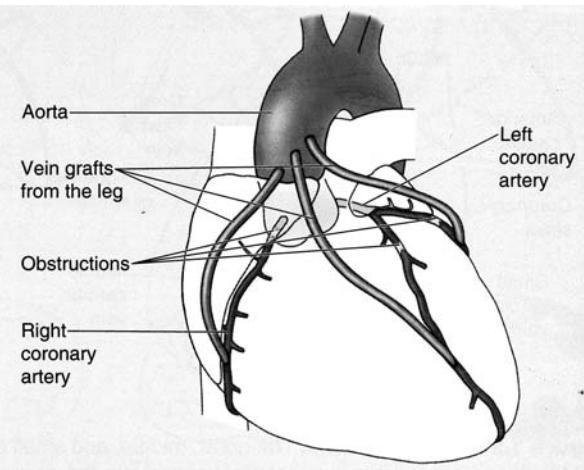


Fig.-(F) : Diagram showing the coronary bypass grafting (Posterior view)

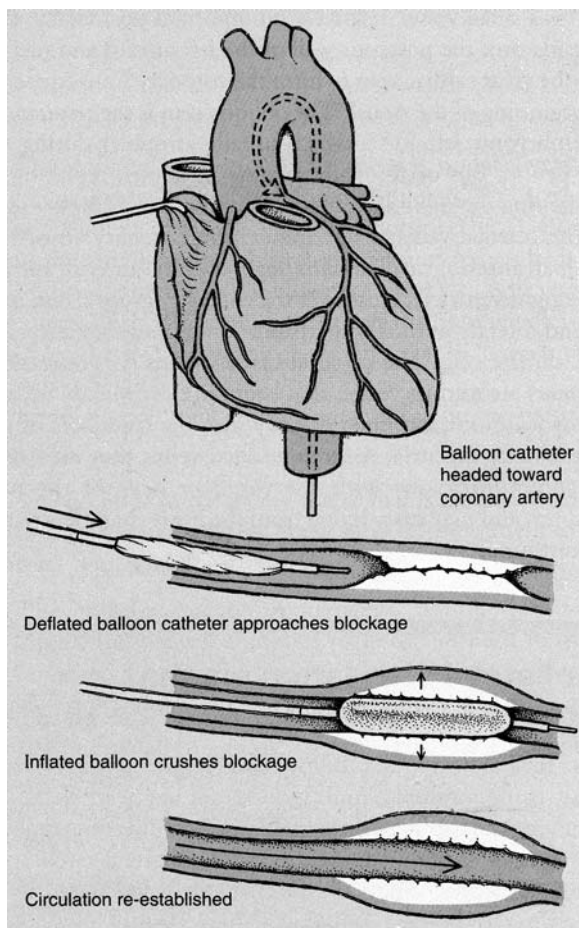


Fig.-(G) : Diagram showing percutaneous transluminal angioplasty

The LCA supplies-

- 1 the left atrium
2. most of the left ventricle
3. parts of the right ventricle

4. most of the IVS including the AV bundle of the conducting system of the heart through its perforating IV septal branch. (Fig.-C)
5. SA node approximately 40% of people.

Variations of the Coronary Arteries -

Variations in the branching pattern and distribution of the coronary arteries are common. In most common right dominant pattern approximately 67% of people RCA and LCA share about equally in the blood supply of the heart. In approximately 15% of hearts the LCA is dominant in that the posterior IV branch is a branch of circumflex artery. There is co-dominance in 18% of people in which branch of both right and left coronary arteries reach crux.^{2,5} A few people have only a single coronary artery. In other people, the circumflex branch arise from the right aortic sinus, approximately 4% people have an accessory coronary artery.

Coronary collateral circulation:

The branch of the coronary arteries are generally considered to be end arteries that supply regions of the myocardium lacking sufficient anastomosis from other large branches to maintain the viability should occlusion occur. However anastomosis does exist between branches of coronary arteries,

1. sub-epicardial
2. myocardial and between these arteries and extra-cardiac vessels such as thoracic vessels (Williams et al, 1995).

Anastomosis exists between the terminations of the right and left coronary arteries in the coronary groove and between the IV branches around the apex approximately 10% of apparently normal heart. The potential for

development of this collateral circulation probably exist in most if not all hearts.

Clinical Co-relation:

1. Coronary atherosclerosis- Is the process which results in lipid accumulations on the internal walls of the coronary arteries begins during early adulthood and slowly results stenosis of the lumina of coronary arteries. As coronary athero-sclerosis progresses, the collateral channels connecting one coronary artery with other expand, which may initially permit adequate perfusion of the heart during relative inactivity, the compensatory mechanism the myocardium may not received, enough oxygen when the heart needs to performed increased amounts of work .The insufficiency of blood supply to heart myocardial ischemia may result in MI.

Slowly progressive coronary artery disease:

In slow occlusion of a coronary artery, the collateral circulation has time to increase so that adequate perfusion of the myocardium can occur when potentially ischemic events occurs on sudden blockage of a large coronary branch, some infarction is probably inevitable but extent of the area depends on the degree development of collateral anastomotic channels. If large branches of both coronary arteries are partially obstructed, an extracardiac collateral circulation may used to supply blood to the heart clinical studies show that anastomosis cannot provide collateral quickly enough to prevent the effects of sudden coronary occlusion. The functional value of this anastomosis thus appears to be more effective in slowly progressive CAD.

Coronary Bypass graft: Some patients with obstruction of the coronary circulation and severe angina undergo a coronary bypass graft. A segment of an artery or a vein is connection to the ascending aorta or to the proximal part of a coronary artery and to the coronary artery distal to

the stenosis. The great saphenous vein is commonly harvested for coronary bypass surgery because: (Fig. E & F)

1. It has a diameter equal to or greater than that of the coronary arteries
2. Can be easily dissected from the lower limb
3. Offers relatively lengthy portions with minimum occurrence of valve or branching.
4. Use of radial artery in bypass surgery has become increasingly more common
5. A coronary bypass graft shunts of blood from aorta to a stenotic coronary artery to increase the flow distal to the obstruction.

Coronary angioplasty:

In selected patients surgeons use percutaneous transluminal coronary angioplasty in which they pass catheter with small inflatable balloon attached to its tip into coronary artery. (Fig.-G).

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