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An Anatomical Study on Branching Pattern of Coronary Arteries: A Cadaveric Study

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Abstract

Background and Aims: With the increasing advancement in the cardiac imaging techniques, it is mandatory to have a proper knowledge in the anatomy of coronary arteries. The present study is conducted to find out the normal and variations of the branching pattern of coronary arteries in human cadaveric hearts. Coronary dominance was also analyzed.

Materials and Methods: 50 human hearts preserved in 10% formalin were collected from our Department of Anatomy of our institution.

Observations: In this present study, 8% of specimens had third coronary artery, the posterior interventricular arteries were two in number in 22% of specimens. Left coronary artery trunk gave two branches in 80% of the specimens and three branches in 20% of specimens. Right coronary dominance was in 72% of specimens and left coronary dominance was in 28% of specimens. Myocardial bridges were present in 18% of specimens.

Conclusion: Studying the variations of coronary artery is helpful for the interventional cardiologist, radiologist and cardiovascular surgeons to interpret in diagnostic and therapeutic procedures.

Keywords: Right coronary artery; Left coronary artery; Third coronary artery; Coronary dominance.

Introduction

Heart is a vital organ that pumps the blood for the tissues in human body. The myocardium is supplied by coronary arteries. With the advances in the use of imaging techniques, it is essential to have a proper knowledge in the normal and variations in the branching pattern coronary arteries.

The right coronary artery arises from the anterior (right coronary) sinus. Usually, right conal artery is the first branch of right coronary artery. This vessel arises independently from the anterior aortic sinus in approximately one-third of hearts and is therefore, sometimes termed the 'third coronary artery'. On approaching the crux, the right coronary artery normally produces up to three posterior interventricular branches. The left coronary artery from the left posterior (left coronary) sinus of the ascending aorta. Reaching the atrioventricular groove, the left coronary artery divides into its main branches namely, the circumflex and anterior interventricular branches. The main arteries and major branches are usually subepicardial, but those in the atrioventricular and interventricular grooves are often deeply sited, and occasionally hidden by overlapping myocardium or embedded in it (myocardial bridging).[1]

The presence of myocardial bridges and their relationship to coronary artery dominance supplying the myocardium may be clinically significant. Myocardial bridges may compress the coronary vessel underneath and compromise myocardial blood supply. Cases of sudden cardiac death where myocardial bridging is the only postmortem finding have been reported.[2] The present study is undertaken to observe the variations in branching pattern coronary arteries.

Materials and Methods

The present study was conducted in 50 adult heart specimens that were used during routine dissection for MBBS students in the Department of Anatomy in our institution. After opening the thoracic cavity by reflecting the anterior thoracic wall, the heart was taken out from the pericardial cavity with the great vessels. The specimens were numbered and stored in 10% formaldehyde. The right and left coronary arteries were studied to observe their origin, branching pattern, coronary dominance and the presence of myocardial bridges.

Results

In this study, the right and left coronary arteries arose from the anterior and left posterior coronary sinus of ascending aorta respectively in all 50 specimens.

Variations found in right coronary artery

The right conus artery arose from the anterior aortic sinus of the ascending aorta directly in 4 specimens (8%) and is called third coronary artery (Fig. 1). In 11 specimens (22%) the number of posterior interventricular artery were two which arose from right coronary artery (Fig. 2).

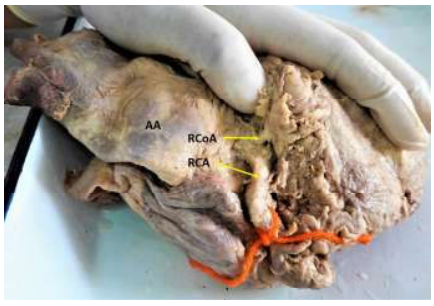

Fig. 1: Rt Conus artery coming directly from aorta

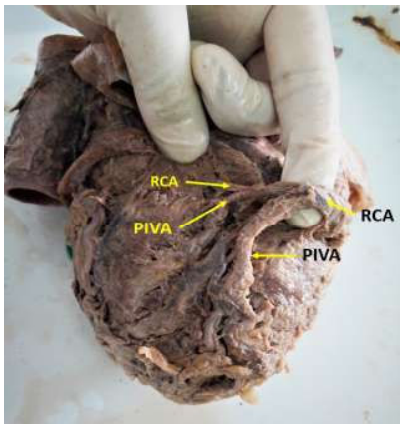

Fig. 2: Two PIVA from RCA

Variations observed in left coronary artery

Trifurcation of the trunk of left coronary artery was observed in 10 out of 50 specimens (20%). In these trifurcated specimens, left coronary artery branched as anterior interventricular artery, left median artery and left circumflex artery (Fig. 3). Table 1 shows the percentage of occurrence of branching pattern of left coronary trunk.

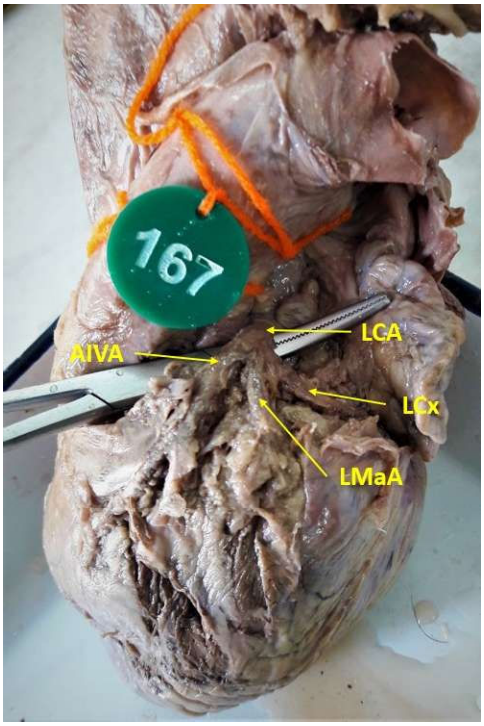

Fig. 3: Trifurcation of LCA as AIVA, median artery and LT circumflex artery

Table 1: Branching pattern of left coronary trunk

Branching pattern of left coronary trunk			
Bifurcation		Trifurcation	
No of Specimens	Percentages	No of Specimens	Percentages
40	80%	10	20%

Posterior interventricular artery arose from left circumflex artery in 14 specimens (28%) indicating the left coronary dominance. In the remaining 36 specimens (72%) the posterior interventricular artery arose from right coronary artery and indicating the right coronary dominance. No balanced pattern of coronary dominance was observed (Fig. 4). Table 2 explains the coronary dominance pattern.

In the present study, 9 specimens (18%) were found to have myocardial bridges. These myocardial bridges were present along the course of anterior interventricular artery in all 18% of specimens (Fig. 5).

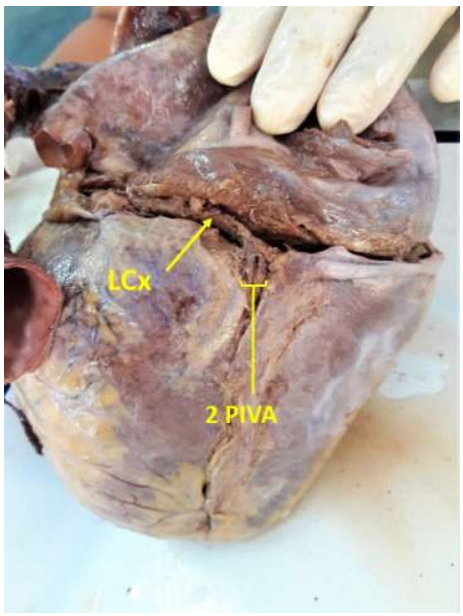

Fig. 4: PIVA from left coronary artery

Table 2: Coronary dominance pattern

Coronary dominance pattern			
Right coronary dominance		Left coronary dominance	
No of Specimens	Percentages	No of Specimens	Percentages
36	72%	14	28%

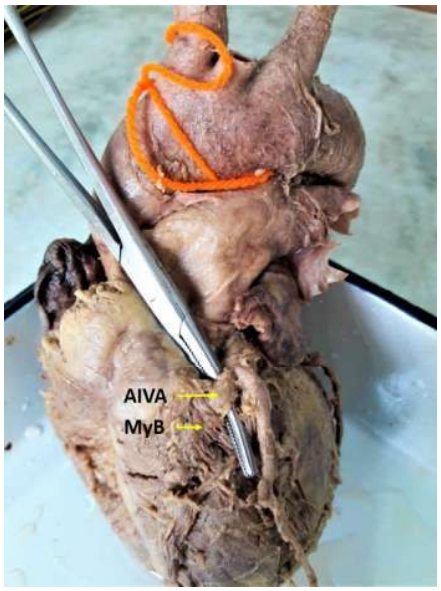

Fig. 5: Myocardial bridge

Abbreviations:

AA- Ascending Aorta

RCA- Right Coronary Artery

LCA- Left Coronary Artery

RCoA- Right Conus Artery

LCx- Left Circumflex Artery

AIVA- Anterior Interventricular Artery

PIVA- Posterior Interventricular Artery

LMaA- Left Median Artery

MyB- Myocardial Bridge

Discussion

Many studies are there on variations in branching pattern of coronary arteries.

Third coronary artery

Schlesinger MJ[3] (1949) discussed the presence of third coronary artery and J Reig Vilallonga[4] (2003) found an accessary orifice for the conal artery in the ascending aorta. Venkateshwar Reddy et al.[5] (2016) stated that right aortic sinus bifurcated as right coronary artery and conus artery in 30% of hearts. Anbumani et al.[6] (2016) observed in their study that 2% of specimens presented third coronary artery and in the present study it was found in 8% of specimens.

Number of posterior interventricular artery

Nordan DG et al.[7] (2012) studied that 2% of specimens had duplication of posterior interventricular artery. Venkateshwar et al. (2016) observed single posterior interventricular artery from right coronary artery in 80% of hearts and 2 or 3 posterior interventricular arteries from right coronary artery in 20% of hearts which correlates with the present study.

Branching pattern of left coronary artery

Banchi A[8] (1904) stated in their study that left coronary artery bifurcated as anterior interventricular artery and circumflex artery in 64%, trifurcation in 31% and left coronary artery gave 4 branches in 5%, Bosco GA et al.[9] (1935) in their study they found bifurcation of LCA (Left Coronary Artery) in 42%, trifurcation in 52% and there was no division of main LCA trunk in 2% of specimens. Mamatha Hosptna et al.[10] (2013) stated bifurcation of LCA in 93.3% of specimens and trifurcation of LCA in ANA6, 7% of specimens. Anbumani et al. (2016) observed bifurcation in 70% of specimens, trifurcation of LCA in 26% of specimens and quadrification in 4% of specimens. Vu Hoang Nguyen et al.[11] (2018) found bifurcation in 51.2%, trifurcation in 43.2% and quadrification in

5.6%, the present study correlates with Anbumani et al. (2016) with little difference in the percentage of occurrence as bifurcation in 80% of specimens and trifurcation in 20% of specimens.

Coronary dominance

Coronary dominance is determined by the arterial supply to the diaphragmatic surface whether it is by right coronary artery and left coronary artery.

In 1940, Schlesinger MJ[12] stated that right coronary dominance was present in 48%, left dominance was present in 18% and balanced type was present in 34%. Mamatha Hosptna et al. (2013) found in their study that in out of 30 specimens, 29 were right dominance and one specimen was left dominance. Cihan Altin et al.[13] (2015) study shows 81.6% right coronary dominance, 12.2% left dominance and 6.2% codominance. Anbumani et al. (2016) observed right dominance in 84%, left dominance in 16% and there was no balanced type. The present study differs a little from this study as 72% right coronary artery, 28% left coronary dominance and no balanced type.

Myocardial bridges

Loukas et al.[14] (2006) documented 34.5% of myocardial bridges in their study. Nordon DG et al. (2012) found muscular bridges in 4% of specimens, Cihan Altin et al. (2915) observed myocardial bridges in 1.1% and Vu Hoang Nguyen et al. (2018) stated the presence of myocardial bridges in anterior interventricular artery in 41.6%, in both anterior interventricular artery and posterior interventricular artery in 5.6% of specimens. Anbumani et al. (2016) observed myocardial bridges in 14% of specimens and this study correlates with our present study in which the myocardial bridges were found in 18% of specimens.

Conclusion

Thorough knowledge of branching pattern of coronary arteries essential for interventional cardiologist and radiologist for diagnosing and performing various procedures like coronary catheterization, coronary angioplasty and bypass graft surgeries. Studying the variations of coronary artery is also helpful to avoid the misinterpretations and complications during the above procedures. It is also mandatory for the anatomists to update the knowledge of the gross anatomy of coronary arteries to their students.

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