

## ARTERIA ANASTOMOTICA INFUNDIBULARIS MAGNA- AN ABNORMAL COMMUNICATION BETWEEN ANTERIOR INTERVENTRICULAR ARTERY AND RIGHT CORONARY ARTERY

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### ABSTRACT

#### BACKGROUND

Knowledge of coronary artery branching pattern and their anomalies that occur during foetal development is essential for clinicians. They are associated with high incidence of morbidity and mortality due to congenital heart diseases. Failure to recognise them can lead to inadequate or prolonged procedures and may also lead to misdiagnosis and complications such as accidental ligation.

#### MATERIALS AND METHODS

A properly embalmed and stored 50 human heart specimens were dissected in the age group of 20-65 years to study the course and distribution of coronary arteries. The study was conducted in dissection hall, Department of Anatomy, Rajah Muthiah Medical College and Hospital (RMMC and H), Annamalai University, Chidambaram, Tamil Nadu, India, from August 2010 to July 2013.

#### RESULTS

We found a very rare incidence of anomalous branching pattern in the coronary circulation out of 50 heart specimens. The anterior interventricular artery was found giving off one communicating branch to Right Coronary Artery (RCA) on the anterior aspect of infundibulum, which after taking sinuous course to join RCA. We coined this anomalous communication as arteria anastomotica infundibularis magna. To our knowledge, this is a very rare incidence and it is not reported elsewhere.

#### CONCLUSION

Due to excessive stress and strain of day-to-day modern life, the incidence of death due to myocardial ischaemia also increases. To treat medically and surgically, the basic knowledge of the coronary arteries and its branching pattern with any anomalous is essential for cardiologists, cardiothoracic surgeons, radiologists and especially anatomists for teaching of undergraduate and postgraduate students of anatomy.

#### KEYWORDS

Coronary Artery, Right Coronary Artery, Left Coronary Artery, Anastomosis, Coronary Artery Anomalies.

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#### BACKGROUND

The heart is supplied by both the right and left coronary arteries namely Right Coronary Artery (RCA) and Left Coronary Artery (LCA). Both the arteries encircle the base of the ventricles like a crown.<sup>1</sup> The RCA supplies whole of right atrium, most of the right ventricle except a strip along the anterior interventricular groove, posteroinferior one third of ventricular septum and SA node and AV node.<sup>2</sup> The LCA supplies most of the left atrium and left ventricle except a strip along the posterior and inferior surfaces of the heart

and also supplies anterosuperior two third of the ventricular septum.<sup>2</sup>

Coronary artery development is a delicate, complex and finely tuned process that includes multiple interactions among many pathways, especially in the pericardium and the developing myocardium.<sup>3</sup> It is important to identify some of the causes of anomalous coronary development as the coronary arteries may present with many anomalies that occur during foetal development. There are different patterns of anomalous coronary arteries with variable risk of myocardial ischaemia, malignant arrhythmias and sudden cardiac death. Angiographic recognition of anomalous coronary arteries is very essential prior to any cardiac surgery. Failure to recognise them can lead to inadequate or prolonged procedures and may also lead to misdiagnosis and complications such as accidental ligation.<sup>4</sup> An inadvertent incision of the anomalous artery or failure to perfuse the anomalous vessel during cardiopulmonary bypass may result in Acute Myocardial Infarction (AMI).<sup>5,6</sup> Therefore, our aim is to find out the incidence of any anomalous coronary

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branching pattern in our study population of 50 heart specimens.

## MATERIALS AND METHODS

The study of coronary arteries regarding its course and distribution was carried out in dissection hall, Department of Anatomy, Rajah Muthiah Medical College and Hospital (RMMC and H), Annamalai University, Chidambaram, Tamil Nadu, India, with 50 heart specimens in the age group of 20-65 years from August 2010 to July 2013. The vital organ, heart is located in the thoracic cavity. A transverse incision was made through the manubrium sternum to expose underneath parts. Another incision was made through the parietal pleura in the first intercostal space extending from the lateral sternal border up to the left mid axillary line. From the ends of the line, the second and subsequent ribs were divided inferiorly up to the level of xiphisternal joint.

The lower part of the sternum and the costal cartilage and anterior parts of the ribs were elevated. The parietal pleura extending from back of sternum up to the mediastinum on both sides were divided. The upper part of the sternum was lifted up by dividing the sternopericardial ligaments. The fibrous pericardium was separated from the adjoining structure by dividing the fibrous pericardium. The heart was exposed and delivered out of middle mediastinum by cutting branches of arch of aorta, superior and inferior vena cava, pulmonary artery and veins. After the removal of heart specimens from the thoracic cavity, they were preserved in 10% formalin solution for one week. After adequate fixation, the manual dissection was carried out on the hearts.

The visceral pericardium from the sternocostal of the heart was removed. The anterior interventricular branch of the LCA and the great cardiac vein were exposed by scraping the fat from the anterior interventricular sulcus. The branches of the artery to both ventricles and to the interventricular septum, which lies deep to it were noted. The artery inferiorly was traced to the diaphragmatic surface and superiorly to the left of the pulmonary trunk. The fat from the coronary sulcus was carefully removed and avoided to prevent any damage to the small anterior cardiac vein crossing from the right ventricle to enter the right atrium directly. The right coronary artery was found in the depth of the sulcus. The course of the artery was traced superiorly to its origin from the right aortic sinus (a swelling at the root of the ascending aorta deep to the right auricle) and inferiorly till it turned on to the posterior surface of the heart. The branches to the right ventricle and atrium were noted. For statistical analysis, the data are expressed as percentage.

## RESULTS

We selected 50 heart specimens and manually dissected. We found that 48 (96%) heart specimens showed normal coronary branching patterns out of 50 heart specimens. Interestingly, we found two (4.0%) anomalous coronary branching patterns in two of the heart specimens. Figure 1, 2 and 3 show normal coronary branching patterns while figure 4 shows the abnormal coronary branching pattern.

Out of the two abnormal coronary branching patterns, one is arteria anastomotica infundibularis magna, which is reported here while the other one is abnormal circumflex artery from posterior aortic sinus, which is yet to be published.

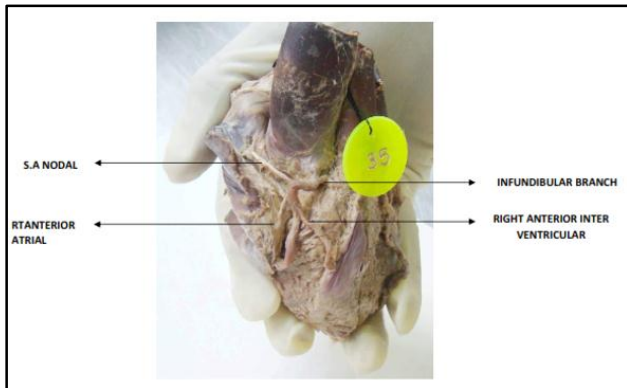
The RCA arose from the anterior aortic sinus. The artery passed at first anteriorly and slightly to the right between the right auricle and pulmonary trunk. Reaching the atrioventricular (coronary) sulcus, it descended in almost vertically to the right cardiac border curving around it into the posterior part of the sulcus where it approached its junction with both interatrial and interventricular grooves, a region appropriately termed the crux of the heart. Branches of the RCA supplied both right atrium and ventricle and variable parts of the left chambers and atrioventricular septum. The first branch was the conus artery and it ramified anteriorly on the lowest part of the pulmonary conus and upper part of right ventricle (Figure 1).

Anterior atrial and ventricular rami diverged from the first segment of the right coronary extending from its origin to the right margin of the heart. The right anterior ventricular rami, ramified towards the cardiac apex. As the RCA approached the crux, it gave off posterior interventricular rami, but only one in the interventricular sulcus; this is the posterior interventricular artery. The atrial rami of the RCA are sometimes described as anterior, lateral (right or marginal) and posterior groups. LCA arose from the left posterior aortic sinus. In its course, it found between the pulmonary trunk and the left auricle emerging to reach the atrioventricular sulcus in which it turned to the left. It reached the coronary sulcus and divided into 3 main branches of which the anterior interventricular (descending) ramus is commonly described as the continuation of LCA. It reached the apex of the heart and turned into the post (inferior) interventricular sulcus to meet the branches of RCA. This artery had anterior septal and anterior ventricular rami, anterior diagonal branch and conus branch (Figure 2).

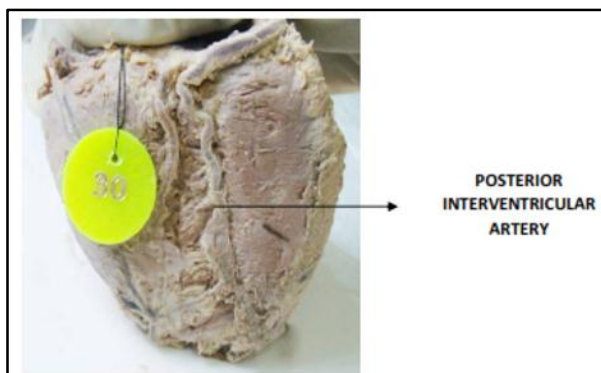
The left anterior ventricular arteries were large in nature arose from LCA perpendicularly from the anterior interventricular artery and supplied anterior two third of interventricular septum. Circumflex artery found running in the atrioventricular sulcus and curved around to end a little to the left of the posterior crux of the heart. A large ventricular branch, the left (obtuse) marginal artery arose perpendicularly from the circumflex and supplied the left margin of the heart and ended at the apex (Figure 3).

As far as the abnormal branching pattern of coronary artery, we noted that the LCA was found arising from the left posterior aortic sinus and dividing into circumflex and anterior interventricular artery. The circumflex artery was traced winding around the left border of the heart and giving off left marginal and left ventricular branch to the left ventricle. The other terminal branch of LCA, the anterior interventricular artery was found going around the left aspect of pulmonary trunk giving off two ventricular branches and the anterior interventricular artery. This anterior interventricular artery was found giving off one communicating branch to RCA on the anterior aspect of

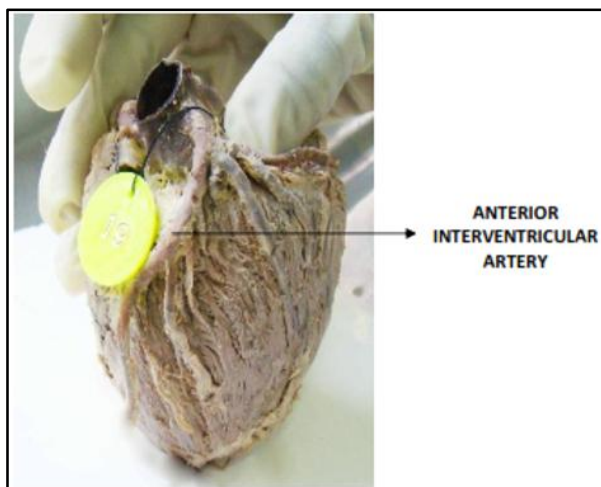
infundibulum, which after taking sinuous course to join RCA. This is we termed as arteria anastomotica infundibularis magna (Figure 4).



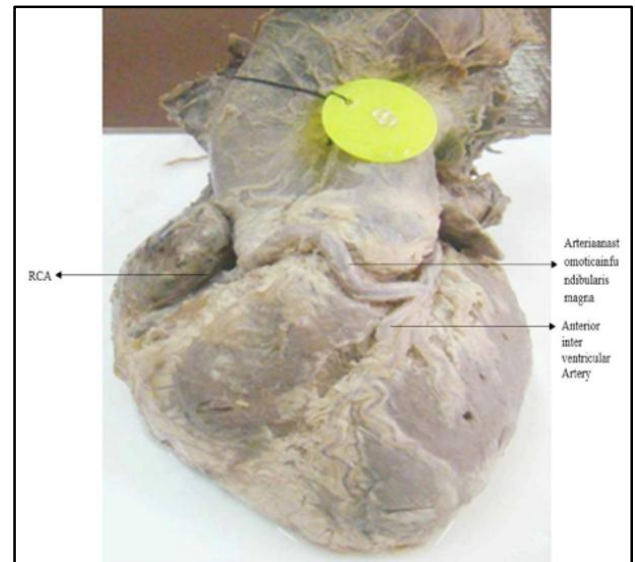
**Figure 1. RCA and its Branches**



**Figure 2. Posterior Interventricular Branch from RCA**



**Figure 3. Anterior Interventricular Artery- Branch of LCA**



**Figure 4. Arteria Anastomotica Infundibularis Magna**

**DISCUSSION**

As the study of various patterns of coronary arteries with variations are essential for the clinicians and surgeons, the coronary artery branching pattern was studied in a properly embalmed 50 heart specimens. In general, majority of people (90%) possesses right coronary dominance, where the posterior interventricular artery is large and arises from RCA. Minority of population (10%) has left coronary dominance where the posterior interventricular artery is a branch of LCA. The coronary circulation was studied by many anatomists by manual dissection method and other special methods like injecting contrast dye into the vessels, then analysed the x-ray picture taken after injecting the dye. We chose to approach with manual dissection for our study.

Coronary Artery Anomalies (CAAs) are a group of congenital disorders. They are defined as variants of the normal coronary artery.<sup>7</sup> Variation with relation to origin, course and termination are most frequently reported in the RCA. The incidence of coronary artery anomalies is approximately 1% among patients undergoing cardiac catheterisation.<sup>8</sup> As mentioned above, angiographic study in western population showed the RCA was the most common anomalous artery. The anomalous coronary arteries are associated with high incidence of congenital heart diseases. However, most of the coronary anomalies are asymptomatic and benign, but may cause myocardial ischaemia and sudden death. Some of them are fatal if they are associated with other heart diseases.

Anastomoses or interarterial communication in the coronary arteries are found to aggravate myocardial hypertrophy, valvular diseases and anaemia.<sup>9</sup> Intracoronary communications are a very rare subset of coronary artery anomalies with uni- or bidirectional blood flow between two or more coronary arteries.<sup>10</sup> These anomalies are mostly asymptomatic, however, clinical presentation in adults may result from myocardial ischaemia manifesting as angina, syncope, arrhythmias and even sudden death.<sup>11,12</sup> In our study, we found a communicating branch of the anterior interventricular artery was anastomosed with RCA on the anterior aspect of infundibulum. This arteria anastomotica

infundibularis magna is a very rare incidence found during our study and a detailed literature survey showed it is not reported elsewhere.

### CONCLUSION

Arteria anastomotica infundibularis magna is a very rare incidence found during our study on coronary arteries among 50 human heart specimens. To our knowledge, it is not reported elsewhere. This rare anomalous of coronary arteries will be useful for anatomists in teaching, radiologists in refining interpretation of cardiac imaging and cardiac surgeons in understanding the defects of coronary arteries and planning of angiography, coronary bypass grafting and other surgical interventions.

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