

Origin and Prevalence of Right Conus Artery: A Cadaveric Study

Abstract

Introduction: The human heart is mainly supplied by the right and left coronary artery. Conus artery is one of the essential branches of the right coronary artery (RCA). If this artery emerges directly from the anterior aortic sinus with no noticeable common trunk, this is known as the third coronary artery (TCA). Often, this anatomic variation left unvisualized during selective coronary arteriography. This study is an effort to notice the incidence and origin of the right conus artery in human cadaveric heart. **Material and Methods:** A total of 50 human cadaveric hearts were dissected, and the incidence and origin of conus artery were noted. **Results:** Out of the 50 hearts examined, 10 hearts had separate source of conus artery through anterior aortic sinus. Here, the artery is termed as TCA. In 11 cases, the conus artery show aortic origin with common opening of RCA. In 29 cases, conus artery arises outside the aorta from RCA. Among the 10 cases, origin of conus artery is directly from the aorta, 7 (14%) were male and 3 (6%) were female. **Discussion and Conclusion:** The occurrence of TCA is a blessing to a person and the one with TCA is less possibly to die from unexpected inherent death from cardiac pathology.

Keywords: Anterior aortic sinus, collateral circulation, coronary arteriography, third coronary artery

Introduction

Coronary artery diseases are becoming an epidemic in developing countries like India. The recent approach created in coronary blood vessel bypass surgeries and current strategies of cardiac muscle revascularization develop absolute awareness of unusual and variant anatomy of the artery. The recent approach created in coronary vessel bypass surgeries and current methods of muscular tissue revascularization develop absolute awareness of unpredicted and variant anatomy of the artery.^[1] Hence, divergent heart structure is of prime significance for appropriate perception and management of heart anomalies. Cardiac research work in unpredicted population suggests a foundation tool for consideration of the standard modification that possibly will aid the grit of the occurrence of disorders and analysis of the value of testing of these disorders.

Right coronary artery (RCA) originates by anterior aortic sinus, and the left coronary artery (LCA) shorter and wider

to the right arises from left posterior aortic sinus (Gray 1918).^[2] The first branch of RCA is the conus artery. Sometimes, this branch arises independently from the anterior aortic sinus. In this case, the conus artery is known as third coronary artery (TCA). It is responsible for the vascular supply of the infundibulum of right ventricular chamber.^[3] Clinicians have named the TCA as accessory (right) arteria coronaria, TCA, conus artery, Vieussen's (artery right), and arteria accessoria.^[4-6]

The TCA usually forms a ring-like structure known as Vieussen's ring after anastomosing with division of the left anterior descending (LAD) artery. This circle contributes a major course of blood flow collaterally in response to cardiac insufficiency.^[7-9] Under normal conditions, there is equal pressure in the right and LCA and no considerable flow is found in the connections. But when stenosis develops in one of the two systems, this vessel dilates and allows the blood to flow through the low-pressure system.^[10] The incidence of TCA is quite common, but still it remain undetected in standard coronary angiography procedures several time.^[11] The frequency of supernumerary ostium for conus branch of RCA emerging from aorta

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is about 50%. An atypical infundibular artery, a separate branch of RCA is at risk for injury from ventricular surgery or alternative techniques used throughout surgical procedure.^[12]

Hence, sound information concerning the presence and distribution of TCA is required for correct analysis of coronary angiograms, evaluation of severity of insufficiency, and acceptable designing of heart muscle revascularization.^[13] The current work has been made to note the prevalence and origin of the right conus artery.

Material and Methods

The present study was conducted in the Anatomy Department, TMMC and RC, Moradabad, over a period of 3 years.

Inclusion criteria

Heart specimens in which conus artery is clearly seen.

Exclusion criteria

Hearts with congenital anomalies and severely damaged vessels were excluded from the study.

Fifty hearts were included in the present work. Thirty-eight hearts belonged to male sex and 12 belonged to female sex. The origin, course, and main branches of RCA were studied in detail, giving emphasis to the conus artery/TCA. The proximal part of ascending aorta was opened at the level of posterior aortic sinus to visualize the separate ostium of TCA.

Results

Out of the 50 hearts examined, 10 hearts had separate origin of conus artery from anterior aortic sinus. Here, the conus artery is known as the third coronary. In 11 cases, the conus artery shows aortic origin with common opening of RCA. In 29 cases, conus artery arises outside the aorta from RCA. Among the 10 cases of origin of conus artery directly from the aorta, 7 (14%) were male and 3 (6%) were female [Table 1 and Figure 1].

Table 1: Origin of conus artery according to gender-wise distribution

Position (Conus artery)	Male (n=38), n (%)	Female (n=12), n (%)
AAS	7 (14)	3 (6)
Both RCA and AAS	11 (22)	0 (0)
RCA	20 (40)	9 (18)

RCA: Right coronary artery, AAS: Anterior aortic sinus

Table 2: Number of Ostia in anterior aortic sinus

Number of Ostia	Percentage
Single (40/50)	80
Double (10/50)	20

The common origin of conus artery with RCA is shown by 11 (22%) hearts which belongs to male only. Among the 29 cases where the conus (infundibular) artery is a branch of RCA, 20 (40%) were male and 9 (18%) were female.

Study of ostium

The “ascending aorta” was dissected horizontally about 1 cm over the root. It was then opened longitudinally at the position of right posterior aortic sinus to analyze ostia, in terms of their number or position. Single ostium was seen in 40 (80%) hearts and double ostia in 10 (20%) hearts [Table 2 and Figure 2].

Discussion

The variation in the emergence of coronary arteries and presence of accessory ostia in aortic sinus is rare but related with clinical consequences. Conus (infundibular) artery is generally the first branch of RCA. If the origin of this artery takes place precisely from the aorta, it is known as “TCA.” Incidence of this variation lies in between 7% and 50%.^[14]

According to our study out of 50 hearts, the origin of conus artery from “RCA” is shown by 29 cases where 20 were male and 9 were female. Eleven male hearts revealed the common source of conus artery and RCA. In 10 cases, conus artery arises directly from the anterior aortic sinus of ascending aorta where 7 were male and 3 were female. Here, the conus artery acts as TCA [Figure 3]. This study revealed the increased incidence of TCA in males.

This study supports the dissection study conducted by Lujinović *et al.* on supernumerary arteries arising from ascending aorta showed a prevalence of 32% for the direct origin of conus artery from aorta. According to them, the name TCA should be used for this artery to differentiate it from the conus branch of RCA.^[9] Fazliogullarietal revealed a very high prevalence of 68% for the direct origin of conus artery from aorta in Turkish cadaveric hearts.^[15]

Wide variations in the frequency of this artery as described through different studies suggest racial differences which may have genetic origin, or it could be due to technical error in cannulating in TCA on conventional angiography.^[16]

Whatever be the prevalence, the distribution of TCA is constant. It may pass forward and to the left on the

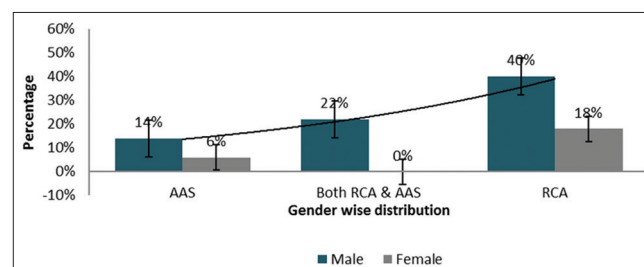


Figure 1: Origin of conus artery according to gender-wise distribution

sternocostal surface of the right ventricle up to the apex of the heart. The TCA represents a major source of collateral circulation when the LAD becomes obstructed.^[17] Collateral circulation plays a prime role in the pathophysiology of coronary artery disease. The presence or absence of collateral circulation determines the clinical status of patient. According to some recent studies, the collaterals may improve myocardial function and rectify some of the effects of myocardial ischemia.^[3] Previous anatomical studies have shown that in about 50% of human hearts, the conus artery does not arise from the RCA but emerges from anterior aortic sinus as a separate branch.^[18] In about 6% of cases, the conus artery may be the only source of alternate supply to occluded LAD. Underneath such circumstances, failure to identify this normal variant early during angiogram may result in unnecessary prolongation of procedure and use of additional diagnostic modalities such as computed tomography coronary angiogram in search of nonvisualized LAD.^[19]

In one of our hearts, the TCA is larger than the RCA supplying greater part of atrium and ventricles [Figure 4]. Underestimation of the extent of collateral circulation in patients with LAD or RCA disease could result under these circumstances. Hence, a caution should be taken throughout operative procedures in the region of the ventral wall of the

right ventricle and infundibulum as like a protracted TCA might end in operative susceptibility.^[20]

Normally, there is one ostium for RCA in the anterior aortic sinus and other for LCA in the left posterior aortic sinus. Our study showed the presence of more than one coronary ostia in the anterior aortic sinus. Out of the 50 hearts examined, 40 hearts represent single ostia in anterior aortic sinus, double in 10 hearts [Figure 5]. The most common variation of coronary ostia in the aortic sinus is the presence of supernumerary orifice for right conus artery or TCA. The clinical importance of multiple ostia lies throughout open-heart surgeries where it is tough to cannulate the vessel that arises from the abnormal Ostia. So while performing coronary arteriography and angiography, attempts are made to visualize the conus artery adequately for judging distal filling via collateral circulation whenever the LAD or RCA is obstructed.

Conclusion

The continuation of right conus artery bridges for anastomotic channel passage among the right and left coronary arrangement which is actually considerable in coronary artery disease. Anatomic variations of the heart

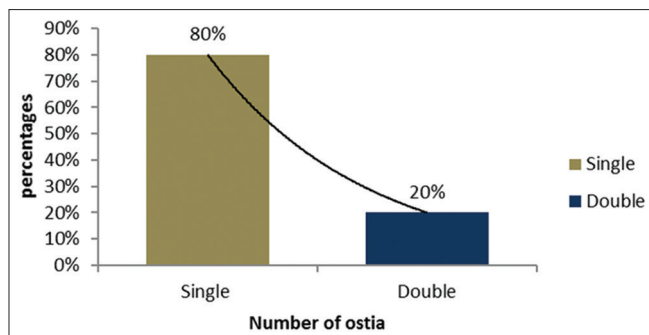


Figure 2: Percentage of ostia cases in the anterior aortic sinuses

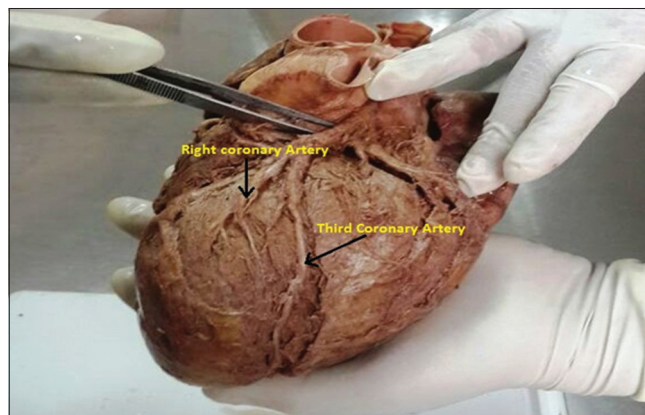


Figure 3: Human heart showing third coronary arteries

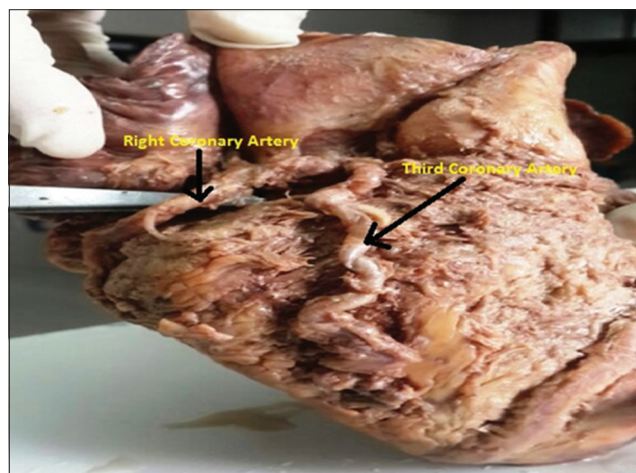


Figure 4: Heart with third coronary artery larger than the right coronary artery

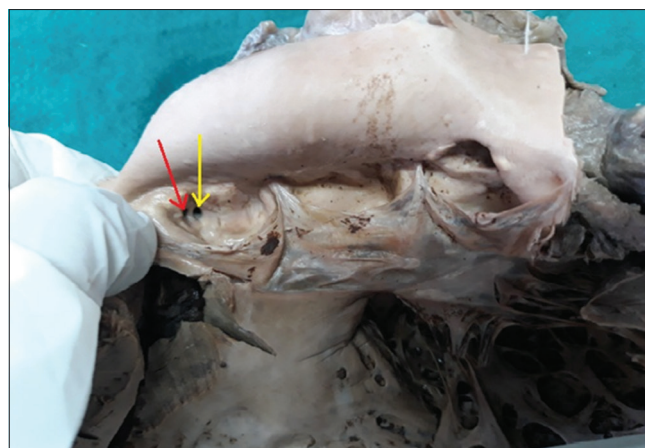


Figure 5: Dissected heart showing anterior aortic sinus with two orifices

vessels are common. Hence, identification of normal coronary artery pattern and variations in its origin and branches are important for cardiologists, cardiothoracic surgeons, and radiologists while performing coronary angiography and surgical procedures.

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Conflicts of interest

There are no conflicts of interest.

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