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Study on third Coronary artery in Cadaveric human hearts and its clinical significance

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Abstract
Introduction: *The human heart is vascularised by the Third coronary artery apart from the right and the left coronary arteries. The first branch of the right coronary artery is the conus artery. This branch may arise separately from the anterior aortic sinus in 36% of the individuals which is sometimes termed a 'Third coronary' artery (TCA).*
Objective: *To detect prevalence of Third coronary artery among cadaveric human hearts.*
Material & Method: *After an ethical approval, 50 formalin fixed human cadaveric hearts were collected from Department of Anatomy as well as from mortuary of SGMH Rewa MP. India and a study was done on the origin of third coronary artery in human cadavers by dissection method.*
Result: *Present study find that among 50 cadeveric human hearts 16 hearts having Third coronary artery i.e 32% taking as a separate opening from anterior Aortic sinus.*
Conclusion: *Sound knowledge on third coronary artery is essential to understand the advances made in coronary artery bypass surgeries and newer methods of myocardial revascularisation. Well developed collateral circulation through TCA may allow diagnostic and therapeutic interventions in patients with coronary artery disease.*
Keywords: *Third coronary artery, Anterior aortic sinus, Right conus Artery.*

Introduction
The word 'coronary' (Latin word) means a crown like arrangement of all coronary arteries in atrio ventricular sulcus of the heart. Right and left coronary arteries a vasava sorum of the ascending aorta supplies the heart.[1] The human heart is vascularised by the Third coronary artery apart from the right and the left coronary arteries. The first branch of the right coronary artery is the conus artery. This branch may arise separately from the anterior aortic sinus in 36% of the individuals which is sometimes termed a 'Third coronary' artery (TCA). It ramifies anteriorly on the lowest part of pulmonary conus and upper part of right ventricle.[2] It is also referred to as supernumerary artery but the term Third coronary artery is more suitable to clearly differentiate it from the conus branch of right coronary artery[3].

Accurate interpretation of coronary angiograms, assessment of severity of coronary insufficiency and appropriate planning of myocardial revascularisation necessitates to know the incidence of third coronary artery.[4]

Objective

To detect prevalence of Third coronary artery among cadaveric human hearts.

Material & Method

This study was conducted at Department of Anatomy Shyam shah medical college Rewa MP during 2011-12. Sample size for study was 50. study sample was collected from the cadavers of Department of Anatomy as well as from mortuary of SGMH hospital Rewa. Ethical approval was taken from the Institutional Ethics committee. Normal hearts from the cadevers of age groups 20-60 were included. hearts with the gross abnormalities and pathologies were excluded. The dissection was done under water, the heart was dissected and the courses of right and left coronary artery were traced from the ostia by cleaning the epicardium and fat by dissection. The coronary arteries and its branches were observed. The coronary veins were removed to avoid confusion. The specimens were duly numbered, preserved in 10% formaldehyde solution. The ascending aorta was sectioned transversely approximately 1 cm above the commissure of aortic leaflets. then insert the probe into the ostia of right anterior aortic sinus. To give contrast in photograph red enamel paint was used to paint the main coronary artery and their branches. The variations and anomalies were observed. After noting all these parameters related to the origin and presence of number of opening of coronary arteries from the aortic sinus .

Result

In 16 (32 %) of the cases, multiple openings were seen in the anterior aortic sinus and in 34 (68%) of cases were seen with single opening. Observations about the origin of the right conus artery to find the incidence of third coronary artery revealed that 16 out of 50 specimens (32%), right conus artery arise from anterior aortic sinus directly and in rest of 34 out of 50 specimens (68%) it arise from proximal part of RCA.(Table No 1)

Table 1: Observations in the present study

SN	Particular	Frequency
1	No. of cases of single ostia in AAS	34 (68%)
2	No of cases of multiple ostia in AAS	16 (32%)
1	Origin from RCA	34 (68%)
2	Origin from AAS (as a TCA)	16 (32%)

The third coronary artery, after taking origin from the separate opening in Anterior aortic sinus then passed downwards and to the left of RCA through the subepicardial adipose tissue of the coronary sulcus for a short distance. After leaving the coronary sulcus, it ran on the anterior wall of the right ventricle to reach the pulmonary conus (Figure 1&2) It often ended by dividing into an upper branch and a lower longer branch. The upper branch is smaller and shorter; ended by supplying the pulmonary infundibulum in most of the cases (Figure 2). The extent of the lower branch was found to be variable, it may extended till the anterior wall of the right ventricle (Figure 3) and it may reached the inferior border of the right ventricle.

Discussion

The first ventricular branch of right coronary artery is called the right conus artery or the third coronary artery when it arises directly from the aorta[5]. The first branch of the right coronary artery is the conus artery .This branch may arise separately from the anterior aortic sinus in 36% of the individuals. It ramifies anteriorly on the lowest part of pulmonary conus and upper part of right ventricle. It may anastomose with a similar left coronary branch from the left anterior descending artery to form the annulus of Vieussens, which is a tenuous anastomotic circle around right ventricular outflow tract[2].
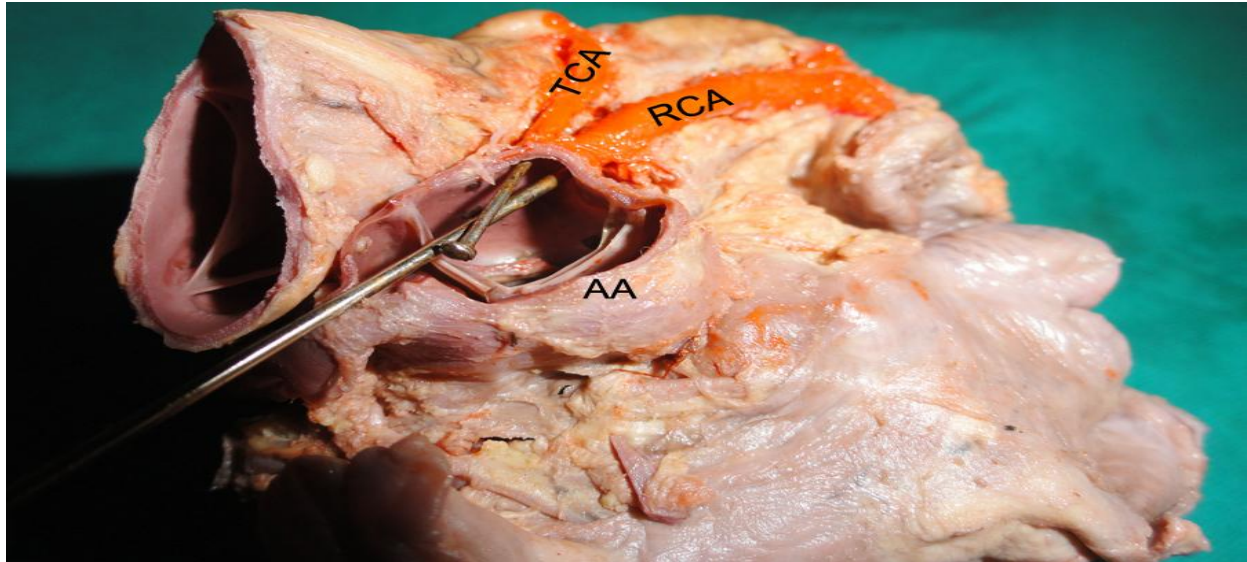
Figure 1 Third coronary artery with separate opening in anterior aortic sinus (Superior View)

Figure 2 TCA reaching up to the pulmonary conus (Superior View)
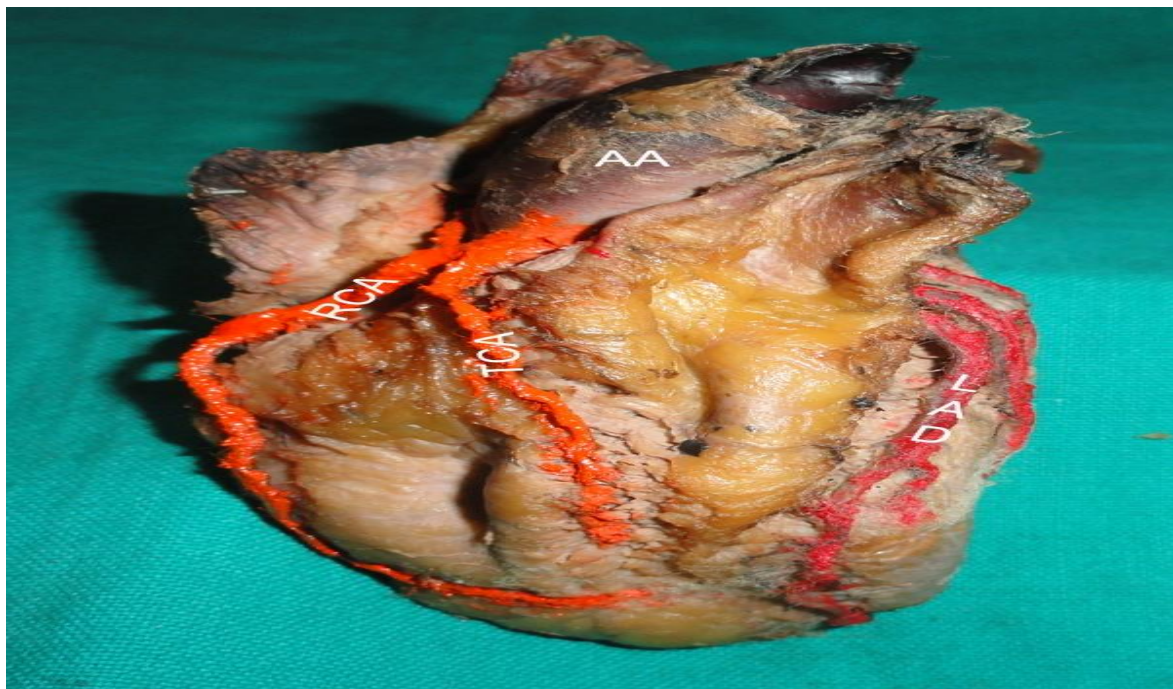

Figure 3 Inferior extension of TCA reaching up to anterior wall of RV (Anterior View)

In present study, Observations revealed that16 out of 50 specimens (32%), the right conus artery arising from anterior aortic sinus directly, is the third coronary artery and in rest of 34 out of 50 specimens (68%) it arising from proximal part of RCA.

Kalpana R. found that the right conus artery arising separately from the anterior aortic sinus is the Third coronary artery, in 24% of the specimens studied[6].

The study of Bharambe VK found the incidence of third coronary artery to be 22%. They explained its importance while cannulating the vessels during procedures like open aortic surgery and coronary arteriography. The number of coronary arteries can be outlined by a preliminary aortic root injection which helps the interventional cardiologist [9].

Stankovic I, Jesic studied 23 hearts and found third coronary artery in 34.8% of heart specimens. The difference in the frequency of third coronary artery between the sexes was statistically insignificant. In all the specimens, the ostium of the third coronary artery was to the left and superior to ostium of right coronary artery[10].

Kaur D et al. found that out of 77 heart specimens minute accessory coronary ostia for third coronary artery was observed in anterior aortic sinus in 12 specimens (15%)[11]

The frequency of the Third Coronary artery in various studies is compared in the

Table 2 Showing Percentage of distribution of the third coronary artery by various workers

SN	Authors	Frequency(%)
2	Kalpana, (2003)	24
	Olabu et al	35.1
3	Standring et al (2005)	36
4	Jyothi Lakshmi G.L.(2017)	30
5	Present study	32

The frequency of the third coronary artery noted in our study is comparable to the values noted in the previous studies on cadavers[5,6,7,8]. Wide variation in the frequency of the TCA observed in previous studies may be attributed to racial differences and age [5,7]. Different methodologies used for the study may also contribute to the observed variations as unless specifically looked for, coronary angiograms frequently fail to visualize the third coronary artery.

Conclusion

The prevalence of TCA observed in our study is 32 %. Although TCA frequently bifurcated to supply the pulmonary infundibulum and anterior wall of the right ventricle. The area of perfusion of the Third coronary artery is variable and may be more extensive than usual in some individuals. Well developed collateral circulation through TCA may allow diagnostic and therapeutic interventions in patients with coronary artery disease. The variant anatomy and the significant contribution of TCA to coronary perfusion necessitate the selective visualization and functional assessment of TCA in patients with coronary artery disease. The knowledge on third coronary artery plays a major role in the interventional cardiology and coronary surgery.

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