Study of Arterial supply to Sinoatrial Node in Normal Human Hearts

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Abstract

Introduction: The arterial supply to Sino-Atrial Node (SA Node) and its variations is of great importance in increasing use of cardiac interventional procedures. **Aim and objective:** The aim of present study is to analyze the arterial supply of SA node. **Materials and Methods:** Fifty-five human hearts, fixed in the formalin solution were dissected and artery to SA node was traced. **Results:** Out of 55 cases, SA nodal artery originated from right coronary artery (RCA) in 64%, left circumflex artery (LCX) in 34% and 2% from both. S-shaped SA nodal artery was seen in 2 cases. In most of the specimens (42 out of 55) SA nodal artery formed a ring around superior vena cava and in all the cases, the branches of SA nodal artery supplied to both atria and auricle based on the origin either from RCA or LCX. **Conclusion:** Variations in arterial supply to SA node will be helpful to interventional cardiac surgeons.

Keywords: SA nodal artery, right coronary artery, left circumflex artery, atrial branch

Introduction

The pacemaker of the heart consists of the nodes and the networks of specialized myocardial cells and its first component is Sinoatrial Node (SAN)/ cardiac pacemaker which initiates each cardiac cycle.^[1] It is located in the upper end of sulcus terminalis.^[2]

SA Nodal artery (SANA) is an atrial branch of RCA (65%) or a branch from LCX (35%).^[3] Any injury or iatrogenic occlusion of SA nodal artery can occur during various surgical procedures like coronary stent insertion or balloon insertion and it leads to ischemia of SA node.^[3] Because of such importance, the origin, course and number of SANA are essential for cardiac surgeons and cardiologist before and during the interventional procedures.^[4]

Materials and methods:

Fifty-five formalin fixed heart specimens (adult human) were included in the present study. Branches of coronary arteries were dissected in the conventional method in the Anatomy Department of Sri Siddhartha medical college, Tumakuru, after removing the epicardial fatty tissue. SA nodal artery was traced and dissected. The details of origin, course and termination

were noted. Any injured, damaged or pathological heart samples were not included in the study

Results:

Out of 55 heart specimens, the SA nodal artery was arising as a single branch from RCA in 35 specimens (64%) and mostly from the anterior segment of RCA. SANA arose from the left circumflex artery in 19 specimens (34%). In one specimen each, the SA nodal artery was arising from RCA and LCX (2%). (Figure 1)

Figure 1 : Site of origin of SA Nodal Artery

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Branches which were originating from RCA were as follows. Out of 35 specimens, 31 specimens showed SA nodal artery arising from the anterior segment of RCA (88%). (Figure 2A) Two specimens (6%) from the marginal segment and in another two specimens (6%) SA nodal artery was arising from the posterior segment of RCA (Table 1, Figure 2).

Table 1: Origin of SA Nodal Artery from Different Segments of RCA

Segments of RCA	No of specimens	Percentage
Anterior	31	88%
Posterior	2	6%
Marginal / Lateral	2	6%

As an anterior segment branch, the artery originated at 1.2cms range, running in the sub epicardial adipose tissue to the base of sinus and then coursed through right side of the atrial wall, posterior aspect of aortic bulb and ascending aorta. Finally it ascends medially and reaches the anterior interatrial groove.

Figure 2 : Origin of SA nodal artery from RCA. A) Proximal segment origin B) Marginal segment origin

Table 2: Branches Originating From Left Circumflex Artery

Segments of LCX	No of specimens	Percentage
Proximal	13	68.4%
Distal	4	21.1%
Marginal/lateral	2	10.5%
Total	19	100%

Branches originating from the LCX are shown in Table 3. In 34 % of cases, branch of LCX which ascends to the left side of atrial wall, then behind ascending aorta and finally enters in to the anterior interatrial groove (Figure 3).

Figure 3 : Origin of SA nodal artery from LCX

Figure 4: Origin of SA nodal artery from RCA and LCX

In one case, the SA node was supplied by two arteries of which one from RCA and another from LCX (Figure 4). Sino atrial nodal artery was arising from the proximal part of RCA, running upwards and to the right side, then it reached the upper end of sulcus terminalis and supplied the SA Node.

A branch from left circumflex artery ran behind the pulmonary trunk and ascending aorta then above the coronary sulcus, divided into two branches, to reach the transverse sinus. Out of the two branches, one branch supplied left atrial wall and other one traversed between the left auricle and left superior pulmonary vein to reach the SA nodal area.

'S' shaped SA nodal artery was observed in 2 cases, one from the LCX and other from RCA. SA nodal artery arising from the RCA supplied to the right atrium, right auricle and ascending aorta. SANA from LCX supplied

to left atrium, left auricle and right atrium.

Discussion:

Coronary arteries variations have been studied by clinicians and anatomists for a long time. When selective coronary angiography method started, the investigations in this field were increased. This evaluation occurred in 1906. In 1907, Keith A and Flack M were the first to describe the SA nodal artery and its variations.^[5] The risk for damage of SA nodal artery during mitral valve surgery is high, especially during transseptal approach.^[6]

Table 3: Arterial supply of SA Node; by various researchers

Authors	Origin of SA nodal artery (%)		
	RCA	LCX	RCA & LCX
Futami et al ⁷	73	3	23
Kalpana R ⁸	56	35	8
Kyriakidis et al ⁹	59	38	3
Ramanathan et al ¹⁰	53	43	4
Verma R et al ¹	52	24	24
Present study	64	34	2

Arterial supply of the SA node has been described in various publications and literature. The present study results are in accordance with previous publications; in majority of the published studies, SA nodal arteries arose from the RCA. In our study 64% of hearts nodal artery arose from RCA; it is closely related with the results of Kyriakidis et al who reported the incidence of 59% of specimens. Majority of authors found the result between 50%-75% (Table 3)

We found that the incidence of SA nodal artery arising from LCX was higher (34%) than the study results of Futami et al (3%). Our results were similar to the study conducted by Kalpana R (35%) and Kyriakidis et al (38%).

2% of the nodal artery originated from RCA and LCX in our study. Present study result was contrary to the study conducted by Verma R et al in 2014. The author observed the highest incidence of SANA from both the major arteries which accounts for 24% of specimens. In a study by Kyriakidis et al, the result was nearly related to our study results. The researcher reported, SANA originated from both the major coronary arteries in 3%

of total specimens studied. Ramanathan et al also reported 4% of nodal arteries arose from both the coronary arteries.

We found a few rare variations in our study. In 4% of our study specimens, we observed that SA nodal arteries are two in number and in 4% of specimens, we observed 'S' shaped nodal artery (2% from LCX and 2% from RCA). Geographical analysis of S shaped SA nodal artery showed higher prevalence in Asian population and our study results closely related to Asian study prevalence. Such rare variations are clinically important, as their long course might be damaged through iatrogenic injury during cox maze operation for atrial fibrillation, so cardio-thoracic surgeons should be aware of such variations and take more care of such variants to avoid injury at the time of surgery.^[11] Several other researchers have reported SANA arising from the bronchial artery, trunk of left coronary artery and right sinus of Valsalva but no such variations were seen in our study.

Conclusion:

The present study results showed the variations of the arterial supply to the SA node in the form of origin and course. These kind of variations should be identified before interventional cardiac procedures through advanced radiological instruments to prevent injury to SA nodal artery.

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Conflicts of interest: Nil

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