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An anatomical insight into 'S' Shaped SA nodal artery: A study in human cadaveric hearts

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Abstract
The SA nodal artery (SANA) is an atrial branch usually in 65% arising from right coronary artery and in 35% from left Circumflex artery (LCx). In the previous studies, the variation such as 'S' shaped course of SANA was reported. Study included 55 human hearts obtained from Department of Anatomy, SSMC. Embalmed human hearts were dissected and analysed to study the incidence of 'S' Shaped SA nodal artery. In the present study, S' shaped SA nodal artery was observed in 2 specimens one from the left circumflex artery (LCx) and other from Right Coronary artery (RCA). There is a high chance of vulnerable injury to SA nodal artery especially "S" Shaped SANA at the time of various surgical procedures like coronary stent insertion or balloon insertion. It is advisable to have MDCT to diagnosis and to establish a good preoperative plan for interventional cardiac procedures.

Keywords: Sinoatrial nodal artery, coronary artery, 'S' shaped SANA

Introduction
The Sinoatrial (SA) node, the dominant pacemaker of the heart usually initiates the cardiac conduction [1, 2]. It is in the upper end of sulcus terminalis, a region between parts of right atrium developed from atrium proper and sinus venosus [3]. The SA nodal artery (SANA) is an atrial branch usually in 65% arising from right coronary artery and in 35% from left Circumflex artery (LCx) [4]. In the previous studies, the variation in the course of the SANA was very less acknowledged. The variation such as course of SANA in relation to the superior vena cava and a rare 'S' shaped course of SANA was reported [5].

Thus any injury or iatrogenic occlusion of SA nodal artery (SANA) leads to ischemia of the SA node at the time of various surgical procedures like coronary stent insertion or balloon insertion. Because of such importance, we undertook the study to investigate the course and anatomic characteristics of the 'S' Shaped SANA which may be helpful for cardiovascular surgeries [4].

Materials and methods
The present study was carried out in the Department of Anatomy, Sri Siddhartha Medical College, Sri Siddhartha Academy of Higher Education, as part of routine under graduate dissection teaching schedule over a period of five years. Totally 55 human adult specimens of embalmed cadaveric hearts were analysed to study the incidence of 'S' Shaped SA nodal artery. The branches of right and left coronary arteries were dissected after removing the epicardial fatty tissue.SA nodal artery was dissected. The observations were noted down and photograph of each specimen was taken after dissection.

Results
Among the 55 cadavers, 'S' shaped SA nodal artery was observed in 2 specimens, one from the left circumflex artery (LCx) and other from Right Coronary artery (RCA). The SA nodal artery arising from right coronary artery also supplied branches to the right atrium, right auricle, aorta, and SANA from left coronary artery supplied left atrium, left auricle and right atrium

Specimen 1: 'S' shaped SA nodal artery was arises from LCx (Fig: 1). As left circumflex artery enter the posterior part of coronary sulci, it gives off SANA which ascends to the left of pulmonary veins and then it enters the posterior part of transverse sinus, runs downwards and again upwards to the junction of SVC with right atrium.

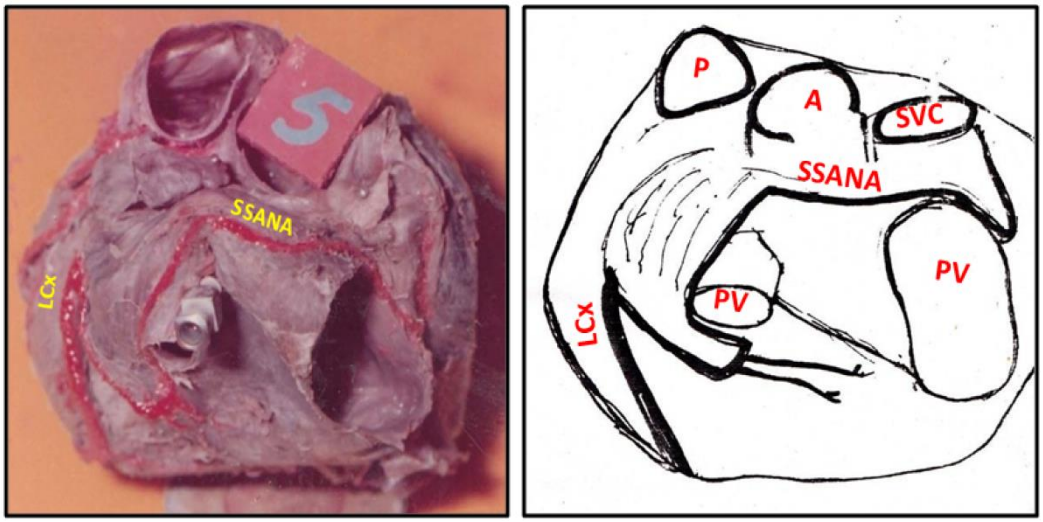

Fig 1: Shows origin of 'S' shaped SANA from LCX

Specimen 2: 'S' shaped SA nodal artery was arises from RCA (Fig: 2). In the posterior part of coronary sulcus after crossing the crux of the heart, right coronary artery gives off 'S' shaped SANA which runs upwards and left to the left pulmonary veins ascend to the superior border of left atrium and runs towards the junction of superior vena cava and right atrium, running posterior to aorta.

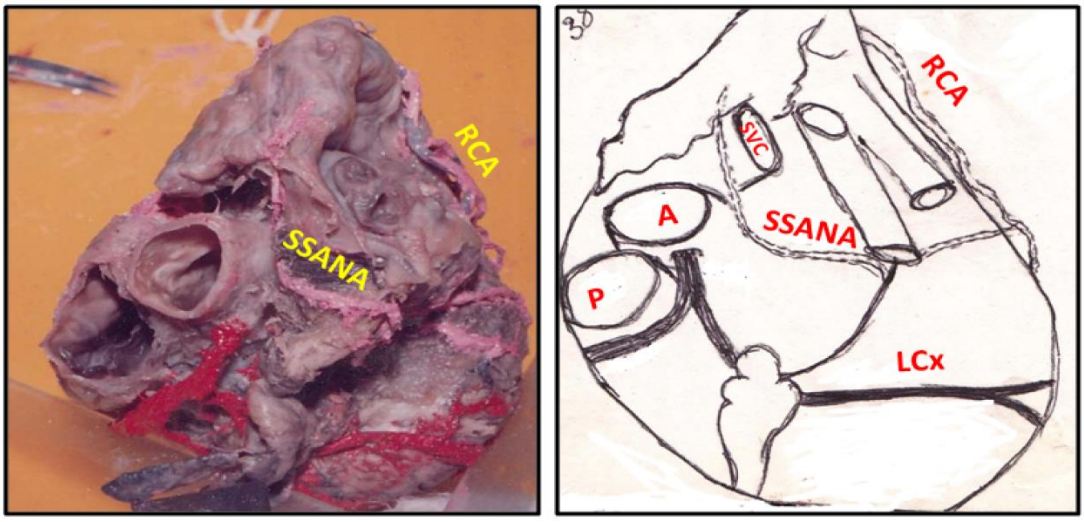

Fig 2: Shows origin of 'S' shaped SANA from RCA.

Discussion

Inborn origin variability, abnormal course and structure of the coronary arteries entail to a condition called coronary artery disease (CAD) or coronary artery anomalies which leads to a risk of sudden death. CAD represents one of the major causes of morbidity and mortality in India especially in the urban population [6]. The artery supplying the SA node is usually branch of right coronary artery (RCA) or the left circumflex artery (LCx).

In the previous studies, the variation in the course of the SANA was very less acknowledged. The variation such as course of SANA in relation to the superior vena cava and a rare 'S' shaped course of SANA was reported [5]. But very few studies in the literature established the course and incidence of 'S' shaped SANA [5, 7-9]. Vikse J et al. in 2016 conducted an extensive review of the literature and reported the prevalence of 'S' shaped SANA in 7.6% cases out of 8 studies (n=5031 hearts). He also analysed based on geographical distribution and reported the incidence of 'S' shaped SANA was seen in 10.4% European, 9.5% North American and 1.3% Asian population [5].

Nerantzis and Avgoustakis (1980) conducted a study on 300 heart specimens. They reported that the incidence of 'S' shaped SANA was found to be 24 (21.5%) of the 111 cases. They described that the 'S' shaped SANA has three types of origins. It may arise as a branch of a long LCx artery or as an upper division or continuation of a short LCx artery [7].

The first noninvasive MDCT imaging of SA nodal artery was conducted in 2008 by Saremi et al, reported the anatomic characteristics of the 'S' shaped SANA. They found that the 'S' shaped SANA was seen in 35 cases (14.3%). Out of 35 cases, 34 (30.6%) was arising from the proximal to middle portion of the LCx artery and one case (0.7%) from RCA. They also added the incidence of dual blood supply to the SA node from the RCA and LCx in 12 cases (4.9%) and usually small branch from RCA and large 'S' shaped SANA from the LCx. They documented the right SANA and the 'S' shaped variant of the left SANA were seen in seven cases (58.3%) [8].

In the present study, we observed the 'S' shaped SA nodal

artery in 2 specimens, one from the left circumflex artery (LCx) and other from Right Coronary artery (RCA) which accounts for 3.63% out of 55 heart specimens. We have not documented the incidence of dual 'S' shaped SA nodal artery.

The course of S' shaped SA nodal artery have received the clinical attention because usually its course is almost similar to that of the left superior cardinal vein of the fetus and the oblique vein of Marshall in adults. Cardiologist and radiologist must aware and should consider for the differential diagnosis in case of recanalised Marshall ligament or persistent left SVC [9, 10]. During surgical procedure for atrial fibrillation, a rare S' shaped course of SA nodal artery may susceptible to iatrogenic injury or lesion because of its long course [8].

Conclusion

There is a high chance of vulnerable injury to SA nodal artery at the time of various surgical procedures like coronary stent insertion or balloon insertion. It is advisable to have MDCT to diagnosis and to establish a good preoperative plan for interventional cardiac procedures.

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