A Study of the Arteries distributed in the Sinuatrial Node of Human Heart : relationship between the Coronary Arterial Dominance and the Origin of the Sinuatrial Nodal Branch

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A Study of the Arteries Distributed in the Sinuatrial Node of Human Heart: Relationship between the Coronary Arterial Dominance and the Origin of the Sinuatrial Nodal Branch

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Abstract

The sinuatrial nodal branch (SANB) of the coronary artery is anatomically and clinically important as it irrigates the sinu-atrial node. Studies of the origin and route of the SANB in human hearts have produced discrepant findings and therefore in this study we macroscopically investigated the origin, route, and distribution of the SANB in 100 human hearts. In addition, we examined the relationship between the coronary artery dominance and numbers of the branches, origin of the SANB. The SANB was found to take one branch in 91cases (91.0%), two branches in 8 cases (8.0%), and three branches in one case (1.0%). Right coronary artery dominance was found in 57 cases (57.0%), while balanced coronary circulation and left coronary artery dominance was found in 28 cases (28.0%) and 15 cases (15.0%). The origin of the SANB was independent of coronary arterial dominance.

Key words: coronary artery, origin and route, human heart, arterial dominance

Introduction

Recently, the cytoarchitecture and vasculature of the cardiac conduction system have attracted considerable attention[1-3]. In the last decade, with the advent of new surgical techniques used in the treatment of arrhythmias, more specifically of atrial fibrillation, knowledge of the characteristics and trajectory of the atrial branches, particularly the sinuatrial nodal branch (SANB) has assumed great important[4]. Anatomical dissections and coronary angiography have demonstrated that the SANB varies both in origin and in route1[1,5-12]. Although, there are no consensus of opinion has yet been reached as to the origin and route of the SANB.

The aim of this study was to clarify the relationship between the dominance of the coronary artery and the origin, numbers of the branch of the SANB in 100 human hearts of Japanese individuals.

Materials and Methods

We examined 100 adult human cadavers during anatomical dissection practice at Kagoshima University School of Dentistry. The cadavers had been fixed in formalin and showed no macroscopic pathological abnormalities. The protocol for the research project was approved by the Ethics Committee of Kagoshima University, within which the work was undertaken, and the study conformed to the provisions of the Declaration of Helsinki in 1995 (as revised in Edinburgh, 2000).

For each heart, the atrial branch of the coronary artery was carefully dissected out as far distal as possible so that the main stem, origin, route and distribution of the coronary ar-

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tery could be determined. The SANB was traced from its origin in the coronary artery to its junction with the SAN as it was dissected along its length. Then, it was visually determined whether the SANB originated from the left or right coronary artery and what routes it took to reach the SAN.

The relationship between the coronary artery dominance and origin of the SANB was determined. The coronary artery dominance was classified into three types according to Schlesinger[13], namely, right dominance, left dominance, and balanced.

Results

The routes of the SANB were classified into the nine routes, the origin of the right coronary artery was five routes, left coronary artery was four routes. The most route of the SANB was as follow. The SANB origin from the proximal portion of the right coronary artery and passed up through the interatrial groove. It ascended through the anterior wall of the right atrium, ran along the ventral aspect of the superior vena cava, and supplied the SAN (Fig.1).The SANB was one branch in 91 (91%), two branches in 8 (8%), and three branches 1 (1%).

Right coronary artery dominance was found in 57 cases (57.0%), while balanced coronary circulation and left coronary artery dominance was found in 28 cases (28.0%) and 15 cases (15.0%) (Figure 2). Among those with right coronary artery dominance, 52 cases (52.0%) were characterized by one branch, while five cases (5.0%) showed two branches.

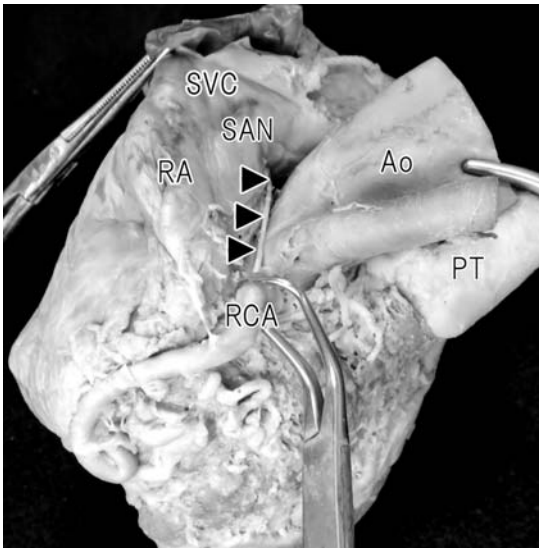

Fig.1 The sinoatrial nodal branch (arrows) originating from the right coronary artery. Ao; aorta, SVC; superior vena cava, RA; right atrium, RCA,; right coronary artery

For those with balanced circulation, 25 cases (25.0%) showed one branch, two cases (2.0%) cases had two branches, one case (1.0%) had three branches. Among those with left coronary artery dominance, 14 cases (14.0%) exhibited one branch, while one case (1.0%) had two branches (Table 1).

In regards to relationship of coronary artery dominance with SANB origin, within the 56 branches from right coronary artery dominant hearts, 32 branches (30.0%) originated from the right coronary artery and, 24 branches (22.4%) emerged from the left coronary artery. In the 37 branches

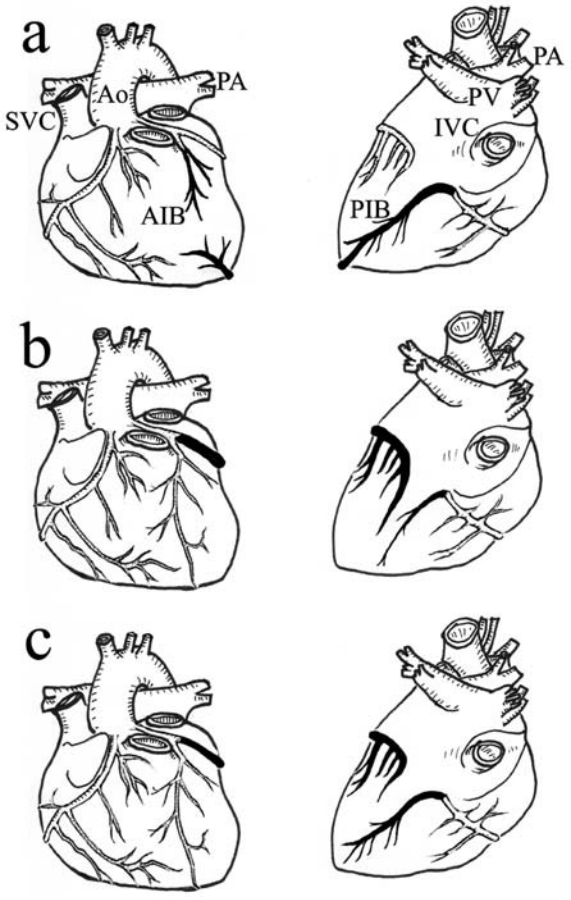

Fig.2 Schema showing the three categories of the dominance of the coronary artery by Schlesinger: Right dominance type, the posterior interventricular branch reach the anterior interventricular groove, and the anterior interventricular branch is short and thin (Fig2a). ; Left dominance type, the posterior interventricular branch is short and thin, and the circumflex artery reach near the posterior interventricular groove (Fig2b). ;Balanced type, the right coronary artery bifurcate the posterior interventricular branch, the left coronary artery bifurcate the anterior interventricular branch and circumflex artery (Fig2c). Ao; aorta, SVC; superior vena cava, AIB; anterior interventricular branch, PA; pulmonary artery, PV; pulmonary vein, IVC; inferior vena cava, PIB; posterior interventricular branch

Table 1. The relationship between the coronary artery dominance and the origin of the SANB (n=100)

coronary artery dominance	one branch		two branches			three branches	total
			unilateral		bilateral		
	right	left	right	left			
Right dominance	30 (30.0%)	22 (22.0%)	1 (1.0%)	1 (1.0%)	3 (3.0%)	-	57 (57.0%)
Left dominance	9 (9.0%)	5 (5.0%)	-	-	1 (1.0%)	-	15 (15.0%)
Balanced	15 (15.0%)	10 (10.0%)	1 (1.0%)	-	1 (1.0%)	1 (1.0%)	28 (28.0%)

Table 2. The relationship between the coronary artery dominance and the numbers of the SANB (n=107)

coronary artery dominance	RCA		LCA		Total	
	n	%	n	%	n	%
Right dominance	32	30	24	22.4	56	52.4
Left dominance	9	8.3	5	4.7	14	13
Balanced	20	18.7	17	15.9	37	34.6

from hearts with balanced circulation, 20 branches (18.7%) stemmed from the right coronary artery, while 17 branches (15.9%) originated from the left coronary. In the 14 branches from left coronary artery dominant hearts, nine branches (8.3%) originated from the right coronary artery, while five branches (4.7%) emerged from the left (Table 2).

Discussion

In regards to type of the coronary artery dominance and numbers of the branches, origin of the SANB, among hearts with right coronary artery dominance, the sinus node artery most frequently derived from the right coronary artery, followed by SANB derived from either the left coronary artery or circumflex branch.

For the right dominant-hearts, on the other hand, there was no obvious left-right difference in terms of the origin of the SANB, with 30.0% of the branches derived from the right coronary artery and 22.4% from the left coronary artery. Similarly, for the left dominant-hearts 8.3% of the SANBs were derived from the right coronary artery and 4.7% from the left. The corresponding values for the balanced hearts were 18.7% and 15.9%, respectively. In Nishi et al.'s (1986) study, coronary artery dominance was classified as the right dominant, left dominant and middle neutral dominance type, which correspond to the right, the left and the balanced types, respectively, defined in the present study.

However, their study revealed a significant difference in the proportions of the SANB derived from the right or left coronary artery for the left dominant-hearts, but not for right or neutral dominant hearts. This is not consistent with our results. This discrepancy may be due to the different number of branches examined in the two studies: 52 branches in Nishi et al.'s study versus 107 branches in the present study.

In an angiographic study on the relationship between the coronary artery and the SANB[3], among right- dominant hearts, 89 cases (29.7%) originated from the right coronary artery, and 75 (25.0%) originated from the left coronary artery. Among balanced hearts, 40 cases (13.3%) originated from the right coronary artery, and 28 (9.3%) originated from the left. In the left-dominant hearts, 43 cases (14.3%) originated from the right coronary artery, and 25 cases (9.3%) originated from the left coronary. Our results are in accordance with these reported findings.

The arteries to the SA nodes show certain anatomical variation. Knowledge of these variations and being able to recognize and identify the anatomical aspects of these vessels help in overcoming potential difficulties in treating arrhythmias and in mitral valve surgery[14].

The results obtained in the present study point to a tendency for the SANB that originates from the coronary artery, and anatomical data of the arterial blood supply to the sinuatrial node (SAN) obtained are expected to contribute to clinical investigations of cardiac rhythm disturbances.

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