

Sinoatrial node artery arising from posterolateral branch of right coronary artery: definition by screening consecutive 1500 coronary angiographies

*Sağ koroner arter posterolateral dalından çıkan sinoatriyal nod arteri:
Ardışık 1500 koroner anjiyografi taraması ile tanımlama*

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ABSTRACT

Objective: Sinoatrial node (SAN) artery originates from proximal segment of right coronary artery (RCA) or from left circumflex artery. Sinoatrial node artery originating from posterolateral (PL) branch of RCA is very rare. Only several cases have been reported. The study was performed to seek the frequency of this variation, evaluate clinical relevance, and describe electrocardiographic, angiographic characteristics of patients.

Methods: Consecutive 1500 coronary angiography were screened to detect specifically SAN artery originating from PL branch of RCA. Patients with this variation were followed-up for one year regarding the arrhythmic events.

Results: The origin of SAN artery was proximal RCA in 1280 (85%), circumflex artery in 208 (14%), and PL branch of RCA in 12 (0.8%) patients (8 male, 4 female, mean age 64±9 years). There was no history of arrhythmia in all patients. One patient presented with atrioventricular block. Indications of angiography were stable angina in 5, unstable angina in 5, and acute myocardial infarction in 2 patients. The patient with inferior myocardial infarction due to RCA total occlusion did not develop bradycardia or conduction defect. In four patients (33%) there was another artery originating from proximal RCA, ending at same territory with the variant artery suggesting dual blood supply. During one-year follow-up none of the patients experienced arrhythmic event.

Conclusions: Sinoatrial node artery originating from distal RCA is very rare. This variation, even in patients with severe RCA disease is not associated with severe arrhythmia. Dual blood supply may be a protective factor in this subgroup of patients from arrhythmic events. To be aware of the origin and course of variant SAN artery may provide safe approach to interventional cardiologist and cardiac surgeon during percutaneous and surgical coronary and atrial interventions. (*Anadolu Kardiyol Derg 2009; 9: 481-5*)

Key words: Sinoatrial node artery, coronary artery disease, coronary angiography

ÖZET

Amaç: Sinoatriyal nod (SAN) arteri sağ koroner arter (SKA) proksimal segmenti ya da sol sirkümlüks arterden çıkar. Sağ koroner arterin posterolateral dalından (PL) çıkan SAN arteri oldukça nadirdir. Bu güne kadar sadece bir kaç olguda saptanmıştır. Araştırma bu varyasyonun sıklığını saptamak, klinik önemini değerlendirmek ve bu varyasyona sahip hastaların elektrokardiyografik, anjiyografik özelliklerini tanımlamak amacıyla planlanmıştır.

Yöntemler: Ardışık 1500 koroner anjiyografi özellikle SKA PL dalından çıkan SAN arterini tespit etmek amacıyla tarandı. Bu varyasyona sahip hastalar aritmik olaylar açısından bir yıl takip edildi.

Bulgular: Sinoatriyal nod arteri çıkış noktası 1280 hastada (%85) proksimal SKA, 208 hastada (%14) sirkümlüks arter ve 12 hastada (%0.8) SKA PL dalı olarak saptandı (8 erkek, 4 kadın, ort yaş 64±9 yıl). Hastaların hiçbirinde daha önce aritmi hikayesi yoktu. Bir hastada AV tam blok mevcuttu. Koroner anjiyografi endikasyonları 5 hastada kararlı angina, 5 hastada kararsız angina ve 2 hastada akut miyokard infarktüsüyü. Sağ koroner arteri tam tıkalı olan alt duvar infarktüslü hastada bradikardi ya da ileti kusuru gelişmedi. Dört hastada (%33) proksimal SKA'den çıkan, varyant SAN ile aynı bölgede sonlanan ve bu nedenle ikili kanlanmayı düşündüren ikinci bir arter mevcuttu. Bir yıllık takiplerde hiçbir hastada aritmik olay gelişmedi.

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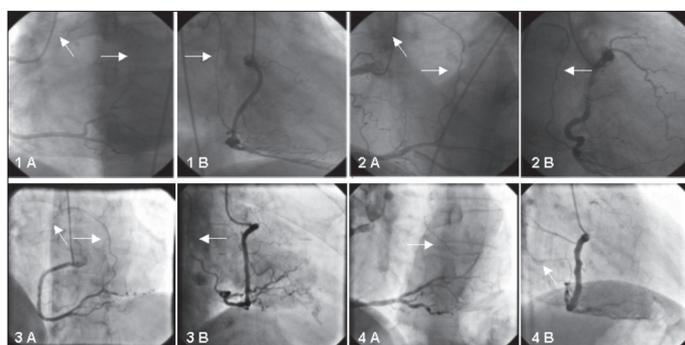


Figure 1. Coronary angiography images of patients 1-4 showing variant coronary artery (white arrow)

A - Left anterior oblique view, B - Right anterior oblique view

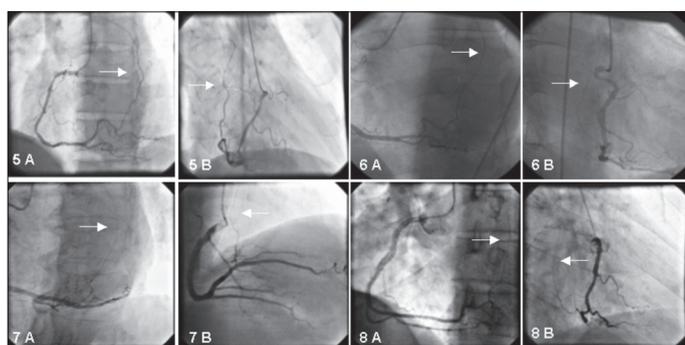


Figure 2. Coronary angiography images of patients 5-8 showing variant coronary artery (white arrow)

A - Left anterior oblique view, B - Right anterior oblique view

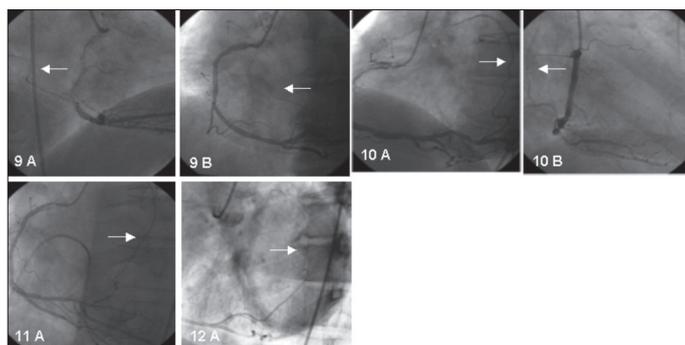


Figure 3. Coronary angiography images of patients 9-12 showing variant coronary artery (white arrow)

A - Left anterior oblique view, B - Right anterior oblique view

Only left anterior oblique views of patient 11 and 12 were available

exercise in all cases, except patient 11 who presented with acute coronary syndrome associated with atrioventricular (AV) complete block. He was admitted to hospital with AV complete block necessitating temporary pacemaker implantation. Right coronary artery was not the responsible artery for AV block since it had no any critical stenosis. Family histories of all patients were unremarkable regarding the sudden death, syncope, severe bradycardia, and permanent pacemaker implantation. The indications of coronary angiography were stable angina and/or positive treadmill test in 5 patients, unstable angina in 5, and acute myocardial infarction in 2 patients. Patient 5 presented with anterior myocardial infarction, and patient 9 with inferior myocardial infarction. Right coronary artery was

totally occluded at midportion in the latter one, and even though there was no antegrade blood flow the rhythm was sinus rhythm with a rate of 60/min. In four patients coronary angiography revealed normal coronary arteries (patients 1, 3, 7, 12), and myocardial bridge in patient 3. One of these patients with normal coronary artery (patient 7) had also hypertrophic obstructive cardiomyopathy with an outflow tract gradient of 60 mmHg. Patient 8 had a patent left anterior descending artery stent that had been implanted 2 years ago.

All cases were followed-up by outpatient clinic visits and electrocardiogram (ECG) recordings every four months for one year (mean follow-up 14 ± 2 months) and none of the patients showed any clinical or electrocardiographic manifestation of sinus node dysfunction, conduction abnormality, bradycardia, or arrhythmia. The anatomic course of the variant artery was similar in all patients except patient 7. In this patient, the course of variant artery initially was laterally in LAO view, and posterior in RAO view instead of towards high right atrium. The patient also had a second artery originating from the midportion of RCA ending at the same region with variant SAN artery. In four patients (33%) there was another smaller artery originating from proximal part of RCA, ending at the same territory with variant artery suggesting a dual blood supply (Fig. 4).

Discussion

The frequency of variant SAN artery arising from PL artery was found to be very rare (0.8%) with the current study. Interestingly, there were no any acute arrhythmic and clinical deleterious effects of this variant during presentation or long-term follow-ups. Almost all patients were in sinus rhythm without any sinoatrial arrhythmia.

With the advent of new percutaneous and surgical techniques used in the treatment of coronary artery disease, and supraventricular bradi-tachy-arrhythmias including atrial fibrillation, awareness of origin and routes of the atrial branches, particularly the sinoatrial nodal branches of coronary tree, have assumed great importance (10-12). Only a few cases of SAN artery originating from distal RCA have been described previously (8, 9). Hutchinson (9) showed that in one of the 40 autopsy cases the SAN artery arose from the terminal part of the RCA, passed over the postero-lateral surface of the left atrium, between the left pulmonary veins and the left auricular appendage, and over the superior surface of the left atrium to the superior vena cava. Similarly, in a recent computerized tomography (CT) angiography study S-shaped SAN artery originating from the RCA distal to the origin of the PL artery has been detected in one of the 244 patients (0.4%) (8). Interestingly, in both cases this artery was coursing posteriorly around the posterior aspect of the coronary sinus and left atrium and then anteriorly, terminating precavally to supply the SAN.

These arteries initially might be thought as collateral vessels by any cardiologist, and possibly for this reason had not been reported frequently. However, these could not be collateral vessels because all of them originate exactly from the same site,

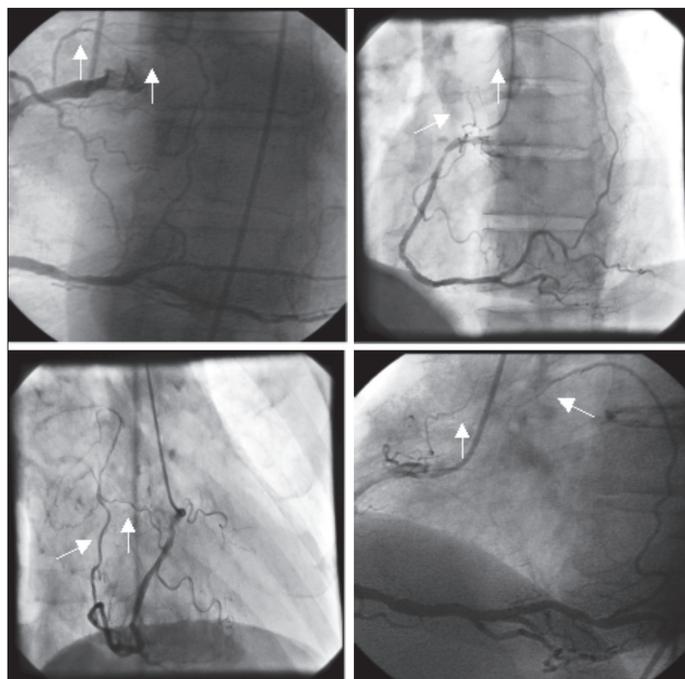


Figure 4. Dual blood supply to the territory of sinoatrial node (white arrows)

follow identical route, and end almost at the same location consistent with sinus node region. There might be relation between coronary artery disease involving RCA proximal to origin of this artery, and atrial arrhythmias including sinus bradycardia, sinoatrial block, sick sinus syndrome, and even atrial fibrillation. However, for the time being, direct relationship could not be established according to findings of our study. Since only a small part of the study group had coronary artery disease, and most of the lesions were not flow limiting any comments on the relation between coronary artery disease and arrhythmia will be incorrect. Longer term follow-up with progression of coronary artery disease in those patients will show whether there is a relationship between coronary artery disease and atrial arrhythmias.

In four patients there was another smaller artery originating from the proximal part of the RCA ending at the same location where the variant SAN artery ends. It seems that, most likely due to dual blood supply and adequate flow compensation to the sinoatrial node through the second artery, complete occlusion of RCA did not result in sinoatrial block or severe bradycardia. Sinoatrial node artery frequently has been described as a solitary artery originating from RCA, or circumflex branch of the left coronary artery and/or from the trunk of the left coronary artery (1, 9, 10, 13). However, plausible existence of two branches in up to 11% of cases has been reported (14-16). In two recent studies, several branches (two or more branches) at much higher frequencies up to 54% of cases among Japanese individuals have been shown (11, 12). Interestingly, in a Brazilian study (17), the frequency of two sinoatrial nodal branches has been found to be very low (6%) which suggests a variation associated with ethnic group origin.

This variant branch from the PL artery is most consistent with the SAN artery based its anatomic course on angiogram.

However, without histopathological examination, it is obviously difficult to claim this artery is the SAN artery, or the sole artery supplying the sinoatrial node. It could also be right atrial or conal artery, yet the course and the high right atrial location of the distal end were similar to the normal end of SAN artery with normal origin. Unless necropsy examination is performed, this cannot be confirmed. Unfortunately, necropsy studies generally have been performed on limited number patients. For instance in a relatively large autopsy study which examined 150 hearts, there was no any patient having SAN artery originating from PL (7). This is likely due to the small number of cases and uncommon occurrence of this variation as described in our study. However, selective coronary angiography may also fail to show the aortic origin of primary or synchronous SAN arteries with two or three projections of coronary angiography in identifying precise arterial supply of an atrial structure without distinct fluoroscopic landmarks, especially representing sinus node. Multi-detector CT is a potential new modality to detect this kind of variations more accurately. Few investigators have studied the anatomy of the SAN with noninvasive imaging modalities (8, 18, 19). The visualization rate of SAN artery by using 64-slice and dual source computed tomography was quite high (91% and 95% respectively) in these CT angiography studies (18, 19).

Several cases have been reported in which the SAN artery does not arise in the right aortic sinus (20) or originates in a bronchial artery or directly from the internal thoracic artery (21). Sinoatrial node artery originating from the proximal part of the left main trunk have also been reported (13, 22-24).

There are difficulties in describing anomalous, variant, aberrant, or accessory coronary artery because of considerable heterogeneity of coronary vasculature. The terms anomalous or abnormal are used to define any variant form observed in less than 1% of the general population (5). Because of blood supply to sinoatrial node via this variant artery is carried out in a physiologically normal appearance without any functional, structural or ECG abnormality, we preferred to use the term of variant for this artery instead of abnormal, even though its frequency actually less than 1%.

Study limitations

The relatively short follow-up period (one year) is one of the limitations of the study. Slow progression of the coronary artery disease may not cause RCA occlusion during one year follow-up, and eventually arrhythmia. Certainly longer term follow-up of these patients or new patients with coronary artery disease associated variant SNA artery will explain the clinical relevance of this anomaly more accurately.

Conclusion

To be aware of the origin and course of SAN artery may provide a safe approach to interventional cardiologist and cardiac surgeon during cardiac interventions. Cardiac surgeons especially should be careful because compensation for the single SAN artery is not possible in the case of its being cut or occluded. Acute coronary syndromes associated with even mid

or distal RCA occlusion may result in severe rhythm disorders related to sinus node. Similarly, during RCA percutaneous interventions, distal embolization of plaque components after balloon inflation and stent implantation may cause sinus node dysfunction, severe bradycardia, which are mostly expected to occur during proximal RCA interventions as a consequence of plaque shifting into a proximally located SAN artery. Fortunately, it seems that if exists, dual or multiple blood supply can prevent catastrophic consequences including severe bradycardia and cardiac arrest during complete RCA occlusion in patients with this variant artery. Besides the dual or multiple blood supply there is also hierarchy of spontaneous depolarizing cells in sinoatrial node, accordingly total occlusion of this artery would not inevitably be expected to lead to significant bradycardia, unless other concurrent pathologic process underway. This systematic study specifically seeking the variant origin of SAN artery from PL branch of RCA by screening 1500 patients revealed relatively high frequency when considering nonexistence of any previous similar study in the literature. We can speculate on the reasons of this finding as the variant artery actually had been observed by many cardiologists but assumed as collateral artery, or this variant could be exclusive for Turkish population suggesting an ethnic variation. Studies on different populations designed particularly to seek this artery will certainly reveal the true causes.

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