Eur. J. Anat. 21 (2): 161-163 (2017)

A long sinus node artery with an unusual origin and course: A case report

Christos Nerantzis[1], Sotirios Bouzianis[1], Stamatios Theocharis[2]

[1]Forensic Medical Service of Athens; 75, M. Asias street, 115 27 Goudi, Athens, Greece, [2]First Department of Pathology, University of Athens, Medical School, 75, M. Asias street, 115 27 Goudi, Athens, Greece

SUMMARY

The purpose of this study was to expand our knowledge of anatomical variations in the blood supply to the sinus node. Gross anatomical examination and postmortem angiographic evaluation and dissection were performed in 600 human hearts in the last forty years. These cases were derived from victims of various accidents.

Angiographic findings of previous unreported cases revealed that the sinus node artery was originated distant from the aorta, outside of the atrioventricular sulcus, from the posterior right diagonal artery. Knowledge of this anatomical variation, although not accompanied with symptoms, is essential for the interventional cardiologists and cardiac surgeons for their medical procedures, as well as for anatomists.

Key words: Heart – Coronary arteries – Sinus node – Sinus node artery – Right atrium

INTRODUCTION

The origin and course of the sinus node artery (SNA) in normal hearts have been well investigated (James, 1961; Nerantzis et al., 1983). In most of the cases the SNA originates from the proximal 2-3 cm of the right coronary artery (RCA) and from the proximal 1-2 cm of the left circumflex (branch of the left coronary artery (LCA). From either right or left origin the SNA courses in a direct route along the anteromedial atria wall to the base of the superior vena cava, whose orifice it encircles either clockwise or counterclockwise, and therefore supplies with blood the SN area, and the myocardium of a large part of the right, left atrium, and the interatrial septum. The sinus node (SN) is the pacemaker of the heart. An integral part of it is the SNA. The SNA has no constant origin, but has a constant termination, which is used as a good guide to the location of the SN. We present here a variation in which the SNA originated outside of the atrioventricular sulcus, from the posterior right diagonal (PRD) artery (Nerantzis et al., 1994), an anatomical finding never reported before.

CASE REPORT

The patient was a 35-year-old healthy male (information from his relatives, and the accident was not caused by him) whose heart specimen derived from a series of 600 angiographies of human hearts, (422 males and 178 females), victims of traffic accidents, ranging in age between 15-89 years. All the angiographies were performed at the Forensic Medicine of Athens by Nerantzis et al. (1983; 2012) in the last forty years. The heart weight ranged from 70 to 530 gr. Postmortem examinations were performed within the first hours of their death. Gross anatomical examination was followed by postmortem coronary angiographic evaluation. In these hearts, radiopaque medium (Ba-Sulfate) of different colors was injected in both coronary arteries at a pressure of 100-160 mm Hg, depending on the size of the heart. Low pressure was used in order to avoid deformation of the vessel's lumen and/or changes to their architecture. This made possible the identification by naked eye of the coronary arteries and branches in their epicardial coarse. In addition, X-rays films were taken at different aspects of the whole heart. In the re-

Corresponding author: Christos E. Nerantzis, MD, PhD. Granitsa 2, 111 41 Athens, Greece. Phone: 210 2283386; Fax: 210 778808.

E-mail: theano9@otenet.gr

Submitted: 7 January, 2017. *Accepted:* 3 February, 2017.

ported case, the posteroanterior projection was the most useful for the identification of the origin, course, distribution, and termination of the SNA Fig. 1. The SNA arose from the right coronary artery (RCA) in 371 cases, and in one from its branches the PRD, totally 372 cases (62%). The SNA arose from the left circumflex, branch of the LCA in 216 cases; in one case the left circumflex and SNA have the same origin (Nerantzis et al (2009); and in another one case the SNA originated from the proximal part of the conus artery (Gavrielatos and Nerantzis, 2011), totally 218 cases (36%). Both coronary arteries were giving one branch each to the sinus node area in 10 cases

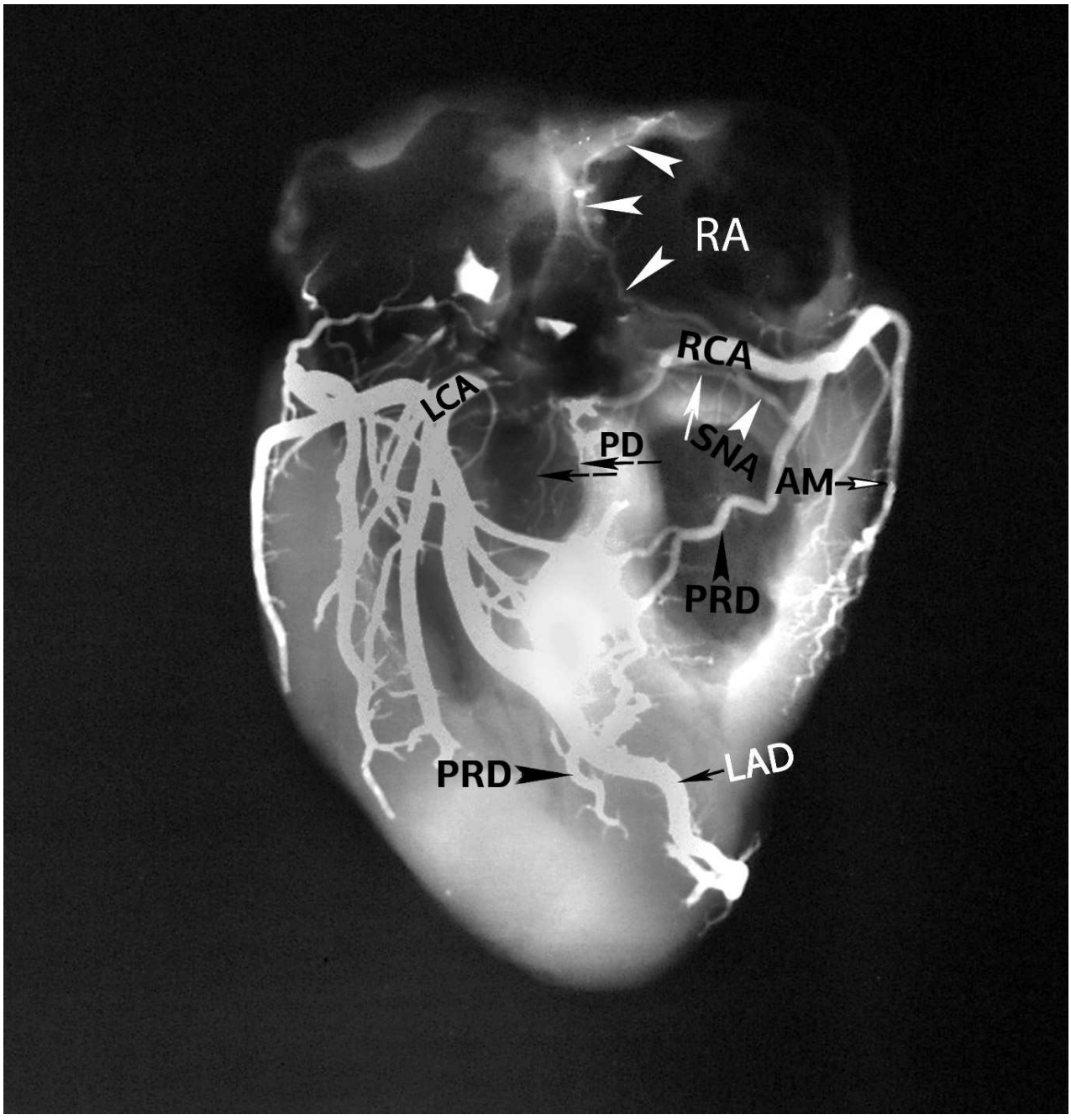

Fig 1. The posteroanterior X-ray view of the heart shows, with four large white arrowheads the origin, course of the sinus node artery (SNA) through the posterior part of the right ventricle, right atrium (RA), interatrial sulcus, again RA to the sinus node area**.** The higher large white arrowhead shows the sinus node area.

Two large black arrowheads show the origin, course and end of the posterior right diagonal artery (PRD) artery. A white arrow shows branch of the SNA supplying with blood the adjacent areas. The figure shows also the right coronary artery (RCA), the acute marginal (AM) artery (pointed with black-white arrow), the left coronary artery (LCA), the left anterior descending (LAD) artery, two short posterior descending (PD) arteries coursing in both sides of the upper part of the interventricular sulcus, pointed with two small discontinued black arrows.

(2%). The present case belongs to the right dominant coronary artery type, with two small posterior descending (PD) arteries (two thin, discontinued black arrow). The PRD artery originated from the RCA artery in the posterior part of the atrioventricular sulcus, 9 mm distal to the origin of the acute marginal (AM) artery, coursed downwards and to the left on the posterior surface of the right ventricle to meet the lower part of the posterior interventricular sulcus, following it up to the apex of the heart, (two black arrowheads). The SNA originated from the PRD artery, 22 mm from the point where it left the posterior atrioventricular sulcus coursing upwards and to the left. After its origin in a distance of 20 mm, it gave a branch turning to the left, (white arrow) supplying with blood part of the right ventricle**,** the base of the right atrium (RA), and the atrioventricular area. The other branch, larger, substituting the SNA, coursed upwards and to the left in part of the right ventricle**,** under the posterior part of the RCA on the posterior surface of the RA for 47 mm until it entered the posterior interatrial sulcus. Afterwards, it followed the sulcus upwards, to rest 21 mm until the top of it. It continued its course to the SN area for 44 mm, (total length of the SNA is 132 mm), encircling the superior vena cava orifice, in a clockwise direction. During its course, the SNA supplied with blood part of the left atrium, part of the interatrial septum and large part of the RA, (four large white arrowheads, Fig. 1). This SNA, with its inter- and intracoronary branches, forms a useful atrial anastomotic net. This net is reinforced with the participation of branches from ventricle arteries.

DISCUSSION

According to our data, the SNA seems to be longer than those previously measured (Nerantzis et al., 2012). Besides, the distal origin of the SNA is not necessary to provoke perfusion disturbance to the sinus node, as supported in the literature (Verhaeghe and Hauwaert, 1967; James, 1973), since our patient was healthy. According to our previous classification (Nerantzis et al., 1983), the artery belonged to group B, since during its course it perfused a large part of the RA, the interatrial septum and a smaller part of the left atrium. The SNA appears to be disproportionally large in comparison with other atrial arteries for two reasons: a) it receives a strong pulse which would help to regulate its functioning (Verhaeghe et al., 1967; James, 1973), and b) it supplies with blood large parts of the atrial myocardium (Nerantzis et al., 1983).

Herein, we describe a unique and hitherto unreported anatomical variation of the SNA. We have also previously reported two other variations of the SNA in two healthy males (Nerantzis et al., 2009; Gavrielatos and Nerantzis, 2011), among the 600 hearts analyzed.

In conclusion, detailed anatomical knowledge of the blood supply to the SN is essential because of the wider implementation of cardiac surgery, interventional cardiology therapies for arrhythmias, in order to avoid damage of this vessel during their medical procedures. We believe that **s**uch a complication could result in the destruction of the artery**,** damage of the collateral circulation, dysfunction of the atrial myocardium and the onset of arrhythmias of various degrees and types as mentioned by Gaudino et al. (2003). On the contrary, there is another study suggesting that cutting of the SNA did not influence the sinus node function, as it receives blood supply from more than one source (Kawashima and Sasaki, 2003).

ACKNOWLEDGEMENTS

We thank the Medical School student Mr Togka Dimitri for his expert assistance.

REFERENCES

GAVRIELATOS G, NERANTZIS CE (2011) Post mortem coronary angiographic visualization of a rare sinus node artery, anatomical variant. *Hellenic J Cardiol*, 52: 84-85.

GAUDINO M, NASSO G, MINATI A, SALICA A, LUCIANI N, MORELLI M, POSSATI G (2003) Early and late arrhythmias in patient in preoperative sinus rhythm submitted to mitral valve surgery through the superior septal approach. *Ann Thorac Surg*, 75: 1181-1184.

JAMES TN (I961) Anatomy of the coronary arteries. Paul B Hoeber, New York.

JAMES TN (1973) The sinus node as a servomechanism. *Cir Res*, 32: 307-313.

KAWASHIMA T, SASAKI H (2003) The morphological significance of the human sinuatrial nodal branch (artery). *Heart Vessels*, 18: 213-219.

NERANTZIS CE, TOUTOUZAS P, AVGOUSTAKIS D (1983) The importance of the sinus node artery in the blood supply of the atrial myocardium. An anatomical study of 360 cases. *Acta Cardiol*, 38: 35-47.

NERANTZIS CE, GRIBIZI JE, MARGARIS NG, ANTONELIS JPR, SALAHAS TI, KOROXENIDIS GT (1994) Posterior right diagonal artery. *Anat Rec*, 238: 528-532.

NERANTZIS CE, GAVRIELATOS G, LEFKIDIS CA, KOUTSAFTIS PN (2009) A secret pathway of the sinus node artery. *Forensic Sci Int*, 186: e25-26.

NERANTZIS CE, ANNINOS H, COUVARIS CM (2012) The most vulnerable large atrial arteries during surgery and radiofrequency ablation of the pulmonary veins. *Int J Cardiol*, 160: 148-149.

VERHAEGHE L, VAN DER HAUWAERT L (1967) Arterial blood supply of the human sinus node. *Br Heart J*, 29: 801-806.