

## Imaging in Cardiology – Persistens of Vena Cava Superior

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### Case Report of DDD Pacemaker Revision

A 53-year old female was referred to our hospital for revision of her pacemaker. In 1994, a two-chamber pacemaker system was implanted to treat symptomatic bradycardia due to AV block. At her request, the pacemaker was implanted on the left side of the thorax. After puncturing the left subclavian vein, the electrodes were introduced into the right side of the heart via an alternative route, as described in many previous case reports. At the end of 1998, the DDD-pacemaker battery showed early depletion, and the pacemaker was replaced. After the replacement, the atrial threshold was markedly increased with a "normal" pacing impedance. Since the threshold was above the output of the pacemaker, the pacemaker was reprogrammed to VVIR. However, the patient had complaints during normal daily activities when the pacemaker was in the VVI mode. A revision of the atrial lead was planned. Based on her history and the records of the first implantation (which was troublesome), a venous angiogram was performed to visualize the venous system of the upper body. It was not known whether a right sided superior vena cava was present. A venous angiogram was made using contrast and digital subtraction techniques (Figure 1).

### Discussion

Although superior vena cava persistens seldom occurs, it is certainly not unheard of. It had been described by Greenfield as early as 1876. It may not be detected on a routine physical exam or an X-ray; however, it can be observed during a more thorough and detailed examination [1,2]. It can be found, by coincidence, during cannulation of the venous system and pacemaker lead implantation. According to the literature, its prevalence is 0.3 to 0.5 % of patients [3,4]. In 10 % of these patients with persistent superior vena cava sinistra, the right superior vena cava is absent (Figure 2, panel C). The presence of the superior vena cava on both sides

occurs more frequently than a one-sided (left) superior vena cava (estimated  $\pm 0.03$  to 0.05 % of the general population; see Figure 2, panel B). For the implanting cardiologist, it is important to recognize the picture of the syndrome, because the implantation technique has to be adjusted. As in this case, the tip of the atrial lead cannot be positioned in the right atrial auriculum and has to be screwed in. Secondly, the ventricle cannot be approached directly. The guide wire in the lead has to be used to follow the rather sharp bend in order to pass through the tricuspid valve [5].



Figure 1. The course of the large right subclavian vein and the continuation in the right superior vena cava and subsequently into the right atrium can be clearly seen. The right ventricle is visible but with less density, and the right ventricular outflow tract and the pulmonary arteries are even less opacified. (right from the center). Two pacemaker electrodes are visible on the left side of the spinal column. One lead is fixated in the right atrium (tip directed to nine o'clock) and the other lead makes a large curve ( $> 180^\circ$ ) in the right atrium and passes through the tricuspid valve; the tip is positioned at the upper part of the right ventricular septum.

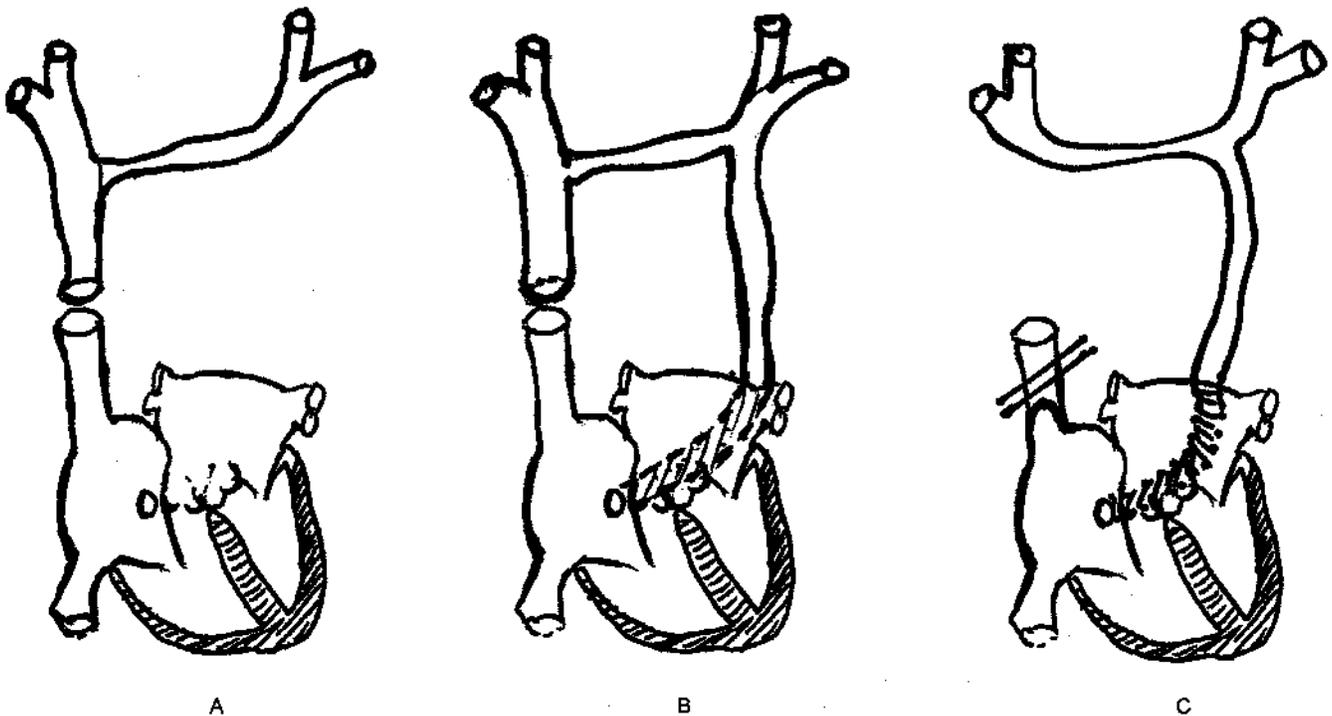


Figure 2. In this schematic figure, three major variations are depicted. In panel A, the normal situation is presented: the left brachiocephalic vein runs obliquely behind the sternum and drains together with its right counterpart into the right superior vena cava. In panel B, the left superior caval vein is persistent, but the innominate vein is also present. The persistent left superior caval vein drains into the coronary sinus, which enters the lower septal right atrium. In panel C, a third anatomical variation is given: The right superior caval vein is absent and the right brachiocephalic vein now runs obliquely behind the sternum and courses posteriorly over the arch vessels (not seen on an anteroposterior projection).

Moreover, the persistent left superior vena cava is associated with congenital defects [6] and AV conduction abnormalities [7], although the left superior vena cava itself is not an anatomical pathology. During embryogenesis, the development of the sinus venosus, the left duct of Cuvier should, but does not atrophy to form the oblique vein of Marshall [8].

## References

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