# Difference Between SA node and AV node

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## Key Difference - SA node vs AV node

The heart is an important organ for living organisms which functions in the circulatory system as the pumping device. This ensures the transportation of different substances in the circulatory medium; blood, which includes oxygen, nutrients, waste products, etc. The human heart is composed of four chambers; two atria (upper chambers) and two ventricles (lower chambers). The rate of the heartbeat and the two circulatory mechanisms; pulmonary circulation and systemic circulation are regulated by nodes present in the heart. The Sino atrial (SA) node and Atrio ventricular (AV) node are two main nodes present in the heart. **The SA node generates cardiac action potential due to spontaneous depolarization by the pacemaker cells whereas, the AV node involves in the reception of the action potential from the SA node and pass it to the AV bundle.** This is the **key difference** between SA node and AV node.

## What is SA node?

The Sino atrial node is present at the posterior region of the atrium at the superior lateral wall closer to the opening of the superior vena cava known as sinus vernarum. It consists of a group of cells known as pacemaker cells. The pacemaker cells are involved in causing a spontaneous depolarization which initiates the generation of an electrical impulse; an action potential. The SA node varies in size and has a banana-shaped structure. The typical dimension of an SA node is 10-30 mm in length, 5-8 mm in width and 1-2 mm in depth.

The pacemaker cells of SA node are present within a connective tissue that comprises of different components such as blood vessels, nerves, fat and collagen fibers. In the SA node, the pacemaker cells are surrounded by another group of cells known as paranodal cells. Paranodal cells consist of structures that have similarities for both SA node cells and the atrium cells. The main function of the paranodal cells is to insulate the SA node with the help of the connective tissue.

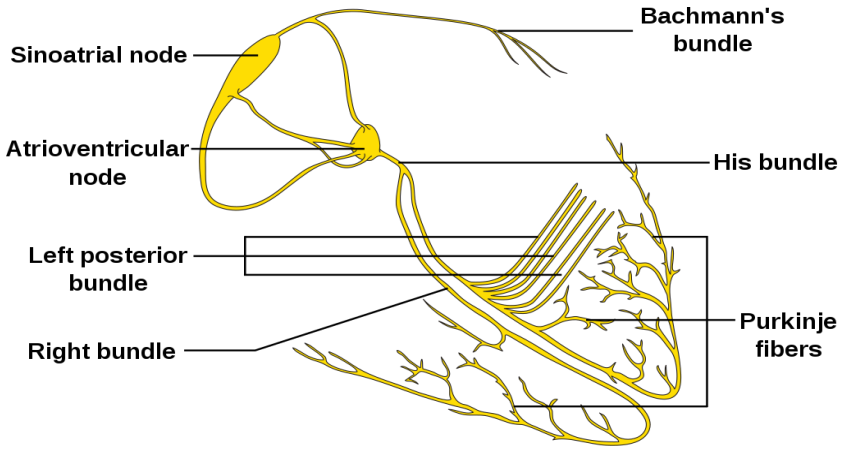


**Figure 01: SA node**

The SA node cells are smaller than atrial cells, and they consist of fewer mitochondria. It receives blood from the sino atrial nodal artery. The number of arteries highly differs according to different individuals. The main role of the SA node is to generate an action potential which causes the contraction of the atriums. This is regulated by the nervous system. The sympathetic nervous system slows down the rate of induction of action potential, and para sympathetic nervous system speeds up the rate respectively.

# What is AV node?

The AV node or the atrioventricular node is a section of the electrical conduction system located in the heart. The AV node is found at the lower posterior portion of the interatrial septum closer to the coroner sinus. Precisely, the AV node lies in the middle of a triangular area known as the Koch's triangle, which is comprised of the tricuspid valve, the coronary sinus, and the interatrial septum membrane. Electrical impulses from the atria to ventricles are generated via the AV node.

The cardiac artery known as the atrioventricular nodal branch supplies blood to the AV node. This artery is mainly originated from the right coronary artery but, the remaining part of the artery originates from the circumflex artery. Bone morphogenetic protein (BMP) is a multifunctional molecule where cell signals are produced for cardiac morphogenesis and differentiation. These BMPs are essential molecules which develop the AV node, and the development is accomplished through a receptor called Activin receptor-like kinase 3 (Alk3). Diseases such as AV conduction disease or Ebstein's anomaly are caused due to abnormalities took place in BMPs or Alk3 receptor.

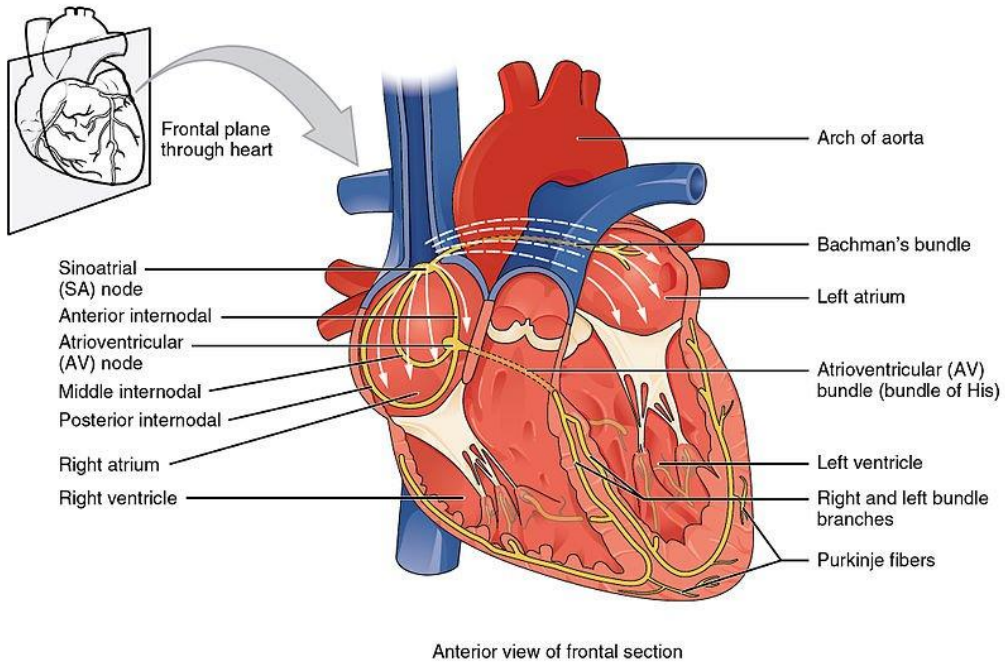


**Figure 02: AV node**

Two inputs from the right atrium are received by the AV node. Posterior input is received through the crista terminalis and anterior input is received through the interatrial septum. AV node, being a part of the cardiac conduction system coordinates the mechanical activity of monocytes. The AV node is activated by the sino atrial node (SA node) after it is excited.

A wave of excitation is spread through the atria for the activation of SA node. After the AV node is activated, a 0.12s delay of impulses is taken place. This cardiac delay is important since the ejection of blood through the atria into the ventricles before its contraction is ensured.

## What is the Similarity Between SA node and AV node?

- SA node and AV node involved in the setting of heartbeat and its regulation during blood circulation.

## What is the Difference Between SA node and AV node?

| SA node vs AV node | |
|---|---|
| SA node is the heart's natural pacemaker which stimulates the heart muscle and regulates its contractions. | AV node is specialized cardiac muscle fibers in the lower interatrial septum that receives impulses from the sinoatrial node and transmits them to the bundle of His. |
| **Location** | |
| SA node is located in the superior lateral wall closer to the opening of the superior vena cava of the heart. | AV node is present at the posterior septal wall in the right atrium closer to the opening of the coronary sinus of the heart. |
| **Function** | |
| SA node generates cardiac action potential due to spontaneous depolarization by the pace maker cells with the help of auto rhythmic fibers which results in setting the basic pace for the heart rate, and this is conducted through both atria. | AV node involves the reception of the action potential from the SA node and passes it to the AV bundle. |
| **Regulation** | |
| The action of the SA node is regulated by autonomic nervous system. | The action of the AV node is regulated by SA node. |
| **Role** | |
| SA node acts as a pacemaker. | AV node acts as a pacesetter. |

## Summary - SA node vs AV node

The SA node and AV node are two main nodes present in the human heart. The SA node generates cardiac action potential due to spontaneous depolarization by the pace maker cells. The AV node involves the reception of the action potential from the SA node and passes it to the AV bundle. In common terms, the SA node act as the Pace maker and the AV node act as the Pace setter. The autonomous nervous system regulates the SA node. The AV node is regulated by the SA node itself. This is the difference between SA node and AV node.

Reference

1.The Editors of Encyclopædia Britannica. “Heart.” Encyclopædia Britannica, Encyclopædia Britannica, inc., 10 Jan. 2017. Available here
2.Anatomy of the Human Heart. Available here

Image Courtesy;

1.'Conduction system of the heart without the Heart-en'By Madhero88 (CC BY-SA 3.0) via Commons Wikimedia
2.'2018 Conduction System of Heart'By OpenStax College - Anatomy & Physiology, Connexions Web site. Jun 19, 2013., (CC BY 3.0) via Commons Wikimedia

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