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## Sick Sinus Syndrome

Gabriel Gregoratos, MD



**S**ick sinus syndrome (SSS) is the name given to several conditions in which the sinus node (also known as the sinoatrial or SA node) does not function normally.

### What Is the Sinus Node?

The sinus node is the normal pacemaker of the heart and is responsible for the regular, rhythmic heartbeat. It consists of a collection of specialized cells located at the top of the right collecting chamber (right atrium) (Figure). These cells generate regular electric impulses that then spread through the atria and pumping chambers (ventricles) and cause the muscular contractions responsible for the pumping function of the heart. Under normal conditions, the sinus node produces 60 to 100 impulses a minute; this is the normal resting heart rate. The sinus node can increase the heart rate during periods of stress, such as exercise or high fever. Conversely, during quiet sleep, the sinus node may slow down to below 60 impulses, or beats, per minute. Well-conditioned athletes often have a slow heart rate at rest. This is normal and does not indicate the presence of sinus node malfunction.

### What Is Sick Sinus Syndrome?

When the sinus node malfunctions several different abnormalities may result:

- (1) The heartbeat may become too slow for the demands of the body (also known as inappropriate bradycardia).
- (2) The heartbeat may become too fast even at rest (also known as inappropriate tachycardia).
- (3) The heart rate may alternate between fast and slow (so-called bradycardia-tachycardia syndrome).
- (4) There may be sudden pauses in the normal activity of sinus node (sinus pause or sinus arrest) of longer than 2 or 3 seconds' duration.

SSS affects about 3 out of every 10 000 persons, and it becomes more common with advancing age. Drugs that are used for other cardiac conditions often may worsen or cause the development of SSS. Women and men are affected equally.

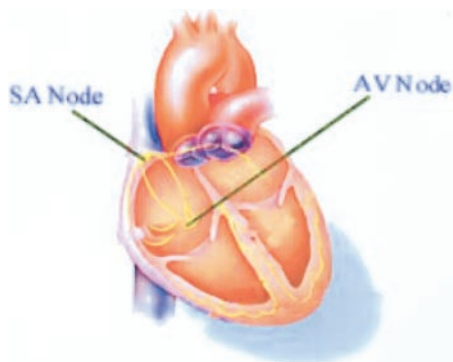
### Who Is at Risk to Develop SSS?

- (1) Persons over the age of 65. As we age, the number of pacemaker cells in the sinus node decreases,

and the normal wear and tear on the sinus node and the conduction system may result in SSS.

- (2) Persons who have suffered a heart attack (myocardial infarction) and who may have sustained damage to the sinus node.
- (3) Persons taking medications for high blood pressure and other cardiac conditions.
- (4) Persons taking medications for heartbeat that is too fast (tachycardia). Such medications include beta-blockers (for example atenolol), some calcium channel blockers (verapamil or diltiazem), digitalis, and others. These medications may contribute to the development of SSS.
- (5) Persons with high blood potassium (hyperkalemia) and other disorders of biochemical imbalance in the blood (electrolyte disorders). These abnormalities are usually the result of kidney diseases.
- (6) Persons with low-level thyroid hormone in the blood (hypothyroidism) and who may have a heart rate that is too slow.
- (7) Persons with sleep apnea, a condition in which breathing stops and starts repeatedly during sleep.
- (8) Children who have undergone corrective surgery (especially in the upper chambers) for a congenital heart defect.
- (9) Persons who have had diphtheria, muscular dystrophy, or amyloidosis. These are rare causes of SSS.

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Schematic diagram of the heart showing the sinus (SA) node. Reprinted with permission from the North American Society of Pacing and Electrophysiology (<http://www.naspe.org>).

### What Are the Symptoms of SSS?

Many persons with early or mild SSS have no symptoms and do not feel ill. Others may experience mild, brief feelings of illness. When SSS becomes established and produces one of the manifestations described above, one or more of the following symptoms may develop:

- (1) Palpitations, or an unusual awareness of one's heartbeat. The person may be aware of rapid and forceful heartbeat, or of a sudden brief cessation of heart activity followed by an extra forceful beat or by a rapid heart beat.
- (2) Fainting, near-fainting, or dizziness (syncope, pre-syncope, or light-headedness). This group of symptoms occurs when the heart is unable to pump sufficient blood to the brain because of a too slow or too fast heart rate.
- (3) Fatigue and weakness. These symptoms may indicate that the heart is not pumping sufficient blood to meet the needs of the body. There are many other causes for these symptoms besides SSS.
- (4) Confusion. When the blood supply to the brain is decreased because of erratic heartbeat, some persons become confused and may have difficulty understanding what is happening around them. Confusion can be especially disturbing to older persons with SSS.
- (5) Chest pain (angina). This symptom develops when the heart is not getting enough blood either because of blocked arteries or because of erratic heart beat as in SSS.

- (6) Disturbed sleep. The erratic heart rhythm may interfere with sleep and wake people repeatedly at night.

### How Is the Diagnosis of SSS Made?

Often a detailed account of a person's symptoms will suggest the diagnosis of SSS. The diagnosis is confirmed by a variety of different tests. The electrocardiogram (ECG) records the electrical activity of the heart and is the simplest. However, since the manifestations of SSS come and go, the basic ECG may not reveal the abnormal heart rhythm. Therefore, when SSS is suspected, physicians may order a monitor that records a person's heartbeat continuously for 24 or 48 hours (Holter monitor). For persons with very infrequent symptoms, other types of monitors are used, such as event or loop recorders. The physician will often order other tests to make sure that no other disease is present because the symptoms described above can result from other medical conditions as well.

### How Is SSS Treated?

There are no medications that reliably increase the heart rate in persons with a heartbeat that is too slow. Most persons with severe SSS symptoms will therefore need to have an artificial pacemaker implanted in their body. An artificial pacemaker is a small electronic device that is inserted under the skin of the upper chest, usually below the collarbone. This device produces regular electrical impulses whose

strength and rate can be adjusted. These electrical impulses are then transmitted to the heart by means of wires that the physician inserts via one of the patient's large veins and guides and anchors into one or two of the heart chambers. Currently, SSS is the most common reason for implanting an electronic pacemaker. After a pacemaker has been inserted, its function must be monitored regularly.

Modern electronic pacemakers are highly sophisticated devices that are able to sense the needs of the body and automatically adjust the heart rate accordingly. In this way, they simulate the functions of the normal sinus node. The artificial pacemaker will take care of the heart rate that is too slow or the prolonged pauses in persons with SSS. For those persons whose heart rate alternates between being too slow and too fast (bradycardia-tachycardia syndrome), medications that slow the heartbeat may be required in addition to the pacemaker. Before a decision is made to implant an electronic pacemaker for SSS, all non-essential drugs are usually discontinued to see whether normal sinus node function returns. Similarly, if a person has other medical conditions which may be precipitating the SSS, these conditions are treated before an artificial pacemaker is inserted.

Some persons with SSS who also have other medical problems (especially rapid irregular contractions of the heart, also called atrial fibrillation) may be at a greater risk of suffering a stroke. For this reason, such patients may be given an anti-clotting (anticoagulant) medicine such as warfarin (sometimes referred to as blood-thinners).

### Additional Resources

- American Heart Association web site. Available at: <http://www.americanheart.org>. Accessed October 20, 2003.
- North American Society of Pacing and Electrophysiology web site. Available at: <http://www.naspe.org>. Accessed October 20, 2003.
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