

**Arrhythmia**



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## Arrhythmia (sinus arrhythmia and sick sinus)

Essential Evidence 

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### Overall Bottom Line

- Electrophysiologic studies are recommended for symptomatic patients in whom sinus node dysfunction (SND) is suspected but for whom a causal relation has not been established. [SORT C](#)

- Permanent pacemaker is recommended in SND patients with documented symptomatic bradycardia. [SORT C](#)
- Permanent dual chamber pacing has no survival benefit but does relieve symptoms and reduce syncopal attacks. [SORT B](#)
- Other possible indications include symptomatic chronotropic incompetence, bradycardia due to medications that cannot be discontinued, and syncope associated with major abnormalities on EPS studies. [SORT C](#)

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### Arrhythmia (sinus arrhythmia and sick sinus)

## Background

Sinus node dysfunction (SND or sick sinus syndrome) constitutes a spectrum of cardiac arrhythmias, including sinus bradycardia, sinus arrest, sinoatrial block, and paroxysmal supraventricular tachyarrhythmias alternating with periods of bradycardia or even asystole. [23](#)

### Incidence

- The incidence of sinus node dysfunction after cardiac transplantation is 175 persons per 1000 patients. [22](#)
- After acute myocardial infarction, the incidence of SND is 46 per 1000 patients. [21](#)
- The incidence in general population increases with age; SND occurs in approximately 2 / 1000 persons greater than 65 years of age.

### Causes of the Condition

- Idiopathic degeneration. [20](#)
- Ischemia [19](#) [21](#)
- Inflammatory diseases like rheumatic fever, chagas disease, lyme disease and other infections.
- Epicardial, myocardial and pericardial diseases.
- Infiltrative disorders like amyloidosis, sarcoidosis, hemochromatosis and tumors.
- Collagen vascular diseases such as systemic lupus erythematosus and scleroderma.
- Medications such as beta blockers, calcium channel blockers, lithium and antiarrhythmics
- Congenital
- Trauma during cardiac surgery
- Heart transplantation
- Augmented vagal tone in athletes
- Other disorders like hypothyroidism, hyperkalemia, hypothermia, hypoglycemia and hypoxia. [18](#)

## Pathophysiology

- SND is caused by either intrinsic or extrinsic etiologies, or both. Intrinsic sinus node function deteriorates with age due to increasing degree of fibrosis, amyloid deposition and atrophy. Extrinsic etiologies such as high vagal tone and drugs are seen more commonly in younger patients.
- Invasion of the area near the sinus node with tumor cells and inflammatory cells may compromise the physiologic function.
- Sinoatrial block results in delay or even non-conduction of impulses through the sinoatrial node to the atrium. The atrioventricular node is also affected in as many as 65% of patients. <sup>17</sup>
- SND may be transient due to medications and completely reversible once withdrawn.
- Bradycardia-tachycardia syndrome (BTS) is characterized by both bradycardia which is due to SND and supraventricular tachycardias which are probably due to diffuse disease of the conduction system.

## Risk Factors

### Risk Factor

Age

Atherosclerosis

Cardiac surgery/transplantation

Medications

Autonomic dysfunction

Hypertension

Cardiomyopathy

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## Diagnosis

### Bottom Line

- Routine 12 lead ECG is the recommended initial diagnostic test. [SORT C](#) <sup>16</sup>
- Electrophysiologic studies are recommended for symptomatic patients in whom SND is suspected as the cause but for whom a causal relation has not been established. [SORT C](#) <sup>15</sup>

## Differential Diagnosis

Diagnosis	Features
Atrioventricular block	Atrial impulses (P waves) waves seen with delay or non-conduction to ventricle

Supraventricular Tachycardia	No bradycardia episode
Atrial Fibrillation	Fibrillatory waves, irregularly irregular QRS complexes
Vasovagal Syncope	Orthostatic hypotension, related to emotional situation, pain, coughing and micturation.

## Diagnostic Criteria

- Sinus arrhythmia: normal P wave morphology and axis; gradual phasic change in PP interval of more than 10% or 120 ms is seen in response to breathing.
- Sinus bradycardia: sinus rate < 60 beats/min with normal P wave axis.
- Sinoatrial exit block Mobitz I: normal P wave morphology/axis and pauses with no visible sinus P waves; progressive increase in the PR interval occurs before the pause.
- Sinoatrial exit block Mobitz II: normal P wave morphology/axis; pauses with no visible sinus P waves. Constant PP interval before and after pause.
- Sinus arrest/pause: a pause without a P wave > 2.0 sec during sinus rhythm. <sup>14</sup>
- Ascertained sick sinus syndrome: good correlation between symptoms and bradycardia. <sup>13</sup>
- Possible sick sinus syndrome: uncertain cause and effect relationship between symptoms and bradycardia in patients with signs of severe sinus dysfunction and other possible causes has been excluded. <sup>13</sup>

## Using the History and Physical

- Patients with bradycardic episodes may present with symptoms resulting from cardiac and cerebral hypoperfusion, such as angina, shortness of breath, exercise intolerance, fatigue, syncope, presyncope and dizziness.
- Patients with episodes of bradyarrhythmias and tachyarrhythmias may present with palpitations, shortness of breath, angina and sometimes flash pulmonary edema.
- Paroxysmal episodes of atrial fibrillation in patients may result in stroke or systemic embolism.
- Physical examination is of limited value apart from detecting abnormally slow or irregularly fast pulse.

## Selecting Diagnostic Tests

- Routine 12 lead ECG is the recommended initial diagnostic test to detect SND. For patients with paroxysmal symptoms or episodes, continuous monitoring with 24-48 hrs holter monitor, 30 day event monitor or 18-24 months implantable loop recorder may be helpful. Symptoms not correlating well with the rhythm disturbances recorded on ECG are of little significance.
- Abnormal autonomic reflexes play an important role in causing clinical symptoms in SSS patients and can help in evaluating nodal dysfunction via carotid sinus massage, tilt table testing and valsalva maneuver. <sup>12</sup>

- Carotid sinus massage is recommended in patients over 40 years with syncope. After carotid massage, more than 3 sec of asystole/sinus pause is considered positive. <sup>11</sup>
- Valsalva maneuver will not increase the heart rate in SSS patients in comparison to normal individuals.
- Pharmacologic evaluation with atropine or isoproterenol can also be used for diagnosing SSS. Increase in the heart rate < 25% or below 90 beats/min is considered abnormal. <sup>1</sup>
- Marked chronotropic incompetence is associated with SND but its role in diagnosing nodal dysfunction is limited due to its low sensitivity and specificity.
- Electrophysiologic (EP) study is recommended in symptomatic patients in whom sinus node dysfunction is suspected, but in whom a causal relation has not been established. <sup>15</sup> Sinoatrial node recovery time (SNRT) and sinoatrial conduction time (SACT) are the most frequently performed tests.
- SNRT is most useful for analysing SN automaticity. Pacing is interrupted after 30 sec or longer of overdrive atrial pacing and the escape interval or SNRT is measured and > 1600 ms is abnormal. This is often corrected for underlying baseline sinus cycle length (SCL) and is called corrected sinus node recovery time (CSNRT). CSNRT > 450 ms is considered abnormal.
- In many patients the delay in conduction of impulse from sinus node to atrium is the abnormality and is measured as SACT. Unidirectional SACT > 120 ms is considered abnormal.

## Approach to the Patient

- Sinus node dysfunction is typically diagnosed incidentally on an ECG or in patients presenting with a variety of cardiovascular symptoms.
- Diagnosis is confirmed by ECG
- Order electrophysiologic studies for symptomatic patients when SND is suspected but a causal relation cannot be established.
- See algorithm in [Figure 1](#) for an overview of treatment.

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## Treatment

### Bottom Line

- Permanent pacemaker is recommended in SND patients with documented symptomatic bradycardia. [SORT C](#) <sup>23</sup>
- Permanent pacemaker is also recommended in patients with bradycardia as a result of essential long-term drug therapy for which there are no acceptable alternatives and for symptomatic chronotropic incompetence. [SORT C](#) <sup>23</sup>
- Syncope of unexplained origin when major abnormalities of sinus node function are discovered or provoked on EPS, and sinus node dysfunction with heart rate < 40 bpm and unclear relationship between symptoms and bradycardia, are also possible indications for permanent pacing although evidence is conflicting. [SORT C](#) <sup>23</sup>

## Drug Therapy

- See algorithm in [Figure 1](#) for an overview of treatment. Asymptomatic SND patients do not require treatment and can be observed. Antiarrhythmic drugs in combination with pacemaker may be used to control tachyarrhythmias in bradycardia tachycardia syndrome (BTS).
- In patients paced for SND who are suffering from atrial tachyarrhythmias, class IC antiarrhythmics (propafenone, flecainide and sotalol) are not inferior to amiodarone in terms of a combined endpoint of death, permanent atrial tachycardia, hospitalizations, cardioversions and antiarrhythmic change. <sup>10</sup>
- Anticoagulation is required in patients with paroxysmal or permanent atrial fibrillation.
- Oral theophylline reduces symptoms and occurrence of heart failure in SND patients by increasing heart rate but has no effect on the occurrence of syncope. <sup>9</sup>

## Surgical Therapy

- See [Table 1](#) for pacemaker indications. <sup>23</sup>
- In patients with SND, dual chamber pacemaker reduces the risk of atrial fibrillation (ARR 3.9%, NNT 26), <sup>8</sup> reduces signs and symptoms of heart failure and slightly improves quality of life as compared with ventricular pacing. <sup>7</sup>
- In some patients with BTS, radiofrequency ablation to prevent recurrence of atrial fibrillation may resolve symptoms.
- Temporary pacing may be used in symptomatic patients awaiting permanent pacemaker placement.

## Other Treatment

- Treat reversible causes such as hypothermia, hypothyroidism, and hypoglycemia.
- Correct electrolyte abnormalities such as hyperkalemia.
- Treat infections such as lyme disease, rheumatic fever.
- Stop calcium channel blockers, beta blockers and digoxin until and unless required and no alternative available.

## When to Refer or Hospitalize

- Hospitalize patients with symptomatic bradycardia in SND and to address reversible causes such as hypothermia and hypoglycemia
- Refer patients to evaluate the need for EP study and pacemaker placement. All patients with symptomatic SSS should also be referred to a cardiologist.

## Management of Complications

- Thromboembolism: anticoagulation with warfarin (INR 2 - 3)
- Paroxysmal or permanent atrial fibrillation: anticoagulation with warfarin (INR 2-3)
- Syncope: pacemaker implantation

- Arrhythmia: antiarrhythmics, anticoagulation, pacemaker and may be radiofrequency ablation.
- Congestive heart failure: diuretics, pacemaker implantation.

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## Prognosis

### Bottom Line

- Permanent dual chamber pacing has no survival benefit but does relieve symptoms and reduce syncopal attacks. [SORT B](#) <sup>6 8</sup>
- Schedule follow-up for patients with SSS, depending on the type of pacemaker implanted and their management needs. [SORT C](#) <sup>23</sup>

### Natural History

- Sinus bradycardia as the sole manifestation of cardiac disease in the elderly patient has little effect on mortality. The overall 5-year survival rate of non-paced sinus bradycardia patients is 74.8%, not significantly different from the 72% rate in the general population with similar age and sex distribution. <sup>5</sup>
- SND progresses slowly and usually takes 7 to 29 years (average 13 years) for total sinus arrest to manifest. <sup>4</sup>
- Clinical cardiovascular events such as syncope, heart failure, chronic atrial fibrillation and poorly tolerated paroxysmal tachyarrhythmias develop in majority (57%) of untreated SSS patients during long term follow up. <sup>3</sup>

### Prognosis

- Mortality does not seem to be affected by permanent pacing in SSS. <sup>6</sup>
- Atrial or dual chamber pacing is associated with lower incidence of heart failure, fewer episodes of syncope, lower risk of atrial fibrillation and overall better quality of life. <sup>6 8</sup>

### Follow-up tests and monitoring

- Pacemaker function should be assessed before discharge from hospital.
- Periodic transtelephonic monitoring with intermittent clinic evaluation to assess pacemaker function.
- Clinical follow up should be twice in the first 6 months and then once every 12 months for single chamber pacemaker patients. ([□](#))<sup>24</sup>
- Dual chamber pacemaker patients should follow twice in the first 6 months and then once every 6 months. ([□](#))<sup>24</sup>
- Clinic follow up includes assessment of the clinical status, battery status, pacing threshold and pulse width, sensing function, lead integrity, and optimization of sensor driven rate response. ([□](#))<sup>24</sup>



## Advice for patients

- Avoid calcium channel blockers, beta blockers, digoxin and antiarrhythmics (may further suppress a sick SA node or unmask latent SND) until and unless no alternative available.
- Avoid contact sports.
- Avoid strong magnetic fields if pacemaker implanted.
- In case of any symptoms follow with clinic immediately.

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# Management of Special Populations

### The Elderly

- Dual chamber pacemaker implantation improves quality of life in elderly patients with SND. <sup>2</sup>

### Infants and Children

- Significant SND occurs most frequently in children with congenital heart disease such as atrial septal defect (particularly following corrective heart surgery), in acquired myocardial disease, with certain medications, and in children with high vagal tone.
- Permanent pacing is recommended in children, adolescents and patients with congenital heart disease presenting with following conditions: 1) SND with correlation of symptoms during age inappropriate bradycardia; 2) brady tachy syndrome requiring long term antiarrhythmic treatment; and 3) asymptomatic sinus bradycardia in the child with complex congenital heart disease with resting heart rate < 40 bpm or pauses in ventricular rate > 3 secs. <sup>23</sup>


## Arrhythmia (sinus arrhythmia and sick sinus)

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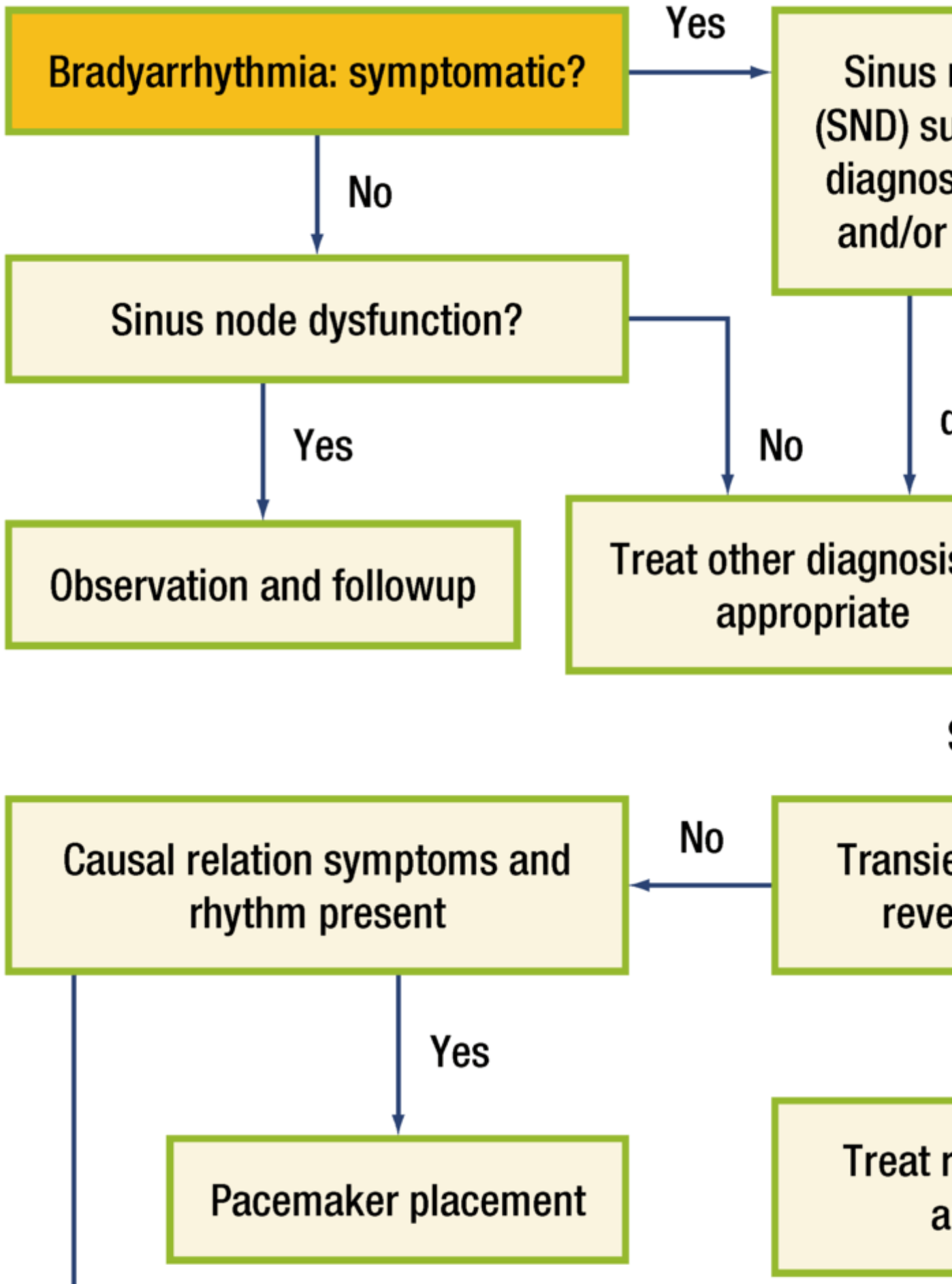
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## Arrhythmia (sinus arrhythmia and sick sinus)

## Tools, Tables, and Images

### Tools

### Figure 1: Sinus Node Dysfunction: Treatment



[View full size](#)



## Tables

### **Table 1: ACC/AHA Indications of Permanent Pacing in Sinus Node Dysfunction.**

#### **Conditions for which there is evidence and/or general agreement that permanent pacing is useful and effective**

- Sinus node dysfunction patients with documented symptomatic bradycardia
- Patients with bradycardia as a result of essential long-term drug therapy for which there are no acceptable alternatives
- Symptomatic chronotropic incompetence

#### **Conditions for which there is conflicting evidence, but the weight of evidence is in favor of usefulness and efficacy**

- Sinus node dysfunction occurring spontaneously or as a result of necessary drug therapy (HR <40 bpm) when a clear association between significant symptoms and bradycardia has not been documented.
- Syncope of unknown origin when major abnormalities of sinus node function are discovered or provoked in electrophysiologic studies.

Data from Gregoratos G, Abrams J, Epstein AE, et al. ACC/AHA/NASPE 2002 guideline update for implantation of cardiac pacemakers and antiarrhythmia devices: summary article: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/NASPE Committee to Update the 1998 Pacemaker Guidelines). *Circulation* 2002;106:2145-61. <sup>23</sup>

## **ICD9 Codes**

<b>Diagnosis</b>	<b>ICD9 code</b>
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Sick sinus syndrome	427.81
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