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)

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The current update of the ACC/AHA/NASPE Guidelines for Implantation of Cardiac Pacemakers and Antiarrhythmia Devices includes several significant changes in the recommendations and in the supporting narrative portion. In this summary, we list the updated recommendations along with the respective 1998 recommendations, each one accompanied by a brief comment outlining the rationale for the changes, additions, or deletions. All new or revised recommendations are listed in the second column and appear in boldface type. References that support either the 1998 recommendations that have not changed or the new or revised recommendations are noted in parentheses at the end of each recommendation. The reader is referred to the full-text version of the guidelines posted on the American College of Cardiology (ACC), American Heart Association (AHA), and North American Society for Pacing and Electrophysiology (NASPE) World Wide Web sites for a more detailed exposition of the rationale for these changes. In addition to the recommendation changes listed here, this update includes an expanded section on the selection of pacemakers and implantable cardioverter-defibrillators (ICDs) that reflects the technical advances that have taken place since 1998. A brief expanded summary of pacemaker follow-up procedures is also new to these guidelines. For both of these expanded sections, the reader is referred to the online full-text version.

This document was approved by the American College of Cardiology Foundation Board of Trustees in September 2002, the American Heart Association Science Advisory and Coordinating Committee in August 2002, and the North American Society for Pacing and Electrophysiology in August 2002.

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In preparing this update, the committee was guided by the following principles:

(1) Changes in recommendations and levels of evidence were made either because of new randomized trials or because of the accumulation of new clinical evidence and the development of clinical consensus.
(2) The committee is cognizant of the healthcare, logistic, and financial implications of recent trials and factored in these considerations in arriving at the class level of certain recommendations.
(3) Minor wording changes were made to render some recommendations more precise.
(4) The committee wishes to re-emphasize that the recommendations in the guideline apply to most patients but may require modification by existing situations that only the primary treating physician can evaluate properly.
(5) All of the listed recommendations for implantation of a device presume the absence of inciting causes that may be eliminated without detriment to the patient (eg, nonessential drug therapy).
(6) The committee endeavored to maintain consistency of recommendations in this and other previously published guidelines. In the section on atrioventricular (AV) block associated with acute myocardial infarction (AMI), the recommendations follow closely those in the ACC/AHA Guideline for the Management of Patients With Acute Myocardial Infarction.[1] However, given the rapid evolution of pacemaker/ICD science, it has not always been possible to maintain consistency with other guidelines. An example of such a discrepancy can be found in Section I-H, in which the recommendation for biventricular pacing in selected patients with heart failure has been listed under Class IIa, whereas in the ACC/AHA Guideline for the Evaluation and Management of Chronic Heart Failure in the Adult,[2] biventricular pacing is cited as an investigational procedure.

The ACC/AHA classifications I, II, and III are used to summarize indications as follows:

Class I: Conditions for which there is evidence and/or general agreement that a given procedure or treatment is useful and effective.

Class II: Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.

IIa: Weight of evidence/opinion is in favor of usefulness/efficacy.

IIb: Usefulness/efficacy is less well established by evidence/opinion.

Class III: Conditions for which there is evidence and/or general agreement that the procedure/treatment is not useful/effective and in some cases may be harmful.

The weight of the evidence was ranked highest (A) if the data were derived from multiple randomized clinical trials that involved large numbers of patients and intermediate (B) if the data were derived from a limited number of randomized trials that involved small numbers of patients or from careful analyses of nonrandomized studies or observational registries. A lower rank (C) was given when expert consensus was the primary basis for the recommendation.

1998 Recommendation	2002 New or Revised Recommendations	Comments
SECTION I-A: PACING FOR ACQUIRED ATRIOVENTRICULAR BLOCK IN ADULTS		
Recommendations for Permanent Pacing in Acquired Atrioventricular Block in Adults		
Class I	***Class I***	***Class I***
1. Third-degree AV block at any anatomic level, associated with any one of the following conditions: a. Bradycardia with symptoms presumed to be due to AV block. (*Level of Evidence: C*) b. Arrhythmias and other medical conditions that require drugs that result in symptomatic bradycardia. *(Level of Evidence: C)* c. Documented periods of asystole greater than or equal to 3.0 seconds or any escape rate less than 40 beats per minute (bpm) in awake, symptom-free patients. *(Level of Evidence: B, C)* d. After catheter ablation of the AV junction. *(Level of Evidence: B, C)* There are no trials to assess outcome without pacing, and pacing is virtually always planned in this situation unless the operative procedure is AV junction modification. e. Postoperative AV block that is not expected to resolve. *(Level of Evidence: C)*	**1. Third-degree and advanced second-degree AV block at any anatomic level, associated with any one of the following conditions:** **a. Bradycardia with symptoms (including heart failure) presumed to be due to AV block. *(Level of Evidence: C)*** **b. (No change)** **c. Documented periods of asystole greater than or equal to 3.0 seconds (3) or any escape rate less than 40 beats per minute (bpm) in awake, symptom-free patients (4,5). *(Levels of Evidence: B, C)*** **d. After catheter ablation of the AV junction. *(Levels of Evidence: B, C)* There are no trials to assess outcome without pacing, and pacing is virtually always planned in this situation unless the operative procedure is AV junction modification (6,7).** **e. Postoperative AV block that is not**	The changes emphasize the importance of the site of the block and introduce "advanced second-degree AV block" as a class I indication. This recommendation is based on several observational studies and is supported by a wealth of clinical experience. The narrative portion of this section also emphasizes that the site of origin of the escape rhythm in cases of advanced AV block is as important (or more important) than the escape rate itself. In recommendation 1a, heart failure is specifically introduced as a major symptom that merits consideration when dealing with AV block–induced bradycardia. In recommendation 1e, "cardiac surgery" was added to specifically define the situation(s) in which this recommendation applies. Recommendation 1f has been amplified to indicate that pacing therapy is recommended in patients with neuromuscular diseases and

1998 Recommendation	2002 New or Revised Recommendations	Comments
f. Neuromuscular diseases with AV block such as myotonic muscular dystrophy, Kearns-Sayre syndrome, Erb's dystrophy (limb-girdle), and peroneal muscular atrophy. *(Level of Evidence: B)*	expected to resolve after cardiac surgery. ***(Level of Evidence: C)*** **(8–10)** **f. Neuromuscular diseases with AV block, such as myotonic muscular dystrophy, Kearns-Sayre syndrome, Erb's dystrophy (limb-girdle), and peroneal muscular atrophy, with or without symptoms, because there may be unpredictable progression of AV conduction disease. *(Level of Evidence: B)* (11–17)**	third-degree AV block whether or not they are symptomatic, in view of the unpredictable progression of AV conduction in this group of diseases.
2. Second-degree AV block regardless of type or site of block, with associated symptomatic bradycardia. *(Level of Evidence: B)* (18)		No change
Class IIa	***Class IIa***	***Class IIa***
1. Asymptomatic third-degree AV block at any anatomic site with average awake ventricular rates of 40 bpm or faster. *(Level of Evidence: B, C)*	**1. Asymptomatic third-degree AV block at any anatomic site with average awake ventricular rates of 40 bpm or faster especially if cardiomegaly or left ventricular (LV) dysfunction is present. *(Levels of Evidence: B, C)***	This change introduces the concept that cardiomegaly and LV dysfunction are important considerations in the decision-making process to implant a pacemaker in asymptomatic patients with third-degree AV block and otherwise "acceptable" heart rates.
2. Asymptomatic type II second-degree AV block. *(Level of Evidence: B)*	**2. Asymptomatic type II second-degree AV block with a narrow QRS. When type II second-degree AV block occurs with a wide QRS, pacing becomes a Class I recommendation (see next section regarding Pacing for Chronic Bifascicular and Trifascicular Block). *(Level of Evidence: B)* (19,20)**	Based on reports and clinical experience, the change in this recommendation calls attention to the site of the block and emphasizes that a wide QRS complex in patients with type II second-degree AV block suggests the presence of diffuse conduction system disease and constitutes an indication for pacing therapy even in asymptomatic patients.
3. Asymptomatic type I second-degree AV block at intra- or infra-His levels found incidentally at electrophysiological study performed for other indications. *(Level of Evidence: B)*	**3. Asymptomatic type I second-degree AV block at intra- or infra-His levels found at electrophysiological study performed for other indications. *(Level of Evidence: B)* (18–21)**	Minor wording change deleting an unnecessary word (incidentally)
4. First-degree AV block with symptoms suggestive of pacemaker syndrome and documented alleviation of symptoms with temporary AV pacing. *(Level of Evidence: B)*	**4. First- or second-degree AV block with symptoms similar to those of pacemaker syndrome. *(Level of Evidence: B)* (22,23)**	Wording change to clarify that symptoms resulting from first- or second-degree AV block may be *similar* to those of the pacemaker syndrome rather than *suggestive of* this syndrome per se.
Class IIb	***Class IIb***	***Class IIb***
1. Marked first-degree AV block (more than 0.30 seconds) in patients with LV dysfunction and symptoms of congestive heart failure in whom a shorter AV interval results in hemodynamic improvement, presumably by decreasing left atrial filling pressure. *(Level of Evidence: C)* (24)		No change
	2. Neuromuscular diseases such as myotonic muscular dystrophy, Kearns-Sayre syndrome, Erb's dystrophy (limb-girdle), and peroneal muscular atrophy with any degree of AV block (including first-degree AV block) with or without symptoms, because there may be unpredictable progression of AV conduction disease. *(Level of Evidence: B)* (11–17)	New recommendation for pacemaker insertion in patients with neuromuscular diseases and second- or first-degree AV block, ie, lesser degrees of AV block than those listed under Class I recommendation 1f.

1998 Recommendation	2002 New or Revised Recommendations	Comments
Class III	***Class III***	***Class III***
1. Asymptomatic first-degree AV block. *(Level of Evidence: B)* (25) (See also "Pacing for Chronic Bifascicular and Trifascicular Block")		No change
2. Asymptomatic type I second-degree AV block at the supra-His (AV node) level or not known to be intra- or infra-Hisian. *(Level of Evidence: B, C)* (18)		No change
3. AV block expected to resolve and unlikely to recur (26) (eg, drug toxicity, Lyme disease). *(Level of Evidence: B)*	**3. AV block expected to resolve and/or unlikely to recur (26) (eg, drug toxicity, Lyme disease, or during hypoxia in sleep apnea syndrome in absence of symptoms) *(Level of Evidence: B)***	Addition of hypoxia occurring during periods of sleep apnea as a cause of transient AV block that is unlikely to recur once sleep apnea syndrome has been treated.
SECTION I-B: PACING FOR CHRONIC BIFASCICULAR AND TRIFASCICULAR BLOCK		
Recommendations for Permanent Pacing in Chronic Bifascicular and Trifascicular Block		
Class I	***Class I***	***Class I***
1. Intermittent third-degree AV block. *(Level of Evidence: B)* (27–33)		No change
2. Type II second-degree AV block. *(Level of Evidence: B)* (34–36)		No change
	3. Alternating bundle-branch block. *(Level of Evidence: C)* (37)	New Class I recommendation that adds alternating bundle branch block to the manifestations of fascicular block that indicate pacing therapy. This recommendation was not explicitly stated in the previous version.
Class IIa	***Class IIa***	***Class IIa***
1. Syncope not proved to be due to AV block when other likely causes have been excluded, specifically ventricular tachycardia (VT). *(Level of Evidence: B)*	**1. Syncope not demonstrated to be due to AV block when other likely causes have been excluded, specifically ventricular tachycardia (VT). *(Level of Evidence: B)* (38–55)**	Change of "proved" to "demonstrated" because it may be very difficult to prove the cause of syncope.
2. Incidental finding at electrophysiological study of markedly prolonged HV interval (greater than or equal to 100 milliseconds) in asymptomatic patients. *(Level of Evidence: B)* (47)		No change
3. Incidental finding at electrophysiological study of pacing-induced infra-His block that is not physiological. *(Level of Evidence: B)* (54)		No change
Class IIb	***Class IIb***	***Class IIb***
	1. Neuromuscular diseases such as myotonic muscular dystrophy, Kearns-Sayre syndrome, Erb's dystrophy (limb-girdle), and peroneal muscular atrophy with any degree of fascicular block with or without symptoms, because there may be unpredictable progression of AV conduction disease. *(Level of Evidence: C)* (11–17)	New Class IIb recommendation for pacing therapy in patients with neuromuscular diseases and fascicular block. Clinical experience suggests that progression of AV conduction disturbance is unpredictable, and high-grade AV block can develop even in asymptomatic patients with these diseases.
Class III	***Class III***	***Class III***
1. Fascicular block without AV block or symptoms. *(Level of Evidence: B)* (41,43,46,47)		No change
2. Fascicular block with first-degree AV block without symptoms. *(Level of Evidence: B)* (41,43,46,47)		No change

1998 Recommendation	2002 New or Revised Recommendations	Comments
SECTION I-C: PACING FOR ATRIOVENTRICULAR BLOCK ASSOCIATED WITH ACUTE MYOCARDIAL INFARCTION		
Recommendations for Permanent Pacing After the Acute Phase of Myocardial Infarction		
Class I	***Class I***	***Class I***
1. Persistent second-degree AV block in the His-Purkinje system with bilateral bundle-branch block or third-degree AV block within or below the His-Purkinje system after AMI. *(Level of Evidence: B)* (36,56–60)		No change
2. Transient advanced (second- or third-degree) infranodal AV block and associated bundle-branch block. If the site of block is uncertain, an electrophysiological study may be necessary. *(Level of Evidence: B)* (56,57)		No change
3. Persistent and symptomatic second- or third-degree AV block. *(Level of Evidence: C)*		No change
Class IIb	***Class IIb***	***Class IIb***
1. Persistent second- or third-degree AV block at the AV node level. *(Level of Evidence: B)* (20)		No change
Class III	***Class III***	***Class III***
1. Transient AV block in the absence of intraventricular conduction defects. *(Level of Evidence: B)* (56)		No change
2. Transient AV block in the presence of isolated left anterior fascicular block. *(Level of Evidence: B)* (58)		No change
3. Acquired left anterior fascicular block in the absence of AV block. *(Level of Evidence: B)* (56)		No change
4. Persistent first-degree AV block in the presence of bundle-branch block that is old or age indeterminate. *(Level of Evidence: B)* (56)		No change
*These recommendations generally follow the ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction (61)		
SECTION I-D: PACING IN SINUS NODE DYSFUNCTION		
Recommendations for Permanent Pacing in Sinus Node Dysfunction		
Class I	***Class I***	***Class I***
1. Sinus node dysfunction with documented symptomatic bradycardia, including frequent sinus pauses that produce symptoms. In some patients, bradycardia is iatrogenic and will occur as a consequence of essential long-term drug therapy of a type and dose for which there are no acceptable alternatives. *(Level of Evidence: C)* (5,62,63)		No change
2. Symptomatic chronotropic incompetence. *(Level of Evidence: C)* (5,62–65)		No change
Class IIa	***Class IIa***	***Class IIa***
1. Sinus node dysfunction occurring spontaneously or as a result of necessary drug therapy, with heart rate less than 40 bpm when a clear association between significant symptoms consistent with bradycardia and the actual presence of bradycardia has not been documented. *(Level of Evidence: C)* (4,5,62,63,66,67)		No change

1998 Recommendation	2002 New or Revised Recommendations	Comments
	2. Syncope of unexplained origin when major abnormalities of sinus node function are discovered or provoked in electrophysiological studies *(Level of Evidence: C)* (68,69)	New Class IIa recommendation for pacing therapy in patients with syncope, no other demonstrable cause, and who were found to have spontaneous or provocable sinus node dysfunction at electrophysiological study.
Class IIb	***Class IIb***	***Class IIb***
1. In minimally symptomatic patients, chronic heart rate less than 30 bpm while awake. *(Level of Evidence: C)*	**1. In minimally symptomatic patients, chronic heart rate less than 40 bpm while awake. *(Level of Evidence:* C) (4,5,62,63,66,67)**	The change of awake heart rate from 30 to 40 bpm was made on the basis of clinical experience and provides the clinician more flexibility to consider pacing in patients with suspected sinus node dysfunction, in whom a firm diagnosis cannot be made.
Class III	***Class III***	***Class III***
1. Sinus node dysfunction in asymptomatic patients, including those in whom substantial sinus bradycardia (heart rate less than 40 bpm) is a consequence of long-term drug treatment.		No change
2. Sinus node dysfunction in patients with symptoms suggestive of bradycardia that are clearly documented as not associated with a slow heart rate.		No change
3. Sinus node dysfunction with symptomatic bradycardia due to nonessential drug therapy.		No change
SECTION I-E: PREVENTION AND TERMINATION OF TACHYARRHYTHMIAS BY PACING		
Recommendations for Permanent Pacemakers That Automatically Detect and Pace to Terminate Tachycardias		
Class I	***Class I***	***Class I***
1. Symptomatic recurrent supraventricular tachycardia that is reproducibly terminated by pacing after drugs and catheter ablation fail to control the arrhythmia or produce intolerable side effects. *(Level of Evidence: C)*		This recommendation was downgraded from Class I to Class IIa. Committee consensus was that it is highly unlikely that treatment with drugs and/or ablation therapy would fail to control supraventricular tachycardia (SVT) (see below).
2. Symptomatic recurrent sustained VT as part of an automatic defibrillator system. *(Level of Evidence: B)*		Deleted because this indication is dealt with in the ICD section.
Class IIa	***Class IIa***	***Class IIa***
	1. Symptomatic recurrent SVT that is reproducibly terminated by pacing in the unlikely event that catheter ablation and/or drugs fail to control the arrhythmia or produce intolerable side effects. *(Level of Evidence: C)* (70–74)	The rewording of this previously Class I recommendation is intended to convey that ablation and/or drugs are effective therapies for SVT, and it is unlikely that pacing therapy will be required.
Class IIb	***Class IIb***	***Class IIb***
1. Recurrent SVT or atrial flutter that is reproducibly terminated by pacing as an alternative to drug therapy or ablation. *(Level of Evidence: C)* (70–75)		No change
Class III	***Class III***	***Class III***
1. Tachycardias frequently accelerated or converted to fibrillation by pacing.		No change
2. The presence of accessory pathways with the capacity for rapid anterograde conduction whether or not the pathways participate in the mechanism of the tachycardia.		No change

1998 Recommendation	2002 New or Revised Recommendations	Comments
SECTION I-E: PREVENTION AND TERMINATION OF TACHYARRHYTHMIAS BY PACING		
Pacing Recommendations to Prevent Tachycardia		
Class I	***Class I***	***Class I***
1. Sustained pause-dependent VT, with or without prolonged QT, in which the efficacy of pacing is thoroughly documented. *(Level of Evidence: C)* (76,77)		No change
Class IIa	***Class IIa***	***Class IIa***
1. High-risk patients with congenital long-QT syndrome. *(Level of Evidence: C)* (76,77)		No change
Class IIb	***Class IIb***	***Class IIb***
1. AV re-entrant or AV node re-entrant supraventricular tachycardia not responsive to medical or ablative therapy. *(Level of Evidence: C)* (71,72,78)		No change
2. Prevention of symptomatic, drug refractory, recurrent atrial fibrillation. *(Level of Evidence: C)*	**2. Prevention of symptomatic, drug-refractory, recurrent atrial fibrillation in patients with coexisting sinus node dysfunction. *(Level of Evidence: B)* (79–81)**	This recommendation was revised and the level of evidence upgraded to "B" to reflect the available information. Several studies suggest that in some patients with recurrent atrial fibrillation and coexisting sinus node dysfunction, atrial-based pacing reduces the recurrence rate of this arrhythmia.
Class III	***Class III***	***Class III***
1. Frequent or complex ventricular ectopic activity without sustained VT in the absence of the long-QT syndrome.		No change
2. Long-QT syndrome due to reversible causes.	**2. Torsade de Pointes VT due to reversible causes.**	Wording change because the arrhythmia is the Torsade de Pointes VT and not the long-QT syndrome.
SECTION I-F: PACING IN HYPERSENSITIVE CAROTID SINUS AND NEUROCARDIOGENIC SYNCOPE		
Recommendations for Permanent Pacing in Hypersensitive Carotid Sinus Syndrome and Neurocardiogenic Syncope		
Class I	***Class I***	***Class I***
1. Recurrent syncope caused by carotid sinus stimulation; minimal carotid sinus pressure induces ventricular asystole of more than 3-second duration in the absence of any medication that depresses the sinus node or AV conduction. *(Level of Evidence: C)* (82,83)		No change
Class IIa	***Class IIa***	***Class IIa***
1. Recurrent syncope without clear, provocative events and with a hypersensitive cardioinhibitory response. *(Level of Evidence: C)* (82,83)		No change
2. Syncope of unexplained origin when major abnormalities of sinus node function or AV conduction are discovered or provoked in electrophysiological studies. *(Level of Evidence: C)*		Deleted from this section and more appropriately placed in the Sinus Node Dysfunction section as Recommendation #2, Class IIa.
	3. Significantly symptomatic and recurrent neurocardiogenic syncope associated with bradycardia documented spontaneously or at the time of tilt-table testing. *(Level of Evidence: B)* (84–87)	This recommendation was added to reflect the results of trials that have demonstrated that pacing therapy is effective in cases of vasovagal syncope associated with episodes of spontaneous or provoked bradycardia. The level of evidence was set to "B" to reflect published trials.

1998 Recommendation	2002 New or Revised Recommendations	Comments
Class IIb	***Class IIb***	***Class IIb***
1. Neurally mediated syncope with significant bradycardia reproduced by a head-up tilt with or without isoproterenol or other provocative maneuvers. *(Level of Evidence: B)*		Deleted
Class III	***Class III***	***Class III***
1. A hyperactive cardioinhibitory response to carotid sinus stimulation in the absence of symptoms.	**1. A hyperactive cardioinhibitory response to carotid sinus stimulation in the absence of symptoms or in the presence of vague symptoms such as dizziness, lightheadedness, or both. *(Level of Evidence: C)***	This Class III recommendation replaces the prior recommendations #1 and #2 for the sake of simplicity.
2. A hyperactive cardioinhibitory response to carotid sinus stimulation in the presence of vague symptoms such as dizziness, lightheadedness, or both.		Deleted
3. Recurrent syncope, lightheadedness, or dizziness in the absence of a hyperactive cardioinhibitory response. *(Level of Evidence: C)*		This becomes #2.
4. Situational vasovagal syncope in which avoidance behavior is effective. *(Level of Evidence: C)*		This becomes #3.
SECTION I-G: PACING IN CHILDREN, ADOLESCENTS, AND PATIENTS WITH CONGENITAL HEART DISEASE		
Recommendations for Permanent Pacing in Children, Adolescents, and Patients With Congenital Heart Disease		
Class I	***Class I***	***Class I***
1. Advanced second- or third-degree AV block associated with symptomatic bradycardia, congestive heart failure, or low cardiac output. *(Level of Evidence: C)*	**1. Advanced second- or third-degree AV block associated with symptomatic bradycardia, ventricular dysfunction, or low cardiac output. *(Level of Evidence: C)***	This recommendation was reworded, substituting "ventricular dysfunction" for "congestive heart failure" to reflect accumulating clinical experience that ventricular dysfunction adversely affects the prognosis of patients with congenital third-degree AV block even in the absence of overt heart failure.
2. Sinus node dysfunction with correlation of symptoms during age-inappropriate bradycardia. The definition of bradycardia varies with the patient's age and expected heart rate. *(Level of Evidence: B)* (3,5,88)		No change
3. Postoperative advanced second- or third-degree AV block that is not expected to resolve after cardiac surgery. *(Level of Evidence: B, C)*	**3. Postoperative advanced second- or third-degree AV block that is not expected to resolve or persists at least 7 days after cardiac surgery. *(Level of Evidence: B, C* (89,90)**	Reworded recommendation to specify that AV block that persists for more than 7 days after cardiac surgery is unlikely to resolve and is best treated with the implantation of a pacemaker. The change was made because of accumulating clinical experience and published studies demonstrating adverse prognosis in such patients who did not receive a permanent pacemaker for rate support.
4. Congenital third-degree AV block with a wide QRS escape rhythm or ventricular dysfunction. *(Level of Evidence: B)*	**4. Congenital third-degree AV block with a wide QRS escape rhythm, complex ventricular ectopy, or ventricular dysfunction. *(Level of Evidence: B)* (91–93)**	"Complex ventricular ectopy" was added to the other elements of this recommendation to reflect growing experience that in this setting, prognosis is adversely affected by such ectopy in the absence of rate support by a permanent pacemaker.

1998 Recommendation	2002 New or Revised Recommendations	Comments
5. Congenital third-degree AV block in the infant with a ventricular rate less than 50 to 55 bpm or with congenital heart disease and a ventricular rate less than 70 bpm. *(Level of Evidence: B, C)* (92,94)		No change
6. Sustained pause-dependent VT, with or without prolonged QT, in which the efficacy of pacing is thoroughly documented. *(Level of Evidence: B)* (76,77,95,96)		No change
Class IIa	***Class IIa***	***Class IIa***
1. Bradycardia-tachycardia syndrome with the need for long-term antiarrhythmic treatment other than digitalis. *(Level of Evidence: C)* (97,98)		No change
2. Congenital third-degree AV block beyond the first year of life with an average heart rate less than 50 bpm or abrupt pauses in ventricular rate that are two or three times the basic cycle length. *(Level of Evidence: B)*	**2. Congenital third-degree AV block beyond the first year of life with an average heart rate less than 50 bpm, abrupt pauses in ventricular rate that are two or three times the basic cycle length, or associated with symptoms due to chronotropic incompetence. *(Level of Evidence: B)* (99)**	Rewording of this recommendation to include symptoms due to chronotropic incompetence and abrupt pauses in ventricular rate in young patients with third-degree AV block after the first year of life. These events have been found to affect prognosis in patients with asymptomatic congenital third-degree AV block.
3. Long-QT syndrome with 2:1 AV or third-degree AV block. *(Level of Evidence: B)* (100,101)		No change
4. Asymptomatic sinus bradycardia in the child with complex congenital heart disease with resting heart rate less than 35 bpm or pauses in ventricular rate more than 3 seconds. *(Level of Evidence: C)*	**4. Asymptomatic sinus bradycardia in the child with complex congenital heart disease with resting heart rate less than 40 bpm or pauses in ventricular rate more than 3 seconds. *(Level of Evidence: C)***	The resting heart rate was changed from 35 to 40 bpm on the basis of clinical experience and expert consensus.
	5. Patients with congenital heart disease and impaired hemodynamics due to sinus bradycardia or loss of AV synchrony. *(Level of Evidence: C)*	New recommendation for pacing in children with impaired hemodynamics as a result of sinus bradycardia or loss of AV synchrony. Clinical experience has accumulated that indicates that children with congenital heart disease and hemodynamic impairment as a result of these conditions have unfavorable prognosis if not paced.
Class IIb	***Class IIb***	***Class IIb***
1. Transient postoperative third-degree AV block that reverts to sinus rhythm with residual bifascicular block. *(Level of Evidence: C)* (102)		No change
2. Congenital third-degree AV block in the asymptomatic neonate, child, or adolescent with an acceptable rate, narrow QRS complex, and normal ventricular function. *(Level of Evidence: B)*	**2. Congenital third-degree AV block in the asymptomatic infant, child, adolescent, or young adult with an acceptable rate, narrow QRS complex, and normal ventricular function. *(Level of Evidence: B)* (91,103)**	Modification of this recommendation to include "young adults" with congenital third-degree AV block by clinical consensus.
3. Asymptomatic sinus bradycardia in the adolescent with congenital heart disease with resting heart rate less than 35 bpm or pauses in ventricular rate more than 3 seconds. *(Level of Evidence: C)*	**3. Asymptomatic sinus bradycardia in the adolescent with congenital heart disease with resting heart rate less than 40 bpm or pauses in ventricular rate more than 3 seconds. *(Level of Evidence: C)***	Change of resting heart rate from 35 to 40 bpm as a result of clinical experience and expert consensus.
	4. Neuromuscular diseases with any degree of AV block (including first-degree AV block), with or without symptoms, because there may be unpredictable progression of AV conduction disease.	New Class IIb recommendation for pacing in children and adolescents with a neuromuscular disease and any degree of AV block. This is similar to the recommendation for pacing in this situation for adults (Section I-A).

1998 Recommendation	2002 New or Revised Recommendations	Comments
Class III	***Class III***	***Class III***
1. Transient postoperative AV block with return of normal AV conduction within 7 days. *(Level of Evidence: B)*	**1. Transient postoperative AV block with return of normal AV conduction. *(Level of Evidence: B)* (90,102)**	Rewording of this Class III recommendation to eliminate the 7-day window. There is clinical evidence that patients with postoperative AV block who regain normal AV conduction at any time have generally favorable prognosis without pacing.
2. Asymptomatic postoperative bifascicular block with or without first-degree AV block. *(Level of Evidence: C)*		No change
3. Asymptomatic type I second-degree AV block. *(Level of Evidence: C)*		No change
4. Asymptomatic sinus bradycardia in the adolescent with longest RR interval less than 3 seconds and minimum heart rate more than 40 bpm. *(Level of Evidence: C)* (104)		No change
SECTION I-H: PACING IN SPECIFIC CONDITIONS		
1. HYPERTROPHIC OBSTRUCTIVE CARDIOMYOPATHY		
Pacing Recommendations for Hypertrophic Cardiomyopathy		
Class I	***Class I***	***Class I***
1. Class I indications for sinus node dysfunction or AV block as previously described. *(Level of Evidence: C)*		No change
Class IIb	***Class IIb***	***Class IIb***
1. Medically refractory, symptomatic hypertrophic cardiomyopathy with significant resting or provoked LV outflow obstruction. *(Level of Evidence: C)*	**1. Medically refractory, symptomatic hypertrophic cardiomyopathy with significant resting or provoked LV outflow obstruction. *(Level of Evidence: A)* (105–110)**	No change in recommendation class. Level of evidence raised from "C" to "A" on the basis of published trials.
Class III	***Class III***	***Class III***
1. Patients who are asymptomatic or medically controlled.		No change
2. Symptomatic patients without evidence of LV outflow obstruction.		No change
SECTION I-H: PACING IN SPECIFIC CONDITIONS (continued)		
2. IDIOPATHIC DILATED CARDIOMYOPATHY		
Pacing Recommendations for Dilated Cardiomyopathy		
Class I	***Class I***	***Class I***
1. Class I indications for sinus node dysfunction or AV block as previously described. *(Level of Evidence: C)*		No change
Class IIa	***Class IIa***	***Class IIa***
	1. Biventricular pacing in medically refractory, symptomatic New York Heart Association (NYHA) class III or IV patients with idiopathic dilated or ischemic cardiomyopathy, prolonged QRS interval (greater than or equal to 130 ms), LV end-diastolic diameter greater than or equal to 55 mm and ejection fraction less than or equal to 35%. *(Level of Evidence: A)* (111,112)	New recommendation for *biventricular* pacing in patients with advanced heart failure, specific indices of LV dysfunction, and prolonged QRS duration. Multiple trials have demonstrated clinical and structural cardiac improvement with this form of therapy.

1998 Recommendation	2002 New or Revised Recommendations	Comments
Class IIb	***Class IIb***	***Class IIb***
1. Symptomatic, drug refractory dilated cardiomyopathy with prolonged PR interval when acute hemodynamic studies have demonstrated hemodynamic benefit of pacing. *(Level of Evidence: C)*		Deleted
Class III	***Class III***	***Class III***
1. Asymptomatic dilated cardiomyopathy.		No change
2. Symptomatic dilated cardiomyopathy when patients are rendered asymptomatic by drug therapy.		No change
3. Symptomatic ischemic cardiomyopathy.	**3. Symptomatic ischemic cardiomyopathy when the ischemia is amenable to intervention.**	Modification of this recommendation to clarify that pacing therapy is not indicated in symptomatic ischemic cardiomyopathy when the patient can be treated with revascularization therapy.
SECTION I-H: PACING IN SPECIFIC CONDITIONS (continued)		
3. CARDIAC TRANSPLANTATION		
Pacing Recommendations After Cardiac Transplantation		
Class I	***Class I***	***Class I***
1. Symptomatic bradyarrhythmias/ chronotropic incompetence not expected to resolve and other Class I indications for permanent pacing. *(Level of Evidence: C)*		No change
Class IIb	***Class IIb***	***Class IIb***
1. Symptomatic bradyarrhythmias/ chronotropic incompetence that, although transient, may persist for months and require intervention. *(Level of Evidence: C)*		No change
Class III	***Class III***	***Class III***
1. Asymptomatic bradyarrhythmias after cardiac transplantation.		No change
SECTION II: INDICATIONS FOR IMPLANTABLE CARDIOVERTER-DEFIBRILLATOR THERAPY		
Recommendations for ICD Therapy		
Class I	***Class I***	***Class I***
1. Cardiac arrest due to ventricular fibrillation (VF) or VT not due to a transient or reversible cause. *(Level of Evidence: A)* (113–134)		No change
2. Spontaneous sustained VT. *(Level of Evidence: B)*	**2. Spontaneous sustained VT in association with structural heart disease. *(Level of Evidence: B)* (113–127)**	This recommendation for ICD implantation was modified with the addition of the requirement for structural heart disease to be present. This change was made because ICD therapy is most efficacious in patients with impaired LV performance. Conversely, VT arising in structurally normal hearts can usually be treated pharmacologically or with catheter ablation.
3. Syncope of undetermined origin with clinically relevant, hemodynamically significant sustained VT or VF induced at electrophysiological study when drug therapy is ineffective, not tolerated, or not preferred. *(Level of Evidence: B)* (127,133,135–140)		No change

1998 Recommendation	2002 New or Revised Recommendations	Comments
4. Nonsustained VT with coronary disease, prior MI, LV dysfunction, and inducible VF or sustained VT at electrophysiological study that is not suppressible by a Class I antiarrhythmic drug. *(Level of Evidence: B)*	**4. Nonsustained VT in patients with coronary disease, prior myocardial infarction (MI), LV dysfunction, and inducible VF or sustained VT at electrophysiological study that is not suppressible by a Class I antiarrhythmic drug. *(Level of Evidence: A)* (141–143)**	No substantive change. Level of evidence raised from "B" to "A" as a result of newly published studies.
	5. Spontaneous sustained VT in patients who do not have structural heart disease that is not amenable to other treatments. *(Level of Evidence: C)*	New recommendation for ICD implantation in patients with sustained VT and structurally normal hearts when alternative treatments have failed (See #2 above)
Class IIa	***Class IIa***	***Class IIa***
	Patients with LV ejection fraction of less than or equal to 30%, at least one month post myocardial infarction and three months post coronary artery revascularization surgery. *(Level of Evidence: B)* (159)	New recommendation for implantation of an ICD prophylactically in the defined population. This recommendation is promulgated as a result of a randomized trial that demonstrated a 5.6% absolute risk reduction and a 31% relative risk reduction for death in the patient group receiving an ICD. The committee consensus was that further risk stratification of the referenced population might better define the benefit of an ICD in such patients. The reader should review the discussion regarding this recommendation in the full-text guideline on the ACC, AHA, and NASPE web sites.
Class IIb	***Class IIb***	***Class IIb***
1. Cardiac arrest presumed to be due to VF when electrophysiological testing is precluded by other medical conditions. *(Level of Evidence: C)* (124,131,144,145)		No change
2. Severe symptoms attributable to sustained ventricular tachyarrhythmias while awaiting cardiac transplantation. *(Level of Evidence: C)*	**2. Severe symptoms (eg, syncope) attributable to ventricular tachyarrhythmias in patients awaiting cardiac transplantation. *(Level of Evidence: C)* (146,147)**	No substantive change. Syncope was added as an example of "severe symptoms."
3. Familial or inherited conditions with a high risk for life-threatening ventricular tachyarrhythmias such as long-QT syndrome or hypertrophic cardiomyopathy. *(Level of Evidence: B)* (27,39,148–154)		No change
4. Nonsustained VT with coronary artery disease, prior MI, LV dysfunction, and inducible sustained VT or VF at electrophysiological study. *(Level of Evidence: B)* (113,118,126,141,142,155,156)		No change
5. Recurrent syncope of undetermined etiology in the presence of ventricular dysfunction and inducible ventricular arrhythmias at electrophysiological study when other causes of syncope have been excluded. *(Level of Evidence: C)*		No change
	6. Syncope of unexplained etiology or family history of unexplained sudden cardiac death in association with typical or atypical right bundle-branch block and ST-segment elevations (Brugada syndrome). *(Level of Evidence: C)* (157,158)	New recommendation for ICD implantation in patients with the Brugada syndrome and syncope or family history of sudden cardiac death. Several reports suggest that ICD therapy in patients with this syndrome is effective in preventing sudden death.

1998 Recommendation	2002 New or Revised Recommendations	Comments
	7. Syncope in patients with advanced structural heart disease in which thorough invasive and noninvasive investigation has failed to define a cause. *(Level of Evidence: C)*	New recommendation based on clinical experience and expert consensus. Patients with advanced structural heart disease and syncope of undetermined etiology despite thorough investigation are likely to have an arrhythmic cause of the syncope and thus may benefit from ICD insertion.
Class III	***Class III***	***Class III***
1. Syncope of undetermined cause in a patient without inducible ventricular tachyarrhythmias. *(Level of Evidence: C)*	**1. Syncope of undetermined cause in a patient without inducible ventricular tachyarrhythmias and without structural heart disease. *(Level of Evidence: C)***	Modification of this recommendation to exclude patients with structural heart disease who fall under #7, Class IIb, above.
2. Incessant VT or VF. *(Level of Evidence: C)*		No change
3. VF or VT resulting from arrhythmias amenable to surgical or catheter ablation; for example, atrial arrhythmias associated with the Wolff-Parkinson-White syndrome, right ventricular outflow tract VT, idiopathic left ventricular tachycardia, or fascicular VT. *(Level of Evidence: C)* (130,160–163)		No change
4. Ventricular tachyarrhythmias due to a transient or reversible disorder (eg, AMI, electrolyte imbalance, drugs, trauma). *(Level of Evidence: C)* (164)	**4. Ventricular tachyarrhythmias due to a transient or reversible disorder (eg, AMI, electrolyte imbalance, drugs, or trauma) when correction of the disorder is considered feasible and likely to substantially reduce the risk of recurrent arrhythmia. *(Level of Evidence: B)* (165–167)**	Changed to address the issue of many patients with structural heart disease who experience cardiac arrest in the setting of abnormal electrolytes. Such patients may still be at risk for recurrent arrhythmic events and may still benefit from ICD therapy.
5. Significant psychiatric illnesses that may be aggravated by device implantation or may preclude systematic follow-up. *(Level of Evidence: C)* (168,169)		No change
6. Terminal illnesses with projected life expectancy less than six months. *(Level of Evidence: C)*		No change
7. Patients with coronary artery disease with LV dysfunction and prolonged QRS duration in the absence of spontaneous or inducible sustained or nonsustained VT who are undergoing coronary bypass surgery. *(Level of Evidence: B)* (170)		No change
8. NYHA Class IV drug-refractory congestive heart failure in patients who are not candidates for cardiac transplantation. *(Level of Evidence: C)*		No change

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