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## REVIEW ARTICLE

# Pacemakers and implantable cardioverter defibrillators – general and anesthetic considerations

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### KEYWORDS

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**Abstract** A pacemaking system consists of an impulse generator and lead or leads to carry the electrical impulse to the patient's heart. Pacemaker and implantable cardioverter defibrillator codes were made to describe the type of pacemaker or implantable cardioverter defibrillator implanted. Indications for pacing and implantable cardioverter defibrillator implantation were given by the American College of Cardiologists. Certain pacemakers have magnet-operated reed switches incorporated; however, magnet application can have serious adverse effects; hence, devices should be considered programmable unless known otherwise. When a device patient undergoes any procedure (with or without anesthesia), special precautions have to be observed including a focused history/physical examination, interrogation of pacemaker before and after the procedure, emergency drugs/temporary pacing and defibrillation, reprogramming of pacemaker and disabling certain pacemaker functions if required, monitoring of electrolyte and metabolic disturbance and avoiding certain drugs and equipments that can interfere with pacemaker function. If unanticipated device interactions are found, consider discontinuation of the procedure until the source of interference can be eliminated or managed and all corrective measures should be taken to ensure proper pacemaker function should be done. Post procedure, the cardiac rate and rhythm should be monitored continuously and emergency drugs and equipments should be kept ready and consultation with a cardiologist or a pacemaker-implantable cardioverter defibrillator service may be necessary.

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## Introduction

Battery-operated pacing devices were introduced by C.W. Lillehei and Earl Bakken in 1958.<sup>1</sup> The natural progression

of pacemaker (PM) developments led to invention of the implantable cardioverter defibrillator (ICD) around 1980 by Michael Morchower.<sup>1</sup>

A pacemaking system consists of an impulse generator and lead or leads to carry the electrical impulse to the patient's heart. Leads can be unipolar, bipolar or multipolar. Generators with bipolar leads can be programmed to the unipolar mode for pacing, sensing, or both.<sup>1</sup>

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**Table 1** North American Society of Pacing and Electrophysiology (NASPE)/British Pacing and Electrophysiology Group (BPEG) (2002) Generic Pacemaker Code (NBG).<sup>2</sup>

Position I: pacing chamber(s)	Position II: sensing chamber(s)	Position III: response(s) to sensing	Position IV: programmability	Position V: multisite pacing
O = none A = atrium	O = none A = atrium	O = none I = inhibited	O = none R = rate modulation	O = none A = atrium
V = ventricle D = dual (A + V)	V = ventricle D = dual (A + V)	T = triggered D = dual (T + I)		V = ventricle D = dual (A + V)

## Pacemaker codes

**Table 1** shows the pacemaker codes given by the North American Society of Pacing and Electrophysiology (NASPE)/British Pacing and Electrophysiology Group (BPEG) (2002) Generic Pacemaker Code (NBG).<sup>2</sup>

**Dual:** Provides atrioventricular (AV) synchrony, where atrial pacing will take place in the “inhibited” mode and the pacing device will ensure that a ventricular event follows.<sup>1</sup>

**Inhibited:** The appropriate chamber is paced unless intrinsic electrical activity is detected during the pacing interval.<sup>1</sup>

**Triggered:** The pacing device will emit a pulse only in response to a sensed event.<sup>1</sup>

## Indications for pacemaker implantation<sup>3</sup>

- Bradycardia due to Sinus Node Dysfunction (SND) and Atrioventricular Node Dysfunction (AND).
  - SND: Persistent sinus bradycardia and chronotropic incompetence without identifiable causes, symptomatic bradycardia.
  - Acquired atrioventricular (AV) block in adults:
  - Third-degree and advanced second-degree AV block at any anatomic level associated with:
    - o Bradycardia with symptoms/ventricular arrhythmias presumed to be due to AV block.
    - o Other medical conditions that require drug therapy that results in symptomatic bradycardia.
    - o Symptom-free patients in sinus rhythm, with documented periods of asystole greater than or equal to 3 s, an escape rate <40 bpm or an escape rhythm that is below the AV node.
    - o Awake, symptom-free patients with AF and bradycardia with  $\geq 1$  pauses of at least  $\geq 5$  s.
    - o After catheter ablation of the AV junction associated with postoperative AV block that is not expected to resolve after cardiac surgery.
    - o Associated with neuromuscular diseases with AV block.
  - Second-degree AV block with associated symptomatic bradycardia regardless of type or site of block.
  - Asymptomatic persistent third-degree AV block at any anatomic site with average awake ventricular rates of 40 bpm or faster if cardiomegaly or LV dysfunction is present or if the site of block is below the AV node.
  - Second- or third-degree AV block during exercise in the absence of myocardial ischemia.
- Chronic bifascicular block: Bifascicular block refers to ECG evidence of impaired conduction below the AV node in the right and left bundles.
  - Advanced second-degree AV block or intermittent third-degree AV block.
  - Type II second-degree AV block.
  - Alternating bundle-branch block.
- Pacing for atrioventricular block associated with acute myocardial infarction
  - Persistent second-degree AV block after ST-segment elevation MI.
  - Transient advanced second- or third-degree infranodal AV block and associated bundle-branch block.
  - Persistent and symptomatic second- or third-degree AV block.
- Hypersensitive carotid sinus syndrome and neurocardiogenic syncope.
  - Recurrent syncope caused by spontaneously occurring carotid sinus stimulation and carotid sinus pressure that induces ventricular asystole of more than 3 s.
- After cardiac transplantation.
  - Persistent inappropriate or symptomatic bradycardia not expected to resolve.
- Prevention and termination of arrhythmias by pacing.
  - Symptomatic recurrent SVT that is reproducibly terminated by pacing when catheter ablation and/or drugs fail to control the arrhythmia or produce intolerable side effects.
  - Sustained pause-dependent VT, with or without QT prolongation.
- Hypertrophic cardiomyopathy.
- Children, adolescents, and patients with congenital heart disease.
  - Advanced second/third-degree AV block associated with symptomatic bradycardia, ventricular dysfunction, or low cardiac output.
  - SND with correlation of symptoms during age-inappropriate bradycardia. (The definition of bradycardia varies with the patient’s age and expected heart rate.)
  - Postoperative advanced second- or third-degree AV block that is not expected to resolve or that persists at least 7 days after cardiac surgery.
  - Congenital third-degree AV block with a wide QRS escape rhythm, complex ventricular ectopy, or ventricular dysfunction.
  - Congenital third-degree AV block in the infant with a ventricular rate less than 55 bpm or with congenital heart disease and a ventricular rate less than 70 bpm.

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