Basic Pacing Concepts and Terminology

A cardiac pulse generator is a device having a power source and electronic circuitry that produce output stimuli. Functionally, at its simplest, current sourced by the device’s battery travels through a connecting pathway to stimulate the heart and then flows back into the pacemaker to complete the circuit.

Although numerous and varied designs of cardiac pacemakers are available, all have the same basic components:

- A power source in the form of a battery
- Circuitry (output, sensing, telemetry, microprocessor or microsequencer, memory)
- A metal casing (can) welded shut to keep out fluids
- A feedthrough (a piece of wire surrounded by glass or sapphire) that maintains a hermetic seal to provide an electrical connection through the can
- A means of connecting a pacing lead (wire to the heart) to the header of the pacemaker
- Sensors (e.g., acceleration, vibration, impedance)

Modern pacemakers are extremely sophisticated and highly programmable, capable of storing a rather impressive array of diagnostic data. Weighing about 25 g, they can pace and sense in one, two, or three chambers and adjust their rate by tracking intrinsic atrial activity or by responding to input from a sensor.

Because the pacemaker is an electronic device, the clinician may be unfamiliar with the engineering nomenclature associated with this technology. The more common terms are listed in Table 2.1. How the pacemaker works and factors to take into consideration when programming a pacemaker are discussed in the following sections.
Power Source (Battery)

Pacemakers directly benefited from advances in battery technology; thus, a variety of power sources have been employed in cardiac pacemakers over the last four decades. The first chemical cell to achieve wide-scale use was composed of mercury–zinc (HgZn) also known as the Rueben or Mallory cell (1,2). Unfortunately, mercury–zinc had some undesirable characteristics. The cell voltage was 1.35 V, so most pacemakers incorporated four to five cells in series to provide the 5.0–6.0V deemed necessary to produce consistent capture or depolarization of the heart. In addition, as the cell is depleted, the voltage decreases to almost zero precipitously with little or no warning. As a consequence, pacemaker patients had to be followed frequently to assure that the battery voltage did not decrease to a point where capture was lost. Several manufacturers flirted with nuclear-powered cells but this much-touted battery failed to achieve much popularity because of the government restrictions and bulky radiation shielding, which made them rather large (3). One manufacturer produced a rechargeable cell (nickel–cadmium); however, these devices required constant recharging and the memory effect of these rechargeable batteries had an adverse effect on the overall longevity.