J Daniels RN, Electrophysiology Lab Milpark Hospital

Patients are paced for a variety of reasons. The most common presenting symptoms are syncope or near syncope. All pacemakers used today are demand pacemakers (they can sense the patient’s intrinsic rate and pace only when needed). There are a variety of programmable features. These include rate (upper and lower rate), whether the rate is sensed. All these features have a bearing on what is seen on the surface ECG.

A pacemaker system is made up of the following components:

- Leads that may be placed in the right atrium, the right ventricle and the coronary sinus permitting left ventricular pacing.
- The pacemaker consists of the battery and the circuitry. This is a sealed unit and is replaced as a whole when the battery is flat.
- Universal coding (NASPE/BPEG) is used to denote the chambers paced and sensed.
  - First letter represents the chamber paced (V=ventricle, A=atrium, D=dual chamber, O=none)
  - Second letter represents the chamber sensed.
  - Third letter represents the response of the pacemaker to sensed beats. A sensed beat either inhibits or triggers pacing or both.

The ECG of the paced patient will depend on a number of factors:

- The chamber or chambers paced
- The patient’s intrinsic rate, rhythm and conduction.
- The pacing lead configuration. Most pacing leads are bipolar. This means that the pacing spike seen on the surface ECG is very small and in fact may not be visible at all in some leads. Unipolar systems have large pacing spikes.

MODES

Right ventricular pacing (VVI)

Pacing will only occur if the patient’s intrinsic rate is less than the lower rate of the pacemaker.

Paced beats:

- Broad QRS (>0.12s)
- Left bundle branch block type configuration
- Left or north west axis (RV apical pacing)
- AV dissociation
- There may be regular VA conduction.

Atrial pacing (AAI)

The atrium is paced when the patient’s sinus rate is below the programmed lower rate of the pacemaker.

- The PR interval and QRS depends on the conduction through the AV node and through the His-Purkinje system.
- A pacing spike may be visible preceding the P wave.

Right atrium/ right ventricle (DDD)

There are pacing leads in the right atrium (usually the right atrial appendage) and the right ventricle.

- P wave with or without a pacing spike preceding it.
- PR interval may vary. This is programmable to a fixed AV interval or can be programmed to shorten with an increase in atrial rate.
- QRS may be broad as with VVI pacing (a fully paced beat) or
- It may be narrow if the paced AV interval is longer than the patient’s own PR interval or
- It may be slightly wider than normal (fusion between the paced and normal QRS)
- If the patient goes into atrial fibrillation most pacemakers revert to pacing the ventricle only
- The rate will vary between the programmed upper and lower rates unless the patient’s intrinsic rate is above the programmed upper rate and the patient has good AV nodal function.
Based on this ECG the patient has a VVI pacemaker with a lead in the apex of the right ventricle. He has atrial fibrillation. A rate of 65 may indicate that the battery has reached end of life and that the pacemaker needs to be replaced.

The rate is 60 bpm. Small (bipolar) pacing spikes can be seen preceding the P wave and QRS complex. The regular rate of 60 bpm strongly suggests that the atria are being paced. The QRS complex is narrow and not typical of left bundle branch block, suggesting a normally conducted beat.

The left axis deviation suggests fusion between the normal and paced QRS.

The 3rd beat in the rhythm strip is a sensed ventricular ectopic beat. This resets the timing cycle of the pacemaker resulting in a compensatory pause.

**POINTS TO REMEMBER**

- Ischaemia can not be seen on a paced ECG.
- The pacemaker cannot control the patient’s upper rate if AV nodal conduction is present.
- If the patient’s rate exceeds the programmed lower pacing rate there may be no sign of pacing on the ECG.
- Dual chamber pacemakers follow the normal sinus rate therefore an increase in rate will be seen with fever, emotion, exercise etc.
- Pacemakers usually last between 5 - 8 years and should be checked annually.

For more information and referrals, please send your request to ecg@jppza.jnj.com