Keywords: ECG monitoring/Continual/Heart/Rhythm
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The first in a three-part series on electrocardiograms explores continual monitoring

ECGs 1: carrying out

In this article...

- **Identifying situations where ECG monitoring is required**
- **The components of a normal sinus rhythm and how these relate to the cardiac cycle**
- **Common problems with ECG monitoring and how to overcome them**
- **Nursing responsibilities when caring for the patient with ECG monitoring**

An electrocardiogram is a recording of the electrical activity of the heart (Huff, 2006). In clinical practice, it has two approaches:

- **12-lead ECG:** This is a definitive diagnostic procedure measuring electrical activity from a three dimensional perspective;
- **Basic monitoring technique:** This provides a less-detailed view of the basic heart rhythm and is performed as a continual process.

The first of a three-part series, this article explores the indications for continual ECG monitoring, how it is performed, and the nursing responsibilities when caring for the patient being monitored. Part two will explore ECG rhythm analysis, and the final part in the series will look at the role of the 12-lead ECG in clinical practice.

Indications for ECG monitoring

ECG monitoring can alert nursing staff to changes in a patient's condition and aid diagnostic decisions (Jevon, 2009). Indications include:

- Any acute critical illness;
- Peri and post cardiac arrest;
- Acute coronary syndromes;
- History of life-threatening cardiac arrhythmias;
- During and following any invasive cardiac procedure;
- Any procedure involving sedation or anaesthesia;
- Cardiovascular or conduction abnormalities, such as electrolyte or metabolic imbalance or drug overdose.

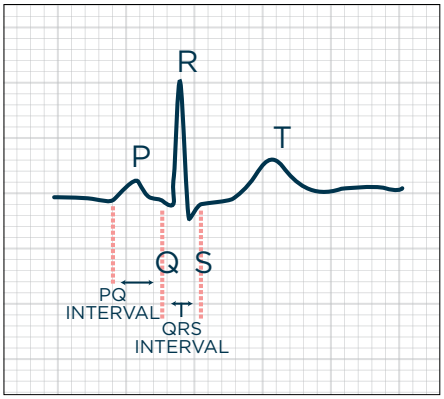
Physiology of the heart

Electrical impulses are initiated from the sinoatrial node of the heart. They are conducted through the atrial muscle and the atrioventricular node, down the bundle of His, and through the right and left ventricles via the Purkinje fibres (Fig 1).

The conduction of electrical impulses is detected through the skin by placing electrodes at specific points. These impulses are amplified and displayed as a graphic waveform either on an ECG machine or on a cardiac monitor. Each part of the graphic display can be related to a part of the conduction pathway and, providing no abnormality is present, the cardiac cycle (Fig 2).

- The P wave represents the electrical impulse spreading across the atria, known as atrial depolarisation. This is associated with atrial contraction.
- The QRS complex represents the electrical impulse conducted down the bundle of His, and into the right and left bundle branches and the Purkinje fibres. This is known as ventricular depolarisation and is associated with ventricular contraction.
- T represents a repolarisation of the ventricles. This is associated with ventricular relaxation.

FIG 2. **CARDIAC CYCLE**



The ECG monitoring process

Before starting ECG monitoring, informed consent must be obtained.

Good contact between the electrode and the skin is essential so the skin should be clean and dry. If excess hair is present, a small patch can be shaved or trimmed with the patient's consent. Skin oil and grease can be removed by rubbing the skin with alcohol or gauze (Navas, 2003). Electrodes are then attached to the patient according to the manufacturer's instructions.

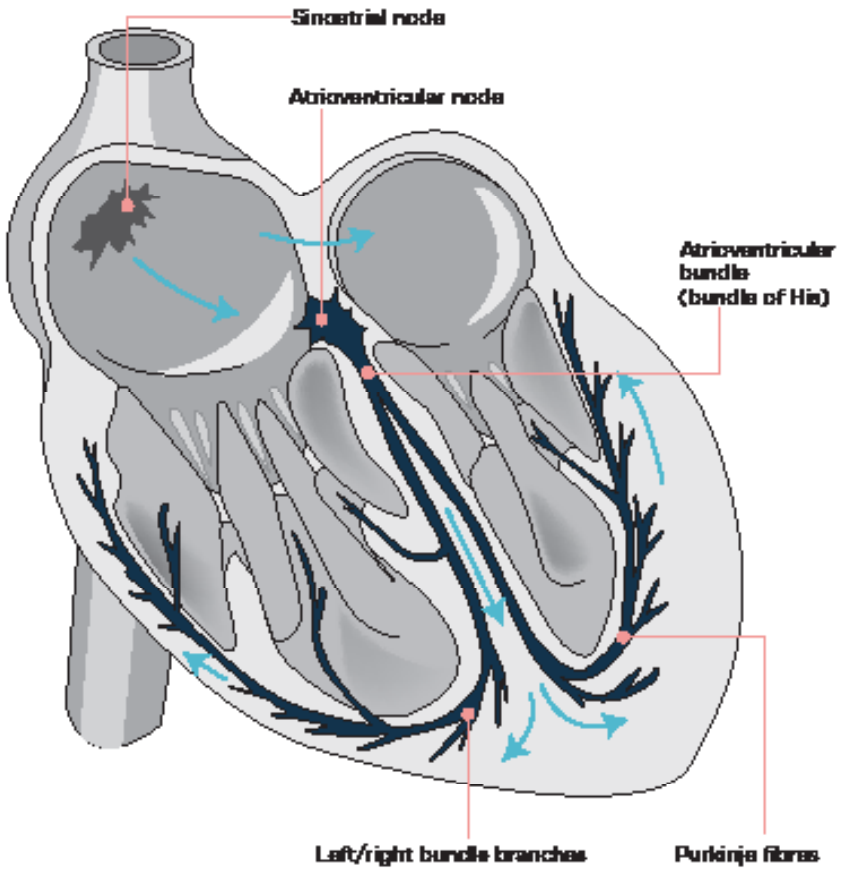
There are several configurations for electrode positions, including three-, five- and 10-lead set-ups. A standard three bipolar lead configuration is most commonly used for continual ECG monitoring. Bipolar lead monitoring can be used to track heart rate, observe basic arrhythmias, and to detect ventricular fibrillation (Drew et al, 2004). Electrode pads are placed below the right clavicle, the left clavicle and the left lower rib cage. The red cable is connected to the right clavicle electrode, the yellow cable is connected to the left clavicle electrode, and the green cable is connected to the lower ribcage electrode.

Recalling this configuration in urgent situations can be challenging for practitioners who do not use this skill frequently. It is important to remember that any configuration has the potential to demonstrate a trace for emergency analysis.

Using the standard three-lead set-up, the heart can be viewed (electrically) from a two-dimensional (bipolar) view using any two of the three electrodes. These views are known as leads I, II and III. The monitor is turned on and connected to the patient, and the lead to record is selected. Lead II tends to be the standard as it provides a good recording of atrial and ventricular activity, enabling cardiac arrhythmias to be identified (Endacott et al, 2009). The ECG will be displayed on the monitor. It should be checked for clarity, size of complexes

monitoring

FIG 1. **ELECTRICAL IMPULSES OF THE HEART**



5 key points

1 An ECG is a recording of the electrical activity of the heart. Either a 12-lead ECG or continual ECG monitoring can be performed

2 ECG monitoring can alert nurses to changes in a patient's condition and aid diagnosis

3 The conduction of the heart's electrical impulses is detected through the skin by electrodes placed at specific points. They are displayed as a graphic waveform on an ECG machine or cardiac monitor

4 A flatline ECG trace is often caused by a lead or electrode becoming disconnected

5 Patients on continual ECG monitoring should be nursed in a high observation area where alarms are easily heard

and any interference. The monitor settings, such as brightness and contrast, may require adjustment to optimise the display.

Common problems with ECG monitoring

If an ECG monitor alarm is triggered or if problems with waveforms are identified, the immediate course of action is to assess and treat the patient using the ABCDE assessment approach outlined by the Resuscitation Council (UK) 2010 guidelines (www.resus.org.uk). A flatline ECG trace is commonly caused by disconnection of a lead or electrode, but the patient may be asystolic or in cardiac arrest.

A patient may also display an ECG rhythm on a monitor but have no pulse. This is known as pulseless electrical activity and should be treated as an emergency as the patient is in cardiac arrest.

ECG electrodes should be changed frequently as the conductive gel can dry easily, affecting trace quality (Sharman, 2007). Electrode sites should be observed for signs of allergy, such as redness or itching. If an allergy is suspected, hypoallergenic electrodes should be used (Jevon, 2009).

Alarms

Heart-rate alarms should be based on normal values for the patient. Alarms should be set for both high and low rates.

Trace

To avoid poor-quality trace, electrode-to-skin contact should be checked to ensure the gel of electrodes is moist. Leads should also be positioned to avoid cable drag and skin should be dried.

Interference

This can occur from other monitoring equipment. Moving electrode positions or configuration may help reduce interference. Some ECG monitoring systems also have electrical filters. If the trace is small, the gain (amplitude of the signal) can be increased. However, practitioners should be cautious when doing this as certain conditions, such as pericardial effusion, can cause a reduction in ECG voltage (Endacott et al, 2009).

Waveforms

Double counting of heart rate can occur if waveform morphology is altered.

Catherine Hollick / Oliver Meyer

Changing configuration or the positioning of electrodes can help rectify this. The patient's respirations can also cause interference with the waveform, resulting in a wandering baseline. This is usually rectified by changing the position of the electrode.

Caring for patients with ECG monitoring and their relatives

The patient should be nursed in a high observation area. ECG monitoring can cause anxiety for the patient or their relatives, especially if alarms sound.

Alarms should be set appropriately and explained to the patient and their family, and the rationale for ECG monitoring should be discussed. Patients and relatives are likely to "monitor watch" so informing them of acceptable values can reduce unnecessary panic. Patients should also be advised that activities, such as brushing teeth, are likely to cause emergency alarms to sound. Electrode repositioning and configuration can reduce the incidence of this.

Once ECG monitoring has started, it is important that certain details of the procedure are documented. These details are outlined in Box 1. Following immediate assessment, any changes in ECG rate or rhythm should be reported as appropriate. If rhythm or waveform morphology changes, a diagnostic 12-lead ECG is usually indicated. **NT**

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BOX 1. **DOCUMENTING CARE**

The following should be documented once ECG monitoring has been commenced:

- Indication for ECG monitoring
- The date and time monitoring started
- The lead configuration used
- Skin preparation
- Any rhythm rate abnormality
- Any action taken as a result of the analysis.

References

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