

## An Introduction to ECG Gating for Cardiac MRI Part 1: Patient preparation for the ECG

**Topic Author: Ben Statton**

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### Introduction

Synchronising the MR image acquisition to the cardiac cycle is an integral part of imaging the heart and often one of the most daunting aspects for technologists approaching cardiac MRI for the first time. To minimise motion artefacts due to the constant beating motion of the heart we need to synchronise the MRI acquisition with the patient's ECG. In most cases this is achieved with an MRI compatible 3 or 4 lead ECG system that is provided by the scanner manufacturer.

This topic of ECG synchronisation is going to be broken down into four subtopics:

1. Patient preparation for the ECG
2. The cardiac cycle and types of synchronisation
3. K-space Segmentation in cardiac MRI
4. Dealing with arrhythmia

### Main Body

Time spent to adequately prepare the patient and ensuring a strong ECG signal before any scanning begins is time well spent. It is much better to spend an extra 3 or 4 minutes optimising the ECG signal at the beginning of the exam, rather than struggling with a suboptimal ECG signal throughout the entire examination, especially if the patient is receiving a stress infusion or after they have received a dose of gadolinium and the late gad clock is ticking.

Steps to ensure the best possible ECG trace:

1. **Shaving** – for male patients this can mean shaving a few small areas to ensure that the electrode stickers have good contact with the skin rather than being stuck to hair. Consider that the patient may get warm during the scan and then sweat, this will then compromise the connection of the electrodes, especially in areas where they have been stuck on top of chest hair. However, be wary of using a razor in the magnet room itself as it may become a projectile, so it would be best to perform shaving in a separate preparation room.



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2. Prepare the skin – remove any lotion or moisturiser.
3. Abrasive gel – use a commercially available abrasive gel on the skin under where you plan to place the electrode stickers, this will reduce the electrical impedance of the skin and create better electrical contact with the electrode.
4. Electrodes – only use clearly marked MRI Safe electrodes as the use of standard electrodes can produce serious burns to the patient. Also, if you are performing the scan on an in-patient, be sure to check and remove any non-MRI 12 lead ECG electrodes that may still be on their skin.
5. Electrode placement – place the electrodes in the configuration recommended by your scanner manufacturer and then connect the cables of the ECG box.
6. ECG box placement – place the ECG box itself down on the patient’s abdomen as far from the imaging volume as possible to reduce artefacts. Manufacturers will often supply a fitted foam holder for the ECG box to sit in.
7. Learning phase – the MRI scanner will often have a “learning phase” where the software will learn what the patient’s normal ECG trace looks like before they enter the bore of the magnet. During this learning phase you should not touch the patient, and they should remain still and refrain from speaking.
8. Breathing – sometimes when the patient inhales more deeply (as they may do when following breathing instructions during the scan) the ECG electrodes can become unstuck or the cables might pull or come off. So once the electrodes are placed and the ECG box connected, perform a couple of practice breath holding patterns with them to ensure that the ECG trace remains strong throughout. This will also be an indicator as to whether the patient understands the breathing instructions they will receive during the scan.

Don’t be afraid of experimenting with different of electrode positions when attempting to optimise the ECG trace. For example, there may be occasions where the patient would rather be positioned feet first in the scanner, in which case it might make more sense to position the ECG box up over the patients shoulder rather than down over their abdomen, or sometime claustrophobic patient’s may feel more comfortable in a prone position, in which case you could position the electrodes on the patient’s back.



## Conclusion

Taking the time to properly prepare the patient for the ECG is a crucial step before starting a CMR examination and a little extra time spent here could save many repeated sequences throughout the course of the study. Always ensure that the ECG signal is strong before placing the patient in the bore of the magnet as this will help the scanner software deal with any artefacts that may be introduced during the pulse sequence.

## References

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## Further Resources

EACVI Cardiovascular Magnetic Resonance - Physics for Clinicians Pocket Guide  
David Broadbent, Ananth Kidambi, John Biglands

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