Arrhythmia Rejection Using a VCG-Based Triggering Algorithm

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Introduction

With standard QRS detection algorithms, arrhythmic heartbeats can be mistaken as normal QRS complexes. This is undesirable for triggered cardiac magnetic resonance examinations since image quality will be lowered when the R-R duration of heartbeats preceding and following ectopic beats varies. Current MR arrhythmia rejection methods compare each R-R interval to a reference interval in order to accept or reject retrospective data cardiac stress test. It has been shown using the vectorcardiogram (VCG) that by using a VCG-based target-distance triggering algorithm [2], certain types of arrhythmias can be rejected.

Methods

A total of six patients were studied. In this group there were five males and one female with an average age of 63±18. Five of the volunteers had premature ventricular contractions (PVC) while one patient had supraventricular extra-systoles. They underwent cardiac functional examinations on a Philips Gyroscan 1 ST whole-body system triggered with the VCG triggering system developed in our lab using a target-distance algorithm [2].

Results and Discussion

In five of the six patients, a precise reference point was established to trigger the examination. However, in the sixth patient, due to the excessive frequency of PVC’s in the heart rhythm, an accurate reference point could not be determined. Thus, this patient was excluded from further analysis.

Figure 1 shows sample output signals from the VCG system. Here it can be seen that the VCG algorithm can distinguish the difference between a premature ventricular contraction (PVC) and a normal QRS complex. Examinations of the ECG signals reveals that the PVC manifests only slightly different characteristics from those of the normal QRS complex. The differences are apparent in the timing and the amplitude of the PVC. Here, it can be seen that the PVC occurs more closely in time after a normal QRS complex. Examinations of the ECG signals reveals that the PVC occurs more closely in time after a normal QRS complex. Examinations of the ECG signals reveals that the PVC occurs more closely in time after a normal QRS complex. Here, it can be seen that the PVC has a different shape than the QRS loop. In addition, the PVC is in a different orientation, so it does not pass through the reference point. Thus, the VCG target-distance algorithm for triggering PVC's has been demonstrated. With this consistent arrhythmia rejection, image quality should be improved. However, more work will be needed to define effective rejection schemes for other types of arrhythmias.

Figure 2 shows the frontal VCG plot from a volunteer. Here it can clearly be seen that the PVC has a different shape than the QRS loop. In addition, the PVC is in a different orientation, so it does not pass through the reference point. Thus, the VCG target-distance algorithm for triggering PVC’s has been demonstrated. With this consistent arrhythmia rejection, image quality should be improved. However, more work will be needed to define effective rejection schemes for other types of arrhythmias.

Conclusions

The potential for the VCG based target-distance algorithm to perform robust rejection of PVC’s has been demonstrated. With this consistent arrhythmia rejection, image quality should be improved. However, more work will be needed to define effective rejection schemes for other types of arrhythmias.

References