Analysis of High Frequency Mid-QRS Potentials vs ST Segment and T Wave Analysis for the Diagnosis of Ischemic Heart Disease

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Abstract

The objective of the present study was to examine the effect of induced ischemia on the morphology of the high frequency MID-QRS (HF-QRS) potentials in patients referred to Thallium stress myocardial perfusion (SPECT) imaging.

High-resolution ECG waveforms from 12 leads were analyzed before, during, and following stress testing using BSP Biological Signal Processing Ltd. (Tel Aviv, Israel) system. The changes in the HF-QRS total energy were examined. Also conventional ST-T analysis for ischemic heart disease was performed. The results from the HF-QRS and the conventional ECG analysis were compared to the nuclear imaging results.

The high frequency method detected 24 out of 28 of the ischemic patients (86%), and 37 out of 52 of the non-ischemic patients (71%). The conventional ST segment and T wave analysis detected only 11 out of 28 of the ischemic patients (39%), and 34 out of 52 of the non-ischemic patients (65%).

In conclusion, the present study shows that the HF ECG has better clinical diagnostic performance compared to the conventional ECG based methods.

1. Introduction

Interpretation of the ECG for ischemic heart disease usually relies on morphological alterations in the repolarization phase (ST and T wave). In the past years, the wide band ECG has been used to examine if the depolarization phase (the high-frequency details in the MID-QRS complex) of the cardiac cycle may enhance the diagnostic value of the ECG for ischemia [1-5]. The objective of the present study was to examine the effect of induced ischemia on the morphology of the high frequency MID-QRS (HF-QRS) potentials in patients referred to Thallium stress myocardial perfusion (SPECT) imaging.

2. Methods

The study population comprised of 80 patients referred to Thallium stress SPECT. High-resolution ECG waveforms from 12 leads were analyzed before, during, and following stress testing using BSP Biological Signal Processing Ltd. (Tel Aviv, Israel) system. Signal averaging and filtering techniques were used in order to enhance the signal-to-noise ratio of the recorded ECG. The averaged QRS waveforms were filtered between 150 and 250 Hz and the changes in the HF-QRS total energy were examined. Also conventional ST-T analysis for ischemic heart disease was performed. The results from the HF-QRS and the conventional ECG analysis were compared to the nuclear imaging results.

3. Results

Figure 1 presents a typical example of the HyperQ signal during stress test for a Ischemic heart disease (IHD) patient. The first row in the figure indicates the subject's heart rate. The second row presents the subject's standard ECG signal and the third row presents the corresponding HyperQ signal. As can be seen in Figure 1, the HyperQ signal changes significantly as the exercise test progresses. Note particularly the decrease in the signal's amplitude - it is that depression that identifies myocardial ischemia.

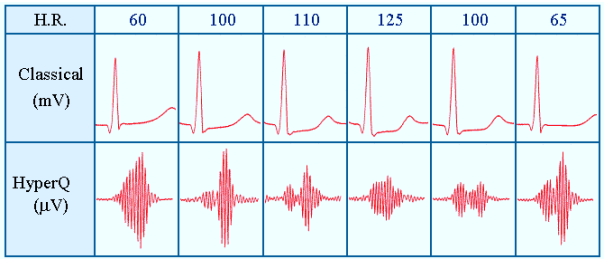

Figure 1: HyperQ versus conventional ECG during exercise test for IHD patient. Note the different amplitude and time scales for the traces.

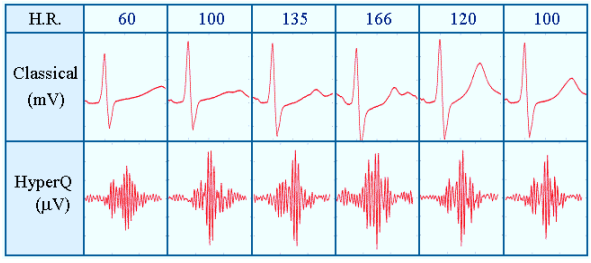

Figure 2: HyperQ versus conventional ECG during exercise test for Healthy subject. Note the different amplitude and time scales for the traces.

Figure 2 presents a typical example of the HyperQ signal during stress test for healthy subject. As in Figure 1, it is possible to follow the evolution of both the standard ECG and the HyperQ signals during the test. Unlike figure 1, no significant change in the HyperQ signal can be detected, indicating that no ischemic episode was detected.

Table 1 shows the results for the complete study group. According to the stress SPECT results 28 patients were diagnosed as suffering from myocardial ischemia, while in 52 patients there was no evidence of ischemia. The high frequency method detected 24 out of 28 of the ischemic patients (86%), and 37 out of 52 of the non-ischemic patients (71%). The conventional ST segment and T wave analysis detected only 11 out of 28 of the ischemic patients (39%), and 34 out of 52 of the non-ischemic patients (65%). It can be seen that the HyperQ method has significantly higher value of sensitivity together with better value of specificity.

Table 1: Sensitivity and specificity for the HyperQ and the conventional ECG analysis

	Specificity	Sensitivity
ST Changes	34/52 (65%)	11/28 (39%)
HyperQ	37/52 (71%)	24/28 (86%)

4. Conclusions

In conclusion, the present study shows that the HF ECG method has superior diagnostic significance over conventional ECG based methods and may be used as an effective tool for identify patients suffering from ischemic heart disease. Further studies in larger groups of patients are required for better assessment of the true diagnostic value of HF-QRS potentials for detecting myocardial ischemia.

References

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