Introduction: Detection of left ventricular hypertrophy (LVH) via the electrocardiogram (ECG) is still of value in cardiovascular risk stratification, whereas secondary ST-T changes due to LVH, which are uniquely determined from the ECG, are known to increase this risk. Improvement of criteria for LVH is still therefore of value. There are more than 30 different ECG criteria that can be used to determine the presence of LVH. This study therefore was aimed at comparing different criteria, including the classic Sokolow-Lyon (SV1 + maxRV5/6) and the relatively newer Cornell (SV3 + RaVL) criteria both as voltage criteria per se and voltage × QRS duration products, as well as point scoring systems such as the Romhilt Estes (RE), Perugia, and the University of Glasgow age- and sex-modified RE (UGRE) score. Regression models for estimating left ventricular (LV) mass from the ECG were also assessed.

Methods: Patients undergoing echocardiography (echo) were recruited from the Cardiology Department in Glasgow Royal Infirmary. The echo LV mass derived using the American Society of Echocardiography method was used as the gold standard. This was indexed to body surface area, and by using sex-dependent cutoffs of 116 g/m^2 for men and 104 g/m^2 for men, echo-based LVH was determined. Electrocardiograms were processed by the University of Glasgow ECG analysis program permitting different LVH criteria to be assessed. Threshold values for abnormality were determined from the literature except in the case of UGRE, which had been developed locally. Regression models were assessed using the Bland Altman method.

Results: Fifty-one men and 76 women (mean age, 60.3 ± 18.5 years) were recruited as a test set. Of these, 33 men and 34 women had LVH by echo. For voltage-only criteria, the Lewis index had the greatest sensitivity of 12%. However, when voltage criteria were adjusted to 95% specificity, the Cornell Index produced the greatest sensitivity at 19%. The best voltage duration product was that of Cornell, which gave 19% sensitivity adjusted to 95% specificity. The point scoring systems proved to be the most accurate, with the Perugia being 22% and the UGRE score being 24% sensitive both at 95% specificity. Electrocardiogram-derived LV mass was found to have a wide variation from the echo-derived LV mass and, therefore, was a poor predictor of LV mass. When the Cornell product was combined with UGRE score, sensitivity increased to 30% with a corresponding 93% specificity.

Conclusions: In general, sensitivity for LVH was low, compared with that found in other studies, but the relative value of different criteria is important. Voltage-based ECG criteria for LVH are the worst-performing, whereas scoring systems are the best, with voltage duration products intermediate. However, the combination of the University of Glasgow modified RE score and the Cornell product gave the best overall result of 30% sensitivity and 93% specificity. This is the first such study to compare the combination of scoring systems and voltage duration products for detecting ECG LVH, and it shows that the sensitivities of established criteria can be improved relatively by 25% and 58%, respectively, with little loss of specificity, when individual strategies are combined.

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Poster

ECG-15

Evaluating the efficacy of thrombolytic therapy in ST-elevation myocardial infarction by using ischemia grade on the enrollment electrocardiogram

Kamil Gülşen, Murat Ersanli, Barş Ökçün, Alev Arat, Isl Uzunhasan, Tevfik Gürmen
Institute of Cardiology, Istanbul, Turkey

Introduction: Patients with ST-elevation myocardial infarction have different prognoses compared to admission electrocardiogram. Patients with grade III ischemia on admission electrocardiogram have higher mortality and larger infarct size than patients with grade II ischemia. We compared achievement of thrombolytic therapy in these 2 groups

Methods: In this retrospective study, we enrolled a total of 46 patients with myocardial infarction, who received thrombolytic therapy. Patients were divided in 2 groups based on enrollment electrocardiogram (grade III ischemia): (1) absence of S wave below isoelectric baseline in leads that usually have a terminal S configuration or (2) ST-J point amplitude greater than 50% of the R-wave amplitude in all other leads (n = 22).To be included the grade III group, grade III criteria in more than 2 adjacent leads were required. Patients with ST elevation but without grade III criteria were classified as having grade II (n = 24). ST resolution above 50% in maximal ST-elevation lead at 90 minutes for TPA and 120 minutes for SKZ was taken as a reperfusion criteria.

Results: Reperfusion achievement by using thrombolytic therapy was less in patients with grade III ischemia (n = 22) than grade II (n = 24). In grade III group, reperfusion therapy was unsuccessful in 8 patients (36%).This was 5 in grade II group (20.8%).There were 7 patients with anterior myocardial infarction in grade III group. Reperfusion therapy was unsuccessful in 4 patients (58%) in this group. There were 8 patients with anterior myocardial infarction in grade II group. Reperfusion therapy was unsuccessful in 2 patients (25%) in this group.

Conclusions: Although thrombolytic therapy seems to be more successful in grade II group than in grade III, it did not reach statistical significance.

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Oral Presentations

ECG-16

The positive T wave

Mark Potse, Ruben Coronel, Tobias Opthof, Alain Vinet
Research Center, Sacré-Coeur hospital, Montréal, Québec, Canada
Institute of Biomedical Engineering, Université de Montréal, Montréal, Québec, Canada
Laboratory for Experimental Cardiology, Academic Medical Center, Amsterdam, Netherlands
Department of Physiology, University Medical Center, Utrecht, Netherlands

Introduction: As a measure of repolarization time (Tr), the instant of maximum slope (Tu) of the T wave in the local unipolar electrocardiogram is commonly used. Although this method has been well established both theoretically and experimentally, recent observations on positive T waves in human hearts have caused a renewed debate, involving also the theoretical basis for the use of Tu. The purpose of this study was (1) to elucidate the mechanism that leads to positive and negative T waves and (2) to investigate theoretically which electrocardiogram feature best predicts Tr.

Methods: We used a bidomain reaction-diffusion model of the human heart with anisotropic myocardium, transmural fiber rotation, and heterogeneous ion-channel properties. This model calculates both propagating action potentials (AP) and electrocardiograms. To explain positive T waves, we compared results with those of a much simpler model, which predicts T waves from local and remote AP. We simulated normal tissue, repolarization abnormalities and fibrotic tissue.

Results: Repolarization time was defined as the instant of steepest downstroke of the AP. The sign of the T wave was almost uniquely determined by Tr. Positive T waves occurred at early-repolarizing sites. In healthy tissue, the 2 models agreed on T-wave sign in 92% of sites and predicted similar T waves. This demonstrates that T-wave shape is determined primarily by the difference between the local AP and the average AP in the ventricles. Correlation between Tu and Tr was above 0.99 in both negative and positive T waves.

Conclusions: Our study predicts that (1) The sign of the T wave is primarily determined by the difference between local AP and the average AP in the ventricles; (2) positive T waves occur at early-repolarizing sites; (3) Local Tr is best estimated by Tu, also in positive T waves; and 4) scarring and fibrosis may preclude any repolarization measurement.

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