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Continuous analysis of echocardiographic movies of left ventricle during cardiac cycle by variational methods: a dedicated software for QRS-T and ECHO beat-to-beat correlations.

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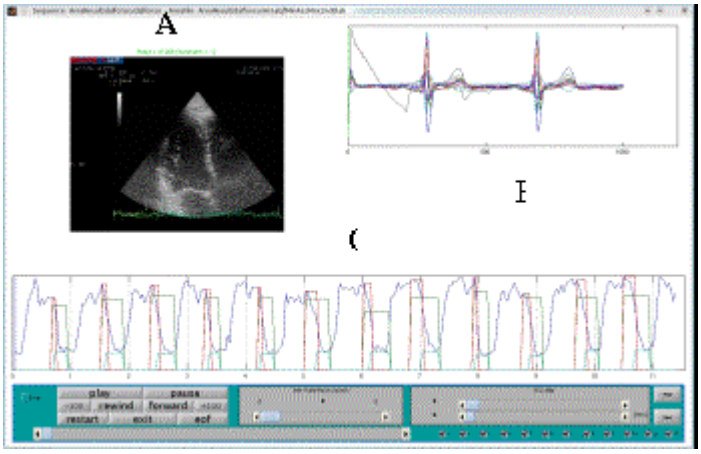
Background:QRS-T amplitude and QRS-T area are correlated with intraventricular volume, but the electrophysiolocical mechanism (Brody effect) is still unclear. QRS-T modifications have been evaluated in some clinical models, in which have been observed modifications in diastolic ventricular filling, like dialysis, arrhythmias or ECG stress test. Whereas these models supply an indirect explanation of this phenomenon (fluids' loss in dialysis, modification of diastolic time in arrhythmias and ECG stress test), only a continuous echocardiographic and ECG recording could aid to detect the connection between ventricular filling and QRS-T area modifications.

Aim: The aim of this study is to create a dedicated software able to detect if QRS-T area's modifications are sensible to haemodynamic changes during entire cardiac cycle, using echocardiographic analysis of left ventricular section area.



Methods:12-lead ECG was monitored with PC-ECG 1200 (Norav Medical Ltd), starting at the same time of the echocardiographic acquisition, performed with Esaote MyLab25 (4-chamber apical window). QRS-T area was elaborated with a dedicated software, using R Statistical Project. Left ventricular echocardiographic section area during entire cardiac cycle has been evaluated with a variational method and than has been synchronized with ECG data; finally, data have been displayed using image processing.

Results:We create a dedicated software able to detect, beat-to-beat, haemodynamic changes and electrocardiographic modifications of QRS-T. Fig.1 shows the final representation after data's analysis. Fig.1A shows a 4-chamber apical echocardiographic window; fig.1B shows a 12-lead ECG superimposed; fig.1C represents trend of section area's values of left ventricle in 12 consecutive cardiac cycles. The maximum excursion of left ventricular area evaluated with echocardiogram corresponds to telediastolic time, the minimum value of excursion corresponds to telesystolic time. These values can be correlated with QRS and T area's values. The difference of telediastolic section area and telesystolic section area, expressed in percentage, represents beat-to-beat ejection fraction.

Conclusion:This method could allow to clarify how ECG signal is influenced by the haemodynamic modifications in normal subjects and successively this program could be used in arrhythmias (atrial fibrillation or supraventricular ectopic beats) or during echo stress to verify abnormalities in left ventricular compliance induced by sudden modification in left ventricular volume.

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