On Deriving Tidal Volume from Electrocardiogram During Maximal Effort Test

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Motivation and aim: Electrocardiogram-derived respiration is a well known method for obtaining respiratory signal estimations only from electrocardiogram (ECG). It has been extensively employed for deriving respiratory rate, whereas much less results concerning tidal volume (TV) estimation have been reported in the literature. In this work, a method for estimating TV from ECG during a maximal effort treadmill test is presented. It is based on the R-S amplitude series and a calibration process of a linear model.

Materials: 23 healthy male volunteers were recruited, and they performed a maximal treadmill effort test during which multi-lead ECG, minute ventilation and respiratory rate were acquired.

Methods: First, the exercise test was automatically segmented in stages based on exercise onset and heart rate. After preprocessing and calibration, TV was estimated from each ECG lead with a first-order lineal model. Moreover, a multi-lead approach based on principal component analysis was considered.

Results and conclusion: Performance was evaluated through absolute and relative estimation error, and lowest estimation error was obtained for lead V4, varying from a median relative error of 6.87% to 17.12% along the stages, suggesting that TV can be estimated from the ECG.
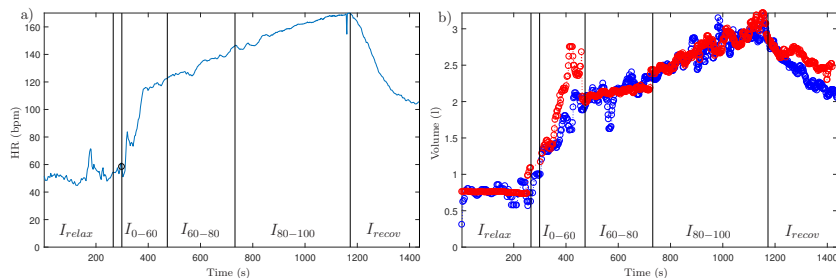
Stage segmentation based on heart rate (a) and original (blue) and estimated (red) TV (b) corresponding to the same subject are displayed.