The Clinical Value of Total Isovolumic Time

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av filosofie/medicine doktorsexamen framläggs till offentligt försvar i hörsal D, Unod T 9. Tisdagen den 10 juni, kl. 09:00. Avhandlingen kommer att försvaras på engelska.

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Abstract

The objective of this thesis is to evaluate the use of total isovolumic time (t-IVT) 1) in predicting cardiac events following CABG surgery; 2) in predicting 6-MWT in patients with LV ejection fraction (EF) <45%; 3) prognosis of patients with chronic systolic heart failure (HF); 4) its predictive value of 6-MWT in heart failure irrespective of EF; 5) its response to age in comparison with other systolic and diastolic cardiac measurements; 6) in predicting response to CRT treatment of heart failure.

Study I

Methods: 74 patients before CABG who were followed up for 18±12 months. Results: At follow-up, 29 were hospitalized for a cardiac event or died. LV-EESD was greater (P=0.003), FS lower (P<0.001), E/A ratio and Tei index higher (all P<0.001), and t-IVT longer (P<0.001) in patients with events. Low FS [0.66 (0.50-0.87), P<0.001], high E:A ratio [14.13 (1.17-14.60), P=0.028], large LV-EESD [0.19 (0.05-0.84), P=0.029], and long t-IVT [1.37 (1.02-1.84), P=0.035] predicted events.

Conclusion: Despite successful CABG prolonged t-IVT contributes to post-op cardiac events.

Study II

Methods: 77 patients with stable HF using 6-MWT. Results: E’ wave (r=0.61, P<0.001), E/e’ ratio (r=0.49, P<0.001), t-IVT (r=0.44, P<0.001), Tei index (r=0.43, P<0.001) and NYHA class (r=-0.53, P<0.001) had the highest correlation with the 6-MWT distance. In multivariate analysis, only E/e’ ratio [0.800 (0.665-0.961), P=0.017], and t-IVT [0.769 (0.619-0.955), P=0.018] independently predicted poor 6-MWT performance (<300m). Conclusion: The higher the filling pressures and the more dysynchronous the LV, the poorer is patient’s exercise capacity.

Study III

Methods: 107 systolic HF patients, 25% females. Results: Over a follow-up period of 37±18 months, t-IVT ≥12.3% sec/min, mean E/E∞ ratio ≥10, log NT-pro-BNP levels ≥2.47 pg/ml and LV EF ≤32.5% predicted clinical events. The addition of t-IVT and NT-pro-BNP to conventional clinical and echocardiographic variables improved the χ2 for prediction of outcome from (P<0.001).

Conclusions: Prolonged t-IVT adds to the prognostic stratification of patients with systolic HF.

Study IV

Methods: 147 HF patients (50.3% male). Results: The 6-MWT correlated with t-IVT (r=-0.49, P<0.001) and Tei index (r=-0.43, P<0.001) but not with any of the other parameters. Group I (<300m) had lower Hb (r=-0.02), lower EF (r=0.003), larger left atrium (r=-0.02), thicker septum (r=0.02), lower A wave (r=0.01) and lateral wall a’ (r=0.047), longer isovolumic relaxation time (r=0.003) and longer t-IVT (p=0.03), compared with Group II (>300m). Only t-IVT ratio [1.257 (1.071-1.476), P=0.005], LV EF [0.947 (0.903-0.993), P=0.02], and E/A ratio [0.553 (0.315-0.972), P=0.04] independently predicted poor 6-MWT performance. Conclusion: The limited 6-MWT is related mostly to severity of global LV dyssynchrony or raised filling pressures.

Study V

Methods: 47 healthy individuals (24 female), arbitrarily classified into: M (middle age), S (seniors), and E (elderly). Results: Age strongly correlated with t-IVT (r=0.8, P<0.001) and with Tei index (r=-0.7, P<0.001), E/A ratio (r=-0.6, P<0.001), but not with global or segmental systolic function measurements or QRS duration. The normal upper limit of the t-IVT (95% CI) for the three groups was 8.3 s/min, 10.5 s/min and 14.5 s/min, respectively, being shorter in the S compared with the E group (P<0.001). T-IVT correlated with A wave (r=0.66, P<0.001), E/A ratio (r=-0.56, P<0.001), septal e’ (r=-0.49, P=0.001) and septal a’ (r=0.4, P=0.006), but not with QRS.

Conclusions: Age is associated with LV global dyssynchrony and diastolic disturbances.

Study VI

Methods: 103 HF patients (82.5% male) recruited for CRT. Results: Prolonged t-IVT [0.878 (0.802-0.962), P=0.005], long QRS duration [0.978 (0.960-0.996), P=0.02] and high tricuspid pressure drop (TRPD) [1.047 (1.001-1.096), P=0.046] independently predicted response to CRT. A t-IVT >11.6 s/min was 67% sensitive and 62% specific (AUC 0.60, P=0.001) in predicting CRT response. Respective values for a QRS ≥151ms were 66% and 62% (AUC 0.65, P=0.01). Combining the two variables was 67% sensitive but highly specific 88% in predicting CRT response. In AF, only prolonged t-IVT ≥11 s/min [0.690 (0.509-0.937), P=0.03] independently predicted CRT response (sensitivity 60% & specificity 79% (AUC 0.78, P=0.015). Conclusion: Combining prolonged t-IVT and broad QRS had higher specificity in predicting response to CRT, particularly in AF patients.

Keywords

Heart failure, cardiac resynchronization therapy, predictors, echocardiography, total isovolumic time, six-minute walk test, left ventricular dyssynchrony

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