

Gyrocardiography: A Preliminary Investigation of Cardiac Timings

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Aim- Gyrocardiography (GCG) is a non-invasive method for measuring the angular velocity of the chest caused by heart motion. In this study, we assessed the reliability and accuracy of GCG as a technology for measuring the cardiac timing intervals.

Database- We recruited 50 adults and recorded GCG signals using a 3-axial MEMS gyroscope sensor and two-lead ECG signals. For each subject, the Tissue Doppler Imaging (TDI) modality was performed to record the apical views of at least 5 cardiac cycles.

Method- On TDI images, aortic valve opening (AO_{tdi}) and aortic valve closure (AC_{tdi}) were labelled and pre-ejection period (PEP_{tdi}) and systolic time (ST_{tdi}) were measured as the time interval from ECG Q to AO_{tdi} and AC_{tdi} , respectively. For the GCG x-axis waveform, two fiducial points, labelled as gx1 and gx2, were suggested. Based on the prior knowledge of the recent studies, we hypothesized that these points would coincide with the AO and AC, respectively. The same procedure was applied to GCG y-axis. The GCG z-axis waveform appeared very noisy and consequently was excluded from further analysis. Later, the time intervals were estimated from GCG with respect to ECG Q-wave. To assess the agreement between the reference TDI and the estimated time intervals from GCG, the bias, 95% LOA and reproducibility coefficient (RPC) were calculated.

Result- In compare to GCG x-axis, the GCG y-axis time intervals had smaller bias and PRC towards TDI measurements, which shows GCG y-axis estimates provide the better approximations for cardiac time intervals (Table 1). However, the findings of this study do not confirm that the fiducial points suggested for GCG could provide the accurate estimates for cardiac timing intervals.

Table 1. The comparison of GCG and TDI time intervals

TDI Measurements	GCG Estimates	Bias (ms)	RPC (ms)
PEP_{tdi}	Q-gx1	6.5	23.3
	Q-gy1	-9.7	18.2
ST_{tdi}	Q-gx2	3.9	19.8
	Q-gy2	6.5	19.2