Purpose: The purpose of this study was to compare computer versus manual spatial QRS-T angle calculations in 12-lead ECGs.
Methods: 12-Lead ECGs with narrow QRS complexes (<120 milliseconds) were selected from an existing database. All ECGs were printed on standard computer paper, and the QRS-T angle was manually calculated using the QRS/T_{simple} formula. Manual measurements were made by a reviewer blinded to the computer scores and to all clinical data. The computer-generated calculations were obtained using automated measurements from SuperECG software (Mortara, Milwaukee WI). Mean QRS-T angle values were compared using paired *t* tests, and Pearson coefficient was used to test the correlation.
Results: The spatial QRS-T angle was calculated from 16 ECGs (n = 16). On average, the computer-generated QRS-T angle was greater than the manual values (104 ± 17 versus 101 ± 27, P = .000). The range for the computer values was smaller than for the manual values, 78 to 132 versus 54 to 168 degrees, respectively. A moderate correlation was observed between the manual and computer measurements (r = 0.70, P < .003).
Conclusions: Although computer measurements of the spatial QRS-T angle are on average only 3 degrees greater than manual measurements, the correlation between the 2 measures was not strong. Thus, computer and manual calculations of the spatial QRS-T angle should not be interchanged in research.

doi:10.1016/j.jelectrocard.2009.08.012

The use of impedance cardiography in automatic external defibrillators to discriminate between shockable and nonshockable ventricular tachycardia in real time

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Introduction: In most currently available automatic external defibrillator (AEDs), real-time processing restraints have always remained a challenge in the development of more intelligent algorithms. Because FFT analysis is not an easily applied technique in real time, an alternative technique had to be developed. The estimation of the main frequency component of the impedance cardiography (ICG) signal by the use of integer bandpass filters, and the analysis of the electrocardiogram (ECG) signal was proposed to produce an algorithm to discriminate between shockable and nonshockable high-rate (>180 beats/min) ventricular tachycardia (HRVT).
Methodology: The frequency spectra of more than 100 ICG traces were analyzed over a range of between 1.5 and 4.5 Hz. The maximum magnitude was recorded, and the ratio of this magnitude to the magnitude of the input ICG signal was used in the algorithm to detect cardiac output. For cases of broad complex HRVT, the maximum magnitude was taken over a narrower range of between 2.5 and 3.5 Hz. The Royal Victoria Hospital database was annotated by 3 independent cardiologists. The diagnostic algorithm was then verified against the AHA, MIT-NST database, and randomly selected cases from the Royal Victoria Hospital's internal database of more than 250 cases. The algorithm was developed in C, in such a way that it could be compiled as either embedded code, as part of an AED system, or as a dynamic link library for offline analysis. The sensitivity and specificity were calculated on a block by block basis, where a block is defined as 170 samples (1 second) of input data.
Results: The table shows that the specificity is improved for HRVT cases when the ICG algorithm is invoked during AED analysis.

Table 1
The sensitivity and specificity for the algorithm for all arrhythmias

	ECG-only algorithm	ECG + ICG
Sensitivity	97.84	97.84
Specificity	99.83	99.93

Table 2
Comparison of the ECG algorithm with the ECG and ICG algorithm for HRVT

		ECG only detects		ECG + ICG detects	
Total cases of HRVT	23				
Total of shockable HRVT blocks	80	80	Sensitivity: 100%	80	Sensitivity: 100%
Total of nonshockable HRVT blocks	219	0	Specificity: 0%	188	Specificity: 85.84%
Total HRVT blocks	299				

Conclusion and future work: The AED algorithm's specificity increased from 0% to 85.84% when cases of HRVT were analyzed using both ECG and ICG. The overall specificity of the device increased to 99.93% without compromising the sensitivity. The incorporation of ICG in discriminating between shockable and nonshockable HRVT has been shown to be beneficial in improving diagnostic algorithm accuracy.

doi:10.1016/j.jelectrocard.2009.08.013

The effect of electrode misplacement in the reconstruction of the 12-lead electrocardiogram from EASI leads

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Introduction: The EASI leads use 5 recordings sites to record 3 bipolar leads. In this study, we assess the effect that misplacement of these recording sites has on reconstruction of the 12-lead electrocardiogram (ECG). We focus on lateral recording sites I and A.
Method: We simulated the effects of electrode misplacement using 117-lead body-surface potential maps recorded from 559 subjects (approximately one third normal, one third myocardial infarction, and one third left ventricular hypertrophy). This data set was interpolated to increase the number of lateral recording sites in the vicinity of I and A. For the vertical misplacement we simulated moving recording sites I and A simultaneously, in 0.5-cm increments, +5 cm (superiorly) and −5 cm (inferiorly) away from the standard locations. We repeated this experiment for the horizontal misplacement this time simultaneously moving +5 cm (anteriorly) and −5 cm (posteriorly) from the standard locations. At each increment, we reconstructed the 12-lead ECG and compared this to the actual 12-lead ECG also obtained from the body-surface potential maps. Root mean square error was used to compare QRS complexes and ST-T segments of actual and reconstructed 12-lead ECGs.
Result: It can be seen that reconstruction error is at its greatest when recording sites I and A are furthest from the standard locations. The maximum reconstruction error is observed when I and A are simultaneously shifted 5 cm anteriorly. When reconstruction accuracy was considered for individual leads, it was found that the error did not always increase as the displacement from the standard locations increased. For example, lead I was more accurately reconstructed when sites I and A were located +5 cm (superiorly) from their origin.
Discussion: This study has illustrated that the misplacement of recording sites in the EASI lead system impacts on the accuracy of the reconstructed 12-lead. Further work is required to evaluate the effects of lead misplacement in other limited lead systems.

Table 1
Subset of results

Misplacement (cm)	Horizontal		Vertical	
	QRS	ST-T	QRS	ST-T
+5	164.8 (150.4-209.9)	49.2 (42.1-67.3)	163.7 (126.3-260.8)	47.5 (34.4-67.9)
+2.5	138.4 (122.7-207.2)	39.5 (33.6-61.2)	150.2 (109.9-243.3)	43.9 (31.3-65.5)
0	135.3	39.1	135.3	39.1