

# Impact of Increased Heart Rate Alone and Heart Rate Plus Contractility Upon Intraventricular ECG Morphology

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Morphologic methods proposed for detection of ventricular tachycardia commonly use a template of averaged intraventricular ECGs acquired during sinus rhythm for comparison with ventricular tachycardia. Whether increased heart rate with and without an accompanying increase in contractility affects the stability of the intraventricular electrogram during sinus rhythm is unknown, however. We examined the intraventricular ECGs from two groups of patients undergoing electrophysiology studies before and during doses of an  $\alpha$ - and  $\beta$ -agonist, epinephrine (group A, 13 patients, 50 ng/kg/min) and of a pure  $\beta$ -agonist, isoproterenol (group B, 11 patients, 2  $\mu$ g/min), and from four groups of patients being treated with atrial pacing at different rates (group C, 8 patients, 600 ms; group D, 7 patients, 500 ms; group E, 8 patients, 450 ms; group F, 8 patients, 400 ms). Sinus cycle length decreased from  $776 \pm 134$  ms to  $684 \pm 146$  ms in group A; from  $733 \pm 117$  to  $519 \pm 54$  ms in group B; from  $796 \pm 90$  ms to  $603 \pm 2$  ms in group C; from  $756 \pm 129$  ms to  $502 \pm 2$  ms in group D; from  $720 \pm 136$  ms to  $452 \pm 1$  ms in group E; and from  $714 \pm 153$  ms to  $402 \pm 2$  ms in group F. Correlation waveform analysis was performed on ventricular ECGs recorded from bipolar RV apex electrodes (1 cm, 1–500 Hz) using a best fit method of alignment of depolarization. When compared to a control passage

of sinus rhythm before drug administration, the mean correlation coefficient decreased by 0.0% to 2.1% in 12 of 13 patients and 9.4% in 1 patient during epinephrine administration. It decreased by 0.0–1.4% in 9 of 11 patients during isoproterenol therapy and by 20.2% and 21.6% in the 2 other patients. When compared to a sinus rhythm control passage before atrial pacing intervention, the mean correlation coefficient decreased by 0.0% to 2.3% in 8 of 8 patients with a pacing rate of 600 ms; by  $-0.2\%$  to 1.4% in 7 of 7 patients paced at a rate of 500 ms; by 0.0% to 2.0% in all 8 patients with a pacing rate of 450 ms; and by 0.5% to 2.3% in the 8 patients being paced at a rate of 400 ms.

## Conclusions

During sinus rhythm, intraventricular ECG morphology appears to remain stable in the presence of epinephrine and isoproterenol in most patients. However, the template representing sinus rhythm may require updating in some patients due to changes in sympathetic tone. During pacing intervention, our results indicate that the morphology of the intraventricular ECG remains unchanged.

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Supported in part by NSF Grant BCS-8909042 and by Cardiac Pacemakers, Inc.

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