

Spatial Dispersion of Activation and Repolarization Times Associated with Different Cardiac Pacing Modes

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Background: Various ventricular pacing modes are currently applied in patients with an indication for permanent pacing. Pacing strategies intended to preserve the physiological electrical activation sequence have gained interest, including selective His-bundle pacing (sHBP) and selective and nonselective left bundle branch pacing (sLBBP and nsLBBP). Other strategies include ventricular septal pacing (LVSP) and right ventricular septal and apical pacing (RVSP and RVAP). This study aimed to compare spatial differences in ventricular depolarization and repolarization times for a range of pacing modes.

Materials and Methods: 535 ultra high-frequency electrocardiograms (UHF-ECGs) from patients with an indication for pacemaker implantation were analyzed. Activation (AT) and repolarization times (RT) were calculated for each precordial lead and grouped according to the ventricular region (Region 1, R1: V1-V2; Region 2, R2: leads V3-V4; Region 3, R3: V5-V6). AT (RT, respectively) corresponded to the time point with the steepest negative (positive) slope within the QRS complex (T wave). For each R1, R2 and R3 regions, AT and RT were taken by their mean value in the two evaluated leads. For analysis, AT and RT in R1 or R3 were calculated with respect to R2, which was taken as the reference time.

Pacing	R1-R2		R3-R2	
	Δ_{AT} (ms)	Δ_{RT} (ms)	Δ_{AT} (ms)	Δ_{RT} (ms)
sHBP	0.29	-1.66	2.80	11.42
RVSP	-9.00	-32.29	20.47	6.38
LVSP	7.50	-10.88	-9.53	-34.28
nsLBBP	15.11	5.54	-14.18	-41.99
sLBBP	22.51	32.07	-7.92	-38.56
RVAP	37.11	19.89	3.20	-20.30

Table 1 - Differences in AT and RT with respect to spontaneous rhythm.

Results: Differences in AT and RT dispersion (i.e. R1-R2 and R3-R2) with respect to spontaneous rhythm (Table 1) achieved the lowest values for sHBP (0.29 and -1.66 ms for R1-R2; 2.80 and 11.42 ms for R3-R2). The highest differences in AT dispersion were found for RVAP (37.11 ms in R1-R2) and in RT dispersion for nsLBBP and sLBBP (-41.99 and -38.56 ms in R3-R2).

Conclusion: sHBP presents activation and repolarization patterns more similar to spontaneous rhythm than other pacing modes.