Autonomic Nervous System Effects on the Atrioventricular Conduction Time - Heart Period Relationship During Physical Exercise and Passive Recovery

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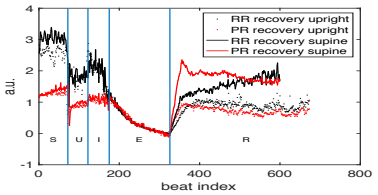
During physical exercise and the following passive recovery, for a given heart period (i.e. RR interval), the atrioventricular conduction time (i.e. PR interval) is known to be lengthened during recovery (i.e. hysteresis phenomenon). Evidence from human and animal experiments indicate that this hysteresis might be linked to a different influence of the autonomic nervous system (ANS) on the sinus and atrioventricular nodes. We thus aimed to modulate the ANS input to the heart during recovery and examine its influence on the PR-RR hysteresis.

12 healthy participants (6 males, 6 females) performed, on separate days, two identical ramp exercise tests on a cycle ergometer to exhaustion (223$\pm$62W). Following exercise, participants remained either in an upright (standing or seated on the bike) or supine position for 30 min. A 12-lead ECG was monitored and P-R intervals were calculated from the ECG lead showing the highest P wave amplitude. An ad-hoc PR estimator was used to limit potential P wave detection error during intense exercise resulting from an overlapping T wave. Raw PR and RR values from the start to the end of exercise were normalized to the [1-0] interval. The PR-RR hysteresis was calculated as the area between the PR and RR intervals during the recovery phase. A PR-RR hysteresis was observed in all participants which was $>$5 times more pronounced ($P<0.05$) in the supine (54$\pm$45) vs. the upright position (10$\pm$7). Our results thus showed that during recovery, the atrioventricular conduction time returned to a faster rate than the heart period toward resting values. This effect was greater in the supine position, when the vagal input to the heart is enhanced. Therefore, PR-RR hysteresis might be explained, at least in part, by a greater vagal input at the atrioventricular compared to the sinus node during recovery.



Normalized PR and RR traces. (S) supine, (U) upright, (I) seated, (E) effort, (R) recovery.