Evaluation of the Changes in RR and QT Circadian Rhythms in Bedridden Subjects

Sarah Solbiati, Alessia Paglialonga, Lorenzo Costantini, Enrico G Caiani

National Research Council of Italy (CNR), Institute of Electronics, Computer and Telecommunication Engineering (IEIIT), Milan, Italy

Aim
Prolonged bed rest (BR), related to hospitalization, induces reduced functional capacity in multiple body systems and rhythms dysregulation, possibly leading to cardiovascular deconditioning and increased arrhythmogenic risk. We aimed at assessing the changes in circadian rhythms in RR and QT duration along a 10-day BR, to describe the phenomenon in a controlled environment.

Methods
Ten healthy volunteers (23±5 years) were enrolled at Hospital of Izola (Slovenia), after ethical approval and signed consent, to participate in 10-day strict horizontal BR, preceded and followed by 2 days in the facility. 12-leads 24-hours Holter ECG was acquired 1 day before BR (BDC-1), the 3rd (BR3), 5th (BR5) and 10th day (BR10) of BR, one (R+1) and two (R+2) days after BR. Beat-to-beat RR and QTend series were extracted, and circadian rhythms were evaluated by Cosinor analysis as MESOR (24h midline), oscillation amplitude (OA, half variation within a night-day cycle), acrophase (φ, time of maximum amplitude). Also, the QTc (Bazett correction) was computed. Statistical analysis was applied to test each epoch versus BDC-1, and to compare two successive epochs (Wilcoxon Test, $p<0.05$).

Results
Prolonged BR elicited cardiac circadian rhythm modifications. The MESOR of RR and QTend increased (respectively up to +12.8% and +4%), while the QTc midline decreased (-4.8%), φ was anticipated , and the OA flattened (RR: -12.3%; QTend: -38.2%), thus decreasing system's capacity of adaptation when, at R+1, BR was terminated, thus causing an abrupt increase in OA for RR (+56.2%) and QTend (+44.1%), and decreased RR and QTend MESOR (respectively up to -11.3% and -4.5%).

Conclusions
Our results proved that a 10-day BR induced changes in RR and QT circadian rhythms, in terms of midline value, oscillation amplitude and acrophase. Strategies or countermeasures aiming at the maintenance of circadianity in RR and QT should be applied also in clinical scenarios.