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Clinical application of fluctuation dissipation theory - Prediction of heart rate response to spontaneous breathing trial LIANG R. NIESTEMSKI, MAN CHEN, Physics & Astronomy, Rice University, Houston, TX, ROBERT PREVOST, MICHAEL MCRAE, Bioengineering, Rice University, Houston, TX, SHARATH CHOLLETI, GABRIEL NAJARRO, TIMOTHY G. BUCHMAN, Emory University, Atlanta, GA, MICHAEL W. DEEM, Physics & Astronomy, Bioengineering, Rice University, Houston, TX — Contrary to the traditional view of the healthy physiological state as being a single static state, variation in physiologic variables has more recently been suggested to be a key component of the healthy state. Indeed, aging and disease are characterized by a loss of such variability. We apply the conceptual framework of fluctuation-dissipation theory (FDT) to predict the response to a common clinical intervention from historical fluctuations in physiologic time series data. The non-equilibrium FDT relates the response of a system to a perturbation to natural fluctuations in the stationary state of the system. We seek to understand with the FDT a common clinical perturbation, the spontaneous breathing trial (SBT), in which mechanical ventilation is briefly suspended while the patient breathes freely for a period of time. As a stress upon the heart of the patient, the SBT can be characterized as a perturbation of heart rate dynamics. A non-equilibrium, but steady-state FDT allows us to predict the heart rate recovery after the SBT stress. We show that the responses of groups of similar patients to the spontaneous breathing trial can be predicted by this approach. This mathematical framework may serve as part of the basis for personalized critical care.

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