A bivariate electrocardiogram (ECG)/arterial blood pressure processing procedure is described which aims at extracting a few parameters from the relevant variability series directly quantifying the complex relationship inside the neural controlling system relative to the two signals. Variability signals are detected from patients in resting conditions and during a treadmill stress test with various levels of stress, as well as before and after tilt stimulation. The power spectral density of the variability series is then carried out (autospectra, cross-spectra and coherence) through autoregressive techniques. Besides the usual spectral and cross-spectral analyses, two other parameters, LH and alpha, are obtained, which are functions of the powers associated with the low frequency peak (congruent 0.1 Hz) and the high frequency peak (0.25-0.35 Hz) calculated in the tachogram (heart rate variability signal derived from ECG), and the systolic discrete series values. The proposed parameters seem to be relevant to the beat-to-beat balance of sympathetic and vagal mechanisms in various pathophysiological conditions.
Heart rate variability at frequencies slower than respiration in humans appear to occur in synchrony with arterial pressure Mayer waves, at frequencies as low as 0.03 Hz and up to 0.15 Hz, but generally close to 0.10 Hz, corresponding to a 10 s rhythm. Mayer waves result from an oscillation of sympathetic vasomotor tone [34, 35, 36]. Pagani M, et al. Power spectral analysis of heart rate and arterial pressure variabilities as a marker of sympatho-vagal interaction in man and conscious dog. Circ Res. 1986;59:178–93.CrossRefPubMedGoogle Scholar. In Nonlinear Biomedical Signal Processing. In: AKAY M, ed. New York: IEEE Press; 2000. p. 159–213.Google Scholar. Chapter 4. Spectral analysis of fetal heart rate variability for fetal surveillance: review of the literature. (Acta Obstet Gynecol Scand 2008;87:300-306). Chapter 5. Heart rate variability: standards of measurement, physiological interpretation and clinical use. Circulation 1996;93:1043-1065. 41. Akselrod S, Gordon D, Ubel FA, Shannon DC, Berger AC, Cohen RJ. Power spectrum analysis of heart rate fluctuation: a quantitative probe of beat-to-beat cardiovascular control. The increased cardiac output raises arterial blood pressure. This rise in blood pressure in turn reduces heart rate through the baroreceptor reflex3. Central factors are also responsible for respiratory cardiac arrhythmia. The respiratory centre in the medulla also directly influences the cardiac autonomic centres3. Arterial blood pressure waveform data was collected from conscious mice instrumented with radiotelemetry devices over 24 hours, at a 100Hz and 1kHz time base. During a 24 hour period, these mice display diurnal variation leading to changes in the cardiovascular waveform. [52] performed a quantitative study of coupling patterns between respiration and spontaneous rhythms of heart rate and blood pressure variability signals by using Recurrence Quantification Analysis. There have been previous attempts to explain heart rate variability in terms of both respiration and nervous stimulation. We assume that the mouse blood pressure time series data is representative of an underlying chaotic system.