Assessment of Latency in Baroreflex Control of Heart Rate during Spontaneous Behavior

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Abstract

This study proposes a new simplified approach for estimating the latency in the baroreflex control of heart rate by the analysis of systolic blood pressure (SBP) and RR interval (RRI) spontaneous variability.

Application of this technique on SBP and RRI 24-h recordings, allowed us to identify a large fluctuation of the baroreflex latency over time with a circadian pattern characterised by a reduction of the latency at night.

Since our approach provides a quantification of the latency in terms of heart beats, there was the possibility that the results would be influenced by the RRI. The observed absence of any significant correlation between latency and RRI excluded this adverse possibility.

These results encourage the use of the proposed procedure for obtaining a simple and noninvasive measure of the baroreflex latency in daily life condition.

1. Introduction

Baroreflex guarantees blood pressure homeostasis by a proper control of several cardiovascular variables, including heart rate. The assessment of the latency in this reflex control of the heart during spontaneous behavior would allow us to deepen our understanding of the baroreflex function in health and disease. Unfortunately, most of the procedures currently available for estimating such a latency are based on complex experimental protocols that can be implemented only in specialized laboratories and that require the subject to be in a steady-state condition during the assessment [1,2].

In this study we propose a new simplified approach for estimating the latency in the baroreflex control of heart rate by the analysis of systolic blood pressure (SBP) and RR interval (RRI) spontaneous variability.

2. Methods

Our approach is derived from an enhancement of the sequence technique, a procedure we proposed several years ago and now commonly used for evaluating the sensitivity of spontaneous baroreflex (BRS) control of the heart [3,4]. In short the new procedure scans any given beat-to-beat SBP and RRI recording - that can be performed while the subject is spontaneously behaving- and estimates the latency by measuring the lag, expressed in number of beats, between the onset of specific spontaneous SBP ramps (i.e. runs of three or more consecutive beats in which SBP progressively increases or progressively decreases) and the onset of a similar reflex pattern in RRI (see Fig.1).

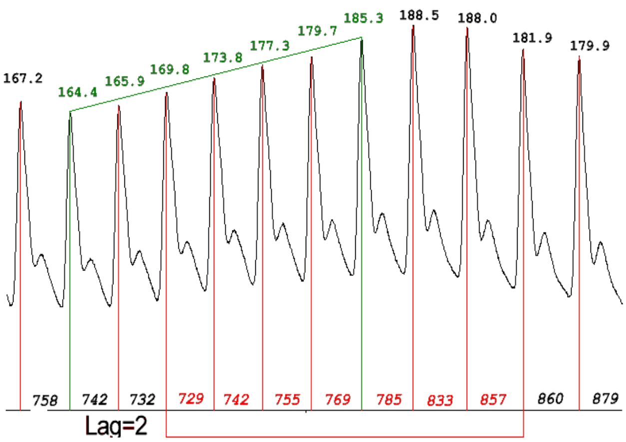

Figure 1. A segment of blood pressure signal including a sequence formed by SBP and RRI ramps with lag 2. SBP values are shown on the top of the figure and RRI values at the bottom.

About 60-80 of these events can usually be observed in each hour, thus allowing this approach to provide us with a detailed profile of the latency over time [5]. We used this technique to evaluate latency in 8 hypertensive subjects in which SBP and RRI have been noninvasively recorded for 24h by a Portapres device.

3. Results

Our analysis indicated that during spontaneous behavior the latency of the baroreflex control of heart rate is not constant but rather largely fluctuates over time scales of minutes. When longer time scales are considered, the latency tends to be modulated over the 24h with a circadian pattern (see a typical profile in Fig.2), and is characterized by hourly-averaged values that ranged from about 0.9 beats during the day to about 0.7 beat at night.

We also observed that such a modulation of the latency was not correlated with RRI values (r2 < 0.28), thus excluding the possibility that the observed changes in the lag, expressed in beats, could actually merely reflect changes in the beat duration (see Fig.3 and 4).

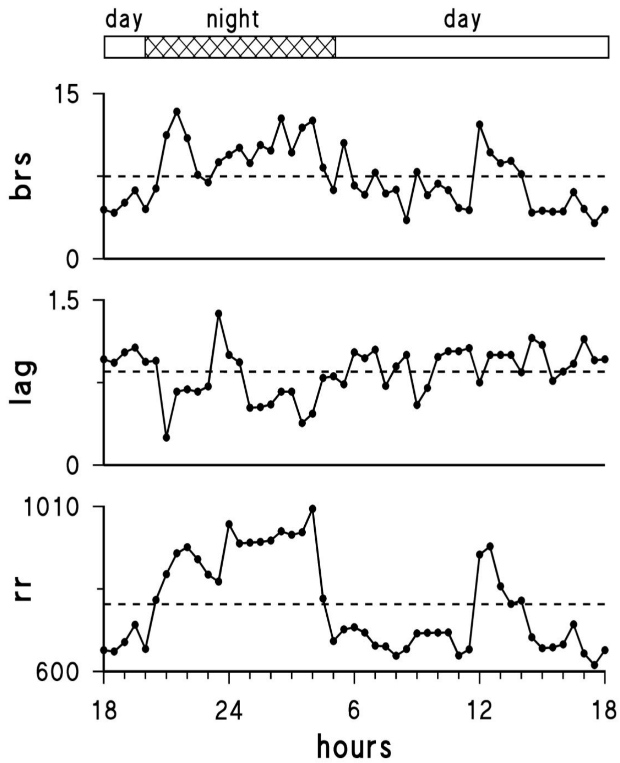

Figure 2. Hourly profile of the baroreflex latency (lag) as compared with BRS and RRI in a typical hypertensive subject.

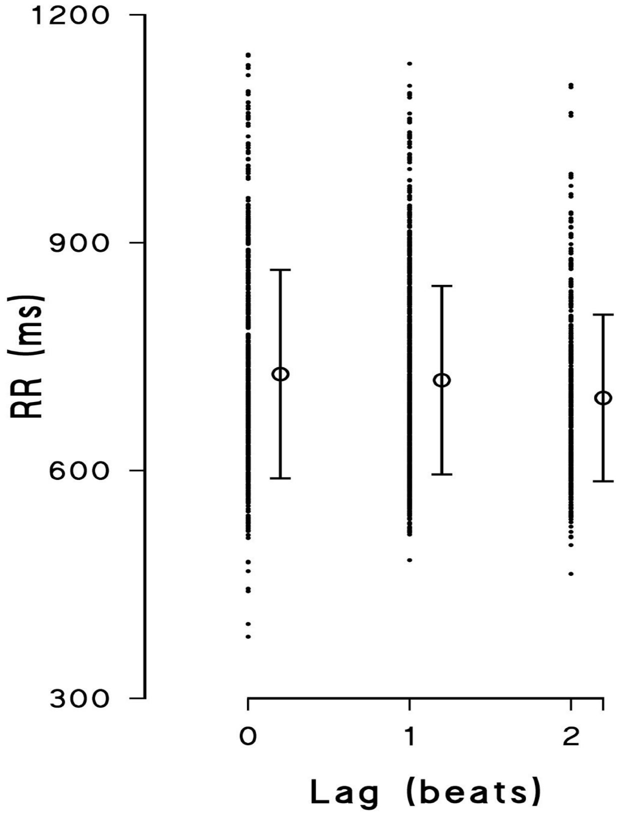

Figure 3. Relation between baroreflex lag and the initial RRI value estimated from the spontaneous sequences observed in a subject over the 24h. The empty circles and the vertical bars represents the mean ±sd of the RRI observed at any given lag.

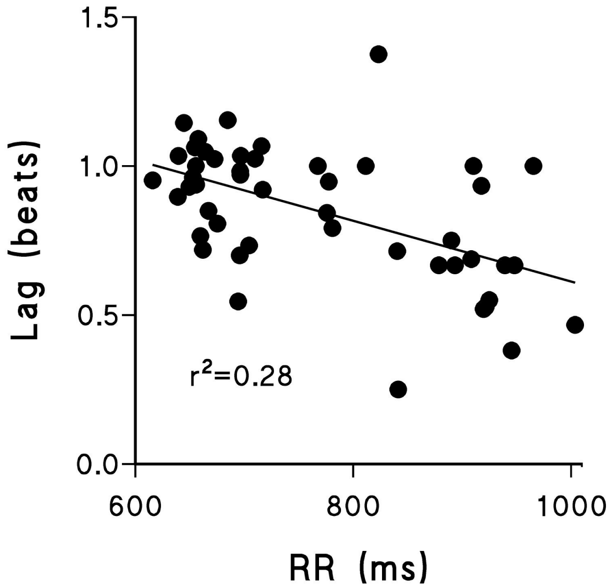

Figure 4. Relation between 30-min averaged lag and initial RRI values observed over the 24h in a typical hypertensive subject

4. Conclusions

This study proposed and tested the applicability of a new technique for the non invasive assessment of baroreflex latency. Application of the technique on 24h recordings showed a clear modulation of the baroreflex latency during spontaneous behaviour.

From the methodological perspective this study encourage the use of the proposed technique for obtaining a simple and noninvasive measure of the baroreflex latency in daily life condition.

References

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