Reviewer’s report

Title: Finger volume pulse waveforms facilitate reliable assessment of heart rate variability, but not blood pressure variability or baroreflex function

Version: 2
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Reviewer: Michael La Fountaine

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The current report sought to determine the reliability of several measures of cardiovascular autonomic control with 2 commercially available devices (i.e., Finapres and EndoPAT) from beat-to-beat quantification of finger arterial pressure. As the manuscript is currently constructed, there are numerous pieces of essential technical information that are missing, which make it difficult to properly evaluate the data.

Background

• The review of literature is incomplete and does not provide the reader with an appropriate accounting of the prevailing knowledge for the reliability of HRV and BPV parameters. Some of the references for the respective components (Akselrod, etc.) were formative studies that identified the presence of oscillations in heart rate, that when analyzed in different ways, yielded an objective reflection of autonomic control (Note: Pagani 1986, one of the gold standard papers for spectral analysis was omitted). The authors use the term “reliably” when describing the methods that “quantify” time or frequency domain parameters, but the references used do not report or support reliability of the outcomes. There are several empirical reports and a few review articles on the topic of test-retest reliability for HRV (for a well-articulated review on the topic see Sandercrock G, 2004; Int J Cardiol). Current dogma for HRV reliability states that time domain parameters from both short (< 10 minutes) and long (30 minutes to 24 hours) term recordings have high intra- and inter-visit reproducibility across numerous clinical and able-bodied cohorts. Linear measurements of HRV (i.e., HF, LF, VLF) have poor to moderate levels of reproducibility within and between visits; VLF and ULF measures are not commonly reported unless the data signal is obtained from a continuous holter monitor recording of up to 1 day (as an aside, the reviewer cannot recall a reference where VLF oscillations from HR alone represent baroreflex function. Please confirm your source; Line 101). More recent advances in non-linear assessments (i.e., entropy, complexity, fractal scaling dimensions, etc) have bridged the gap, and routinely demonstrate very good reproducibility, but they are difficult to interpret. HRV is emerging as one of the most widely used and abused outcomes in health. A snapshot data collection is often used and interpreted to reflect a state of psychophysiological health. While inter-group comparisons frequently yield statistical differences, individual subject outcomes may lie well within the standard deviation of the other group. Because of this, there exists no threshold values for which normal/abnormal can be defined. Thus, a relative increase or decrease in HRV is often reported
(compared to the control or ideal group). HRV reliability is confounded by the psychophysiological state, respiration rate and depth, and numerous other reasons. Thus, the technical aspects of the data collection and processing must be iron-clad. On the other hand, BPV is less well described and is extremely difficult to obtain. The dearth of empirical evidence for BPV is not an accident.

Methods

• Lines 138-9: the customary period to abstain from food, caffeine and tobacco is a minimum of 6 hours. In addition, please verify if subjects abstained from exercise for a period of at least 24 hours. Vigorous exercise may confound HRV parameters, too.

• Line 148 and 151: simultaneous recordings of each device were performed with the finapres cuff on the middle and EndoPAT on the index finger. This is a potentially problematic design because pulses may differ slightly from digit to digit.

• Line 149: finapres data were collected at 200 Hz, but there is no mention of the sampling frequency of the EndoPAT. The Task force recommends that autonomic collections be performed within a 250-500 Hz sampling range. It is almost universal that data are sampled at 500 Hz, while many investigators opt for 1000 Hz. It is easy to downsampling your data after collection, but upsampling is not possible. Please provide clarification on the EndoPAT sampling rate and why finapres sampling was below the recommended data collection standards. It may be possible that there is little or no agreement in the data between the devices because they were sampling data at different frequencies. This may seem like parting hairs, but if each device is doing this, then you are effectively biasing your results toward an unfavorable outcome because you are not comparing apples to apples.

Points requiring technical clarification

• Were data signals lined up during analysis so that each device was recording the same pulse at the same time?

• There was not a continuous, digital EKG obtained during this investigation. HRV was derived from the beat-to-beat blood pressure signal. It is not customary to use an indirect measure of a primary outcome in the determination of reliability. Why did the authors elect to not obtain an EKG for HRV? Also, if the signals were not lined up, collected at the same sampling rate, and used different processing filters, there will be dramatic differences that emerge. Also, if HR is exclusively defined by the BP device on 2 different fingers, then the pulse arrival time may differ between devices/fingers. When dealing in milliseconds, every potential source of delay adds up.

• What filters were used on the data, if any.

• If data were collected for 30 minutes, why was only 5 minutes of data used for time domain paramaters, and 30 minutes for frequency domain? There is inconsistency, which makes it difficult to figure out what was done and why. The confusion I have as a reader makes the results not at all surprising, which could prove detrimental if the EndoPAT is truly a useful device at satisfying the
intended aims.

- Although providing the link to the analysis program used in the study, every manuscript must provide sufficient detail so that it functions as a stand-alone entity. The reader should not have to go to a source to obtain primary information on how measurements were calculated.

- Baroreceptor heart rate reflex sensitivity was calculated using the arterial waveforms. Similar to my previous comment, it is not common practice to calculate baroreceptor sensitivity from one device alone. A majority of the respected literature on baroreflex sensitivity use signals from 2 devices (i.e., EKG and finapres or equivalent). Please clarify.

**Level of interest:** An article of limited interest

**Quality of written English:** Acceptable

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

No conflicts of interest.