

## CROSSTALK

**Last Word from Mark Boyett and Alicia D'Souza****Mark Boyett and Alicia D'Souza***Division of Cardiovascular Sciences, University of Manchester, 46 Grafton Street, Manchester M13 9NT, UK*

The CrossTalk debate (Boyett *et al.* 2019; Malik *et al.* 2019) prompted a vigorous reaction and 17 responses, 16 of which, dauntingly, oppose our view to a varying extent. Some authors (Cerutti & Sassi; Kligenheben; Tharion: see the accompanying CrossTalk Comments) simply vigorously defend the use of heart rate variability (HRV) to measure autonomic tone. Some authors (Barbic *et al.*; Peçanha *et al.*; Prakash; Shinba) give examples when a change in HRV can be separated from a change in heart rate. We agree that this demonstrates an independent factor acting on HRV, but most authors do not take such care to separate a change in HRV from a change in heart rate. This is what we are advocating needs to be done in all cases. Several authors in the Comments (Barbic *et al.*; Karemaker) give evidence linking HRV to the autonomic nervous system (ANS). We do not dispute that HRV could be linked to the ANS. However, we have argued that, if such evidence comes from blocking autonomic nerve activity to the heart, any change in HRV has to be demonstrated not to be the result of any concurrent change

in heart rate. Furthermore, the effect of the ANS (if it is involved) on HRV will still be highly dependent on heart rate. Zaza (see Comments) states that if HRV spectral measures are normalised (ratio of LF/HF, LF/total or HF/total power), they are expected to be heart rate independent and may, therefore, be sound 'autonomic indices', and this is echoed by others (Kligenheben; Porta & Baumert; Silva *et al.*). We agree this is possible, but it remains to be proven. However, several authors (Julien; Valenti & Garner) remind the reader that the origin of the LF and HF components of power and the meaning of the LF/HF ratio in terms of the autonomic nervous system is disputed. This of course then questions Zaza's assertion that LF/HF, LF/total or HF/total power may be sound 'autonomic indices'. Moorman and Lake appear to be saying (see Comments) that, regardless of what HRV is, it saves the lives of babies with a risk of sepsis and of course, if true, we cannot argue with this. Finally, only Valenti & Garner criticise HRV and advocate more direct measures of autonomic nerve activity to the heart such as electroneuromyography. We are throwing down the gauntlet to people working on HRV and saying that definitive proof needs to be provided about any relationship between HRV and the ANS. Karemaker states that we are like a blindfolded person describing an elephant. This is true, but this is true in the case of all science.

**References**

- Boyett M, Wang Y & D'Souza A (2019). CrossTalk opposing view: Heart rate variability as a measure of cardiac autonomic responsiveness is fundamentally flawed. *J Physiol* **597**, 2599–2601.
- Malik M, Hnatkova K, Huikuri HV, Lombardi F, Schmidt G & Zabel M (2019). CrossTalk proposal: Heart rate variability is a valid measure of cardiac autonomic responsiveness. *J Physiol* **597**, 2595–2598.

**Additional information****Competing interests**

None declared.

**Author contributions**

All authors contributed to the conception and design of the work, acquisition and interpretation of data for the work and drafting the work and revising it critically for important intellectual content. All authors have approved the final version of the manuscript and agree to be accountable for all aspects of the work. All persons designated as authors qualify for authorship, and all those who qualify for authorship are listed.

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