

Heart Rate Variability and Brain Death

To the Editor:

We read with interest the article by Rapenne, et al, noting their methodology for obtaining a noninvasive determination of brainstem death based upon a time and frequency domain analysis of heart rate variability.¹ This study corroborates and complements a number of previous studies, including ours.²⁻⁵ Our data, based upon a population of severely head injured children (GCS ≤ 8), suggested an association between the LF/HF ratio and functional outcome. Patients who progressed to brain death had a markedly lower LF/HF ratio throughout the first seventy two hours of their hospital course and had a significant decrease after the first four hours of hospitalization. Patients in the other GOS groups had significantly higher LF/HF ratios throughout the first seventy-two hours of hospitalization. The LF/HF ratios were not significantly different between the GOS 2-3 (severely disabled) and the GOS 4-5 (well recovered) group. However the mean LF/HF ratio for the GOS 4-5 group was greater than that for the GOS 2-3 group for each day.

Baillard demonstrated similar findings in their patients that progressed to brain death.² The LF/HF was markedly low prior to brain death (1.01 ± 0.07) and decreased to near nil (0.14 ± 0.05). An earlier study by Rapenne demonstrated a progressive extinction of the influence of the autonomic nervous system on cardiovascular regulation for six hours before brain death.⁴ Freitas noted that HRV parameters were significantly

lower in the brain death group compared with the deep coma group.⁵

What we found curious was that while the pNN50 and the rMSSD were significantly higher in the brain death group, compared to the controls, the LF/HF ratio did not demonstrate a significant difference (1.14 ± 0.25 vs. 1.35 ± 0.34) and was nearly identical to that from their healthy volunteers (1.5 ± 2). We suspect that since the LF/HF ratio reported by Rapenne was calculated from a twenty four hour recording, significant variations may have been "smoothed out" in the analysis.¹

Physiological mechanisms of heart rate modulation responsible for the low- and high-frequency components are not stationary during a 24-hour period and long term averages such as with Time Domain Measurements (pNN50, rMSSD) may obscure the detailed information about autonomic modulations available in shorter recordings such as with Frequency Domain Measurements (LF/HF ratio). Likewise, isolated short term recordings may not accurately represent the autonomic modulations over a period of time. Frequent measurements of the LF/HF ratio may provide a more accurate representation of autonomic function over time and offers the ability to continuously re-evaluate the autonomic cardiovascular function of the neurologically injured patient. The system used by Baillard was similar to ours in that it allowed continuous HRV observation of critically ill patients.^{2,3} This is novel because most HRV studies base their interpretations upon an arbitrary short-term data set (e.g. 5 minutes obtained at 8AM).

We applaud the study by Rapenne, et al,¹ demonstrating that HRV power spectral analysis may be a useful adjunct in the determination of the severity of neurologic insult and of the prognosis for recovery. Further larger studies are still warranted to fully investigate this potential predictive power of heart rate variability and the role it may play in the management of brain injury in children and adults.

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