

The effects of transcutaneous electroacupuncture stimulation (TEAS) on heart rate variability (HRV) and nonlinearity (HRNL): Is stimulation **frequency** or **amplitude** more important?

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Background. The balance of parasympathetic/sympathetic (PNS/SNS) activity can be assessed using heart rate variability (HRV) measures derived from the ECG. Newly developed heart rate nonlinearity (HRNL) indices also reflect this balance.

Patients often report that they find acupuncture relaxing. However, electroacupuncture (EA) and transcutaneous EA stimulation (TEAS) are often used without understanding the autonomic effects of different parameters of frequency and amplitude. This study investigates such effects using 'PNS-like' and 'SNS-like' HRV measures and HRNL indices.

Methods. In this single-blind, semi-randomised cross-over study, 66 participants attended for four sessions. Following a 5-minute baseline ECG, TEAS was applied bilaterally for 20 minutes to LI4 (*hegu*) and the ulnar border, at a different frequency in each visit – 2.5, 10 or 80 pulses per sec (pps) at a 'strong but comfortable' amplitude, or as 'sham' at 160 pps and zero amplitude. After stimulation, ECG continued for 15 minutes to assess post-stimulation changes (making eight 5-minute recordings for each session). See QR code or URL below for references & more details.

Results. Significant differences for stimulation frequency and amplitude ('high' vs 'low') were found in 24 HRV measures (12 PNS-like, 12 SNS-like) during successive 5-minute time slots. Numbers of significant differences and their effect sizes (ES) were similar for amplitude ($N = 156$, median ES = 0.29) and frequency ($N = 133$, median ES = 0.30). Some significant differences with larger ES were also found for changes after TEAS compared to baseline ($N = 26$ for 12 PNS-like measures, median ES = 0.48; $N = 53$ for 12 SNS-like measures and two SNS-like HRNL indices: median ES = 0.44). Amplitude had different effects at different frequencies, often most markedly at 10 pps.

Conclusions. The frequency and amplitude of TEAS at LI4 both influence autonomic function.

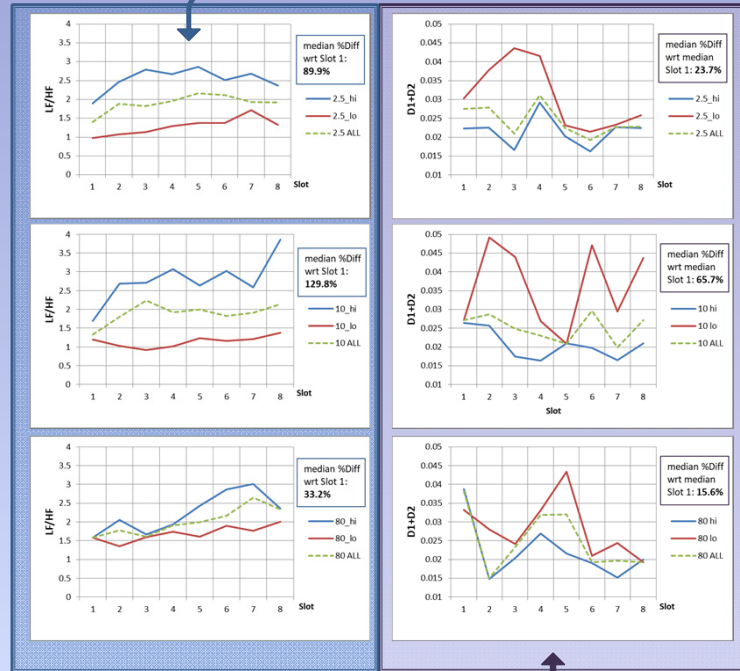
Findings with potentially useful clinical applications are that:

- (1) At all frequencies, HRV and HRNL indicate that **stronger TEAS appeared to be experienced as more stressful**;
- (2) **TEAS at 10 pps was more likely to decrease the stress response than at 2.5 or 80 pps**, particularly following stimulation;
- (3) However, **fewest HRV changes from baseline were found for 10 pps, particularly for low amplitude TEAS**.

Limitations. Baseline differences may have influenced results, and interactions between amplitude and frequency mean it was not always easy to disentangle their effects without using more advanced statistical methods than could be managed in the time available to prepare this poster. Further analysis is planned to explore these issues.

Amplitude and frequency ($N \approx 63$)

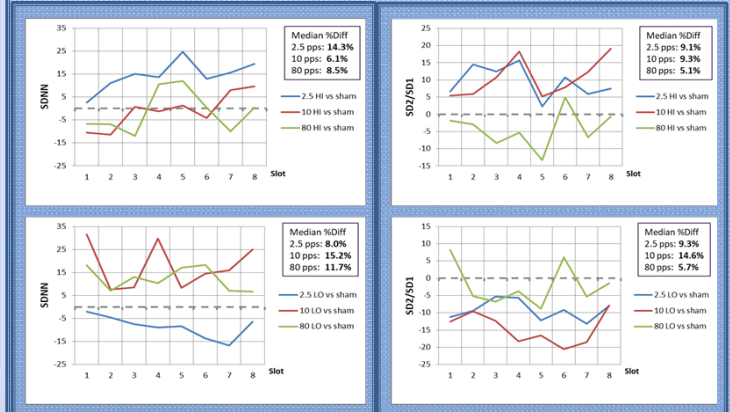
LF/HF, a 'SNS-like' HRV measure, reflects sympathetic activation. Group median LF/HF was higher for TEAS at *higher* amplitudes at all active frequencies, *lowest* for low-amplitude TEAS at 10 pps.



D1+D2, a 'PNS-like' HRNL index, reflects parasympathetic activity. Group median D1+D2 was higher for TEAS at *lower* amplitudes at all active frequencies, *highest* for low-amplitude TEAS at 10 pps.

Differences from sham stimulation (2 gps, $N \approx 31$)

Several HRV measures showed a pattern of negative differences from sham at one amplitude and positive differences from sham at the other. Two examples are shown below.



Note that in three of these graphs, greatest difference from sham was for stimulation at 10 pps.



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For further information, use QR code or go to <http://electroacupuncture.qeeg.co.uk/teas-hrv2>