Low Vagal Tone is Associated with Impending Necrotizing Enterocolitis in the Preterm Infant

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Background & Significance

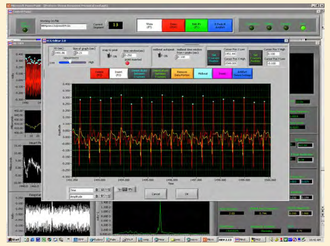
Necrotizing enterocolitis (NEC) is a common and devastating neonatal disease affecting 6-10% of preterm infants. Despite technological advances in care, acute morbidity, mortality and long-term disability associated with NEC remain constant. Intestinal motility, secretion, and blood flow are important in gut integrity and are mediated by the vagus nerve. Heart Rate Variability (HRV) provides a measure of sympathetic and parasympathetic balance. The High Frequency (HF) power spectrum of HRV reflects parasympathetic system innervation (vagal tone). Thus, low vagal tone may be a biomarker for impending GI disease.

Hypothesis

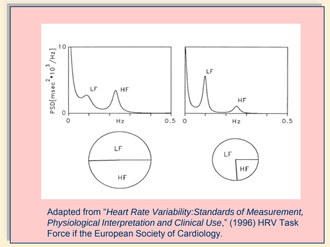
Low vagal tone as measured by HRV in the first week of life will be associated with NEC in healthy preterm infants.

Methods

This was a prospective, observational study. Sample infants were 32.6 ±1.5wks GA(Mean ± SD), weighed 1878 ±409gms, had a low morbidity index (SNAP≤9) at 48 hrs, were without congenital anomalies, and were off the ventilator by day 5 of life. On day 5-7 of life the infants' postprandial measures of HRVwere done in the afternoon when the infant was in a light sleep state. Analysis was done using Mindware HRV 2.51 software. Infant heath outcomes were obtained prospectively with chart audit by coders blinded to HRV.



Example of pre-selected segment of ECG for HRV spectral analysis



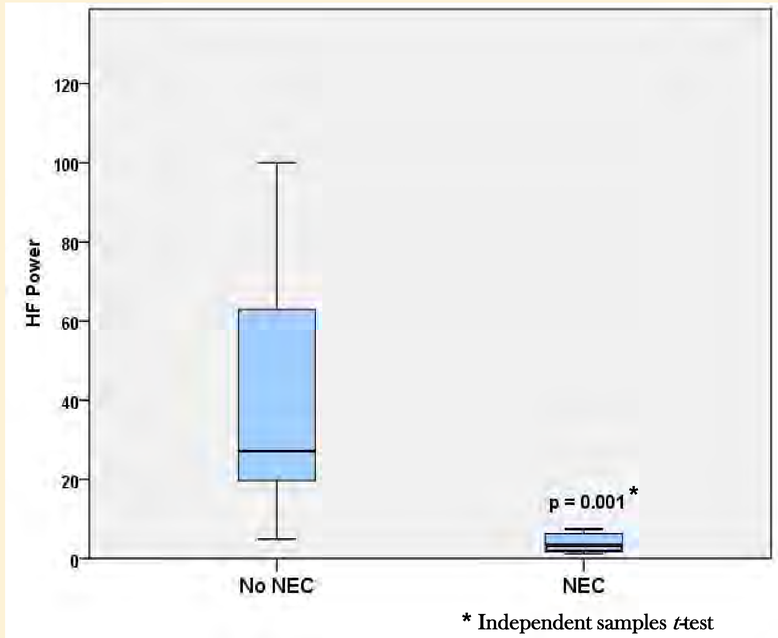
Characteristic HRV spectral frequency graphs with representative LF to HF ratios

Results

•4/30 subjects (13%) developed NEC which was confirmed by radiographic pneumatosis intestinalis and clinical findings.

•Of the 26 non-NEC subjects, 7 who were treated for sepsis within the first 10 days of life were excluded from the analysis.

Reduced HF Power in Impending Necrotizing Enterocolitis



•There was a statistically significant difference in HF power between No NEC (45 ±10 $msec^2$) vs NEC (2.8 ±1.4 $msec^2$) groups.

•The detection of low HF power was obtained from 12 hrs to 9 days prior to the onset of necrotizing enterocolitis, which was subsequently confirmed by clinical and radiographic evidence.

Conclusion

This pilot study found that markedly low HF power (i.e. low vagal tone) was associated with the onset of NEC in preterm infants. Hence, low vagal tone may be useful in identifying a subgroup of infants most susceptible to developing NEC.

Clinical Implications

The early recognition and treatment of NEC is critical to infant survival and the prevention of long-term disability in preterm infants. Low HF power may serve as a useful biomarker for NEC allowing prompt recognition, early treatment, and potentially improved neonatal outcomes for infants with NEC.

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