Characterization of body temperature, heart rate and sleeping patterns in preterm neonates

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Objectives: As a result of postnatal maturation body temperature changes (BT), sleeping patterns (SL) and circadian heart rate oscillations (HR) are different in newborns than in older children and adults, especially in preterm neonates. The goal of this model-based analysis was to characterize and compare BT changes, SL patterns and HR oscillations in preterm neonates during their first 5 days of life.

Methods: BT, SL and HR measurements were available from 67 preterm neonates without sepsis (gestational age 30.6 ± 2.3 weeks, birth weight 1303 ± 326 g). BT, SL and HR were monitored daily during a continuous 3 hour time interval. BT was measured by zero heat flux method were a sensor was placed between the infants trunk and the mattress, SL was scored based on video recordings every 10 seconds as awake, active sleep or quiet sleep, and HR measurements were obtained by surface electromyography. For data analysis the average value from each minute interval was used. As dynamics of BT, SL and HR followed oscillating patterns cosine functions were applied. Non-linear mixed effect modelling was utilized to characterize individual and population behaviour.

Results: Individual BT, SL and HR oscillations could be well described by the applied cosine functions. BT, SL and HR had different population period lengths: 5 hrs, 110 mins and 3 hrs, respectively. Interestingly, HR showed additional overlying oscillations with period lengths of 5.5 days and 10-20 minutes, indicating that this endpoint is a combination of overlying slow and fast rhythms.

Conclusions: As a result of an immature “internal clock”, preterm neonates show BT, SL and HR oscillations that are not yet completely synchronized and have shorter period lengths than those observed in older children and adults. A better understanding of physiological regulatory processes such as oscillation of BT, SL and HR could give further insights in infants at risk for autonomic dysregulation and deterioration.