28th World Congress on
Neonatology & Diagnosis
December 06-07, 2018 | Amsterdam, Netherlands

Analysis of pain effect on EEG recordings and oral sucrose suckling effect on pain reduction in neonates

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Background & Aim: Evaluating pain in neonates is a considerably difficult task, given the fact that pain is merely a subjective phenomenon. This study aimed at assessing the effects of pain on the EEG picture of neonates, and whether or not, sucrose administration can alleviate pain associated with invasive neonatal procedures.

Methods: The EEG recordings of a cohort of 21 neonates, who did not exhibit any manifestations of neurological deficits, were prospectively analyzed. Postnatal age ranged between three and 27 days, with a mean of 14.05±7.32 days. EEG recording, vital data and neonatal infant pain scale (NIPS) scoring were performed before and following painful stimulation via heel stick blood sampling during routine blood glucose measurements via glucometer, during non-nutritive suckling (NNS) and during suckling of sucrose.

Results: Analysis of obtained data revealed significant rise in heart rate, lower oxygen saturation following nociceptive stimuli (without soothing ($p=0.0007$ & $p=0.016$ respectively). Suckling of sucrose was associated with a significantly lower heart rate than stimulation without soothing ($p=0.015$). A significantly higher NIPS score during heel lancing, without soothing (median score=6) as opposed to during heel lancing with NNS, and while suckling sucrose ($p=0.000$). EEG wave's frequency of alpha waves at electrode position F3 was significantly higher, following induction of pain while suckling sucrose ($p<0.05$). The results yielded a significant correlation between random blood sugar levels and the frequency of both of alpha and beta EEG waves following induction of pain, without soothing ($r=0.529$, -0.589 respectively and $p=0.014$, 0.005 respectively). Moreover, results also concluded that there is a significant positive relationship between heart rate and the frequency of beta waves at electrode position F4 following induction of pain, without soothing ($r=-0.452$ and $p=0.039$). A significant correlation between oxygen saturation levels and the frequency of delta EEG waves at electrode position F4 was noted following induction of pain with NNS ($r=-0.478$ and $p=0.028$). A significant correlation between heart rate and the frequency of theta EEG waves at electrode position F3 was detected ($r=0.448$ and $p=0.042$). Moreover, a significant correlation was noted between oxygen saturation levels and the pain scale score, as well as the frequency of both alpha and delta EEG waves ($r=-0.492$, 0.433, -0.453 respectively and $p=0.023$, 0.049, 0.039 respectively). Results also pointed to a significant correlation between oxygen saturation levels and NIPS score, during sucrose suckling ($r=-0.492$ and $p=0.023$).

Conclusion: Pain triggers nociceptive brain electrical activities as evidenced by EEG changes. It was also proven that oral sucrose administration significantly affects the electrical activities of the neonatal brain's nociceptive neural circuits.

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