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Short communication

Impact of skin-to-skin contact on the autonomic nervous system in the preterm infant and his mother

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ABSTRACT

Before, during and after mother-newborn skin-to-skin contact (SSC), parasympathetic activity was evaluated by heart rate variability (HRV) analysis. SSC had a favorable impact on maternal and premature infant parasympathetic activities with a more pronounced response for neonates when the basal HRV values were lower, without modifications of EDIN scores, temperatures or oxygen saturation.

1. Introduction

Preterm infant is at high risk to face learning and behavioral difficulties with attention deficit and emotional disturbance (Delobel-Ayoub et al., 2009). Furthermore, preterm birth and mother-infant separation due to prolonged hospitalization caused maternal stress, anxiety and depression, which contributes to alter bonding processes (Feldman and Eidelman, 2007). Skin-to-skin contact (SSC) is a widespread procedure, well-known to improve the cardio-respiratory stabilization (Bergman, Linley, & Fawcus, 2004), the temperature regulation, the stress or pain response, the behavioral states and to offer a better sleep organization during the neonatal period. It improves the long term cognitive and psychomotor development (Feldman, Rosenthal, & Eidelman, 2014) and it promotes bonding (Tessier et al., 1998). SSC also encourages mother-infant interactions and reassures the mothers on their maternal abilities (Bigelow, Power, MacLellan-Peters, Alex, & McDonald, 2012).

Heart rate variability (HRV) analysis is a non-invasive method able to evaluate autonomic nervous system activity (Akselrod et al., 1981). Some studies have shown that high frequencies (over 0.15 Hz) correspond to parasympathetic activity (Saul et al., 1991), whereas low frequencies correspond to both parasympathetic and sympathetic activities (Anon, 1996). In adults, pain, fear or anxiety phenomena reduce high frequencies HRV, revealing a decreasing parasympathetic activity due to unpleasant stimuli (Miu, Heilman, & Miclea, 2009; Appelhans and Luecken, 2008). In infants, lower high frequencies HRV that reflects low parasympathetic nervous system activity, were observed during surgery (Sabourdin et al., 2013;Migeon et al., 2013) or during nociceptive stimuli (Oberlander, Grunau, Pitfield, Whitfield, & Saul, 1999; Avez-Couturier et al., 2016). Our HRV analysis is well correlated to neonatal behavioral pain scale score (EDIN, *Echelle de Douleur et d'Inconfort du Nouveau-né,* (Debillon et al., 2001) in the postoperative period (Faye et al., 2010) or after assisted deliveries (De Jonckheere et al., 2011).

Herein, we hypothesize that SSC could potentiate maternal and neonatal parasympathetic activities. We have measured high

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frequencies HRV using two specific indexes: ANI (Analgesia Nociception Index) for mothers and NIPE (Newborn Infant Parasympathetic Evaluation) for infants; before, during and after SSC. We also studied the impact of SSC according to newborns' basal parasympathetic tone.

2. Methods

This pilot study was prospective and observational. Inclusion criteria were: birth before 37 weeks of amenorrhea, patients hospitalized in neonatal intensive care unit older than 3 days-old; with a minor respiratory distress (FiO2 < 30%), without mechanical ventilation. Patients with congenital malformation, brain injuries, perinatal asphyxia, painkillers treatments and corticosteroid therapy were excluded from the study. Parents were orally informed and gave their consent. The study respected the Helsinki declaration. Newborns were installed on their mother's chest in decubitus ventral position (inclination degree 30 – 40°). Maternal and neonatal HRV indexes were recorded: 1) 30 min before the installation in SSC, 2) during SSC and 3) 30 min after the end of the session (when the infant was back in his bed). Environmental parameters (noise, light, alarms) were controlled by a dedicated nurse and were the same for all the recordings. Recordings were performed in semi-darkness of artificial light, and sound levels were reduced and maintained as lower as possible through the use of centralized alarms and the reduction of the person number in the room. No intervention was performed from 30 min before the beginning to the end of the recording except the installation on the mother's chest. All children were under continuous enteral and parenteral feeding. During the study, EDIN score (De Jonckheere et al., 2011), and oxygen requirements were reported by a nurse before and after SSC session. Temperature, oxygen saturation, and heart rate were recording continuously by specific sensors during the experiment and averaged according to the three study periods. Maternal heart rate was also recorded during all the session.

The ANI technology is already detailed by Jeanne, Clément, De Jonckheere, Logier, & Tavernier, 2012. An algorithm allows a real time analysis in a 64 s moving window (moving period 1 s) of high frequencies HRV between 0.15 and 0.40 Hz for the ANI and over 0.15 Hz (Alexandre et al., 2013) for the NIPE (NIPE monitor® and ANI monitor ®, Mdoloris Medical Systems, Loos, France). Maternal ANI and neonatal NIPE are numerical values between 0 and 100. A high NIPE or ANI value correspond to a high parasympathetic activity, so it reflects patient's wellbeing.

ANI and NIPE values were recorded continuously during the three periods: before, during and after SSC and then averaged during each period. We have evaluated the difference (ΔNIPE) between the NIPE value at the beginning of the SSC (= basal NIPE) and the NIPE value at 60 min of SSC. We have determined a NIPE threshold from the regression line resulting to basal NIPE and ΔNIPE values (Fig. 1). Consequently, data were grouped relative to NIPE threshold.

Data are presented as medians and 1st-3rd quartiles. Non parametric Friedman and Wilcoxon tests were used for time repeated values and Mann-Whitney tests were used for comparison between both groups. The significance threshold was fixed at $P < 0.05$. Statistical analysis were realized with SPSS 20.0 Software (IBM, New York, United States).

3. Results

Twenty two infants (13 boys and 9 girls) and their mothers were included in the study. Mothers were 32 (30–34) years old with a parity at 2 (1–2). The infants' median birth term were 27 + 2 (26 + 0–29 + 3) weeks of amenorrhea (WA), and the median birth weight was 900 [530–1210] g. At the moment of the study newborns were at a median age of 31 + 4 (29 + 2–31 + 5) WA and weighed 1100 (970–1490) g. Oxygen saturation (upper than 95% for both groups), oxygen requirements (21%), body temperature (36.0–36.4) and EDIN scores (lower or equal to 2) were not significantly different when we compared the periods before, during and after the SSC. The repartition of respiratory support was as followed: CPAP (Continuous Positive Airway Pressure, 64%), oxygen with nasal cannula (27%), Optiflow (4.5%) and Ambient Air (4.5%).

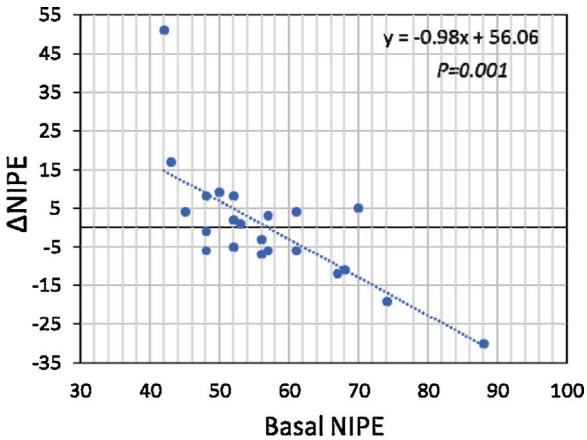

Fig. 1. Relation between the Newborn Infant Parasympathetic Evaluation variations (ΔNIPE) and the basal NIPE value, 60 min after the beginning of skin-to-skin contact.