

Neurobehavioural Disorganisation (NBD) as a result of Targeted Neonatal Echocardiography (TNE) in extremely preterm infants – a pilot study

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Background: Stress is a disturbance of the dynamic equilibrium between body systems and environment. Repeated stress, inherent in the NICU, is related to negative consequences for extremely preterm infants. Various tools are available to identify stressful responses to care giving in the NICU. These tools could also help clinicians to reduce the stress of various interventions. Stress is inferred from the observation of neurobehavioural disorganization (NBD), although the different tools differ in their ability to recognize subtle signs of NBD. The Synactive Theory of Development (Als. *Toward a Synactive Theory of Development. Infant Mental Health Journal* 1982; 2:229) provides a framework whereby changes in infant neurobehaviour can be interpreted in the context of ongoing interventions. The NIDCAP model of caregiving is based on Synactive Theory and requires caregivers to be observant of these subtle signs of NBD.

Targeted Neonatal Echocardiography (TNE) is frequently used for cardiovascular management of extremely preterm infants. Methods to help infants experience less pain, and stress during TNE include oral sucrose (Potana et al. *Oral Sucrose for pain in neonates during Echocardiography. Indian Pediatrics*, 2015; 52:493), as well as glucose, sucking on a soother and/or facilitated tucking. It has been suggested that TNE is neither painful nor disruptive for preterm infants (Lavoie et al. *RCT of use of oral glucose with or without gentle facilitated tucking of infants during Neonatal Echocardiography. PLOS ONE* 10 (10):e0141015.doi:10.1371/journal.pone.0141015). However, our observations of very preterm infants undergoing TNE were that it often caused profound NBD, leading to this pilot study.

Objective: To document NBD caused by TNE in extremely preterm infants.

Methods: A convenience sample of preterm infants born at less than 28 weeks gestational age, who underwent TNE when investigators were available, were included. Infants were assessed using the NIDCAP Naturalistic Observation and video recorded before, during and after TNE. Neurobehavioral functioning and pain assessments were carried out using

- 1- ABSO, the Assessment of Behavioral System's Organisation (Als. *Assessment of Behavioral System's Organisation. NIDCAP Federation International*, 2006),
- 2- BIIP, the Behavioral Indicators of Infant Pain (Holstii et al. *Initial validation of the BIIP. Pain* 2007;132:264), and
- 3- ALPS-Neo, the Astrid Lindgren and Lund Children's Hospital Pain and Stress Assessment - Neonatal (Lundquist et al. *Development and psychometric properties of the Swedish ALPS-Neo pain and stress assessment scale for newborn infants. Acta Paediatrica* 2014. doi:10.1111/apa.12672).

All TNE's were performed by one investigator trained in TNE (AN), and neurobehavioural assessments by another investigator certified in NIDCAP and APIB (JMT). Bedside caregivers were not guided to provide neurobehavioural facilitation, but were free to provide whatever support they felt necessary.

Results: 7 infants born at \geq / $<$ 26 weeks were included in the study. Age at time of TNE varied from 4 days to 5 weeks.

ABSO and ALPS-Neo scores indicated fairly high degrees of NBD at baseline.

NIDCAP observations indicated that NBD increased during and after TNE, although the numerical value of the scoring systems used for this study did not change significantly; for example:

- a) ABSO scores for Autonomic / Motor /State were 8/8/8 pre-TNE, increasing to 9/9/9 both during and post-TNE.
- b) ALPS-Neo scores were 10 pre-TNE and remained 10 and 10 during and post-TNE.
- c) BIIP scores were difficult to assign accurately, as facial behaviours (a key part of this scoring) were often not well seen, due to nesting rolls, TNE operator's hands and / or the probe.

Most babies entered the AA state (severe autonomic and motor dysregulation, leading to removal from the sleep-wake state continuum) during TNE and many did not recover from the AA state post TNE. The BIIP does not include the AA state in its descriptors. ABSO and ALPS-Neo do include AA state, but many babies were already at scores of 10 (the maximal possible score) for reasons such as motor flaccidity, so that moving into the AA state did not increase their score.

Conclusions:

- a) More attentive, individualised supportive care is required at baseline for very preterm infants in our NICU, given the high scores reflective of NBD, pre-TNE.
- b) TNE caused increased NBD in the extremely preterm infant, which was often due to the infant entering the AA state.
- c) The scoring systems used in this pilot study were not sensitive enough to accurately portray the increased NBD.

For Discussion:

- a) What would be the most accurate method of documenting NBD during TNE? Assessment methods should recognise the AA state as that of profound NBD.
- b) How can this message be disseminated to Neonatal Clinicians who use TNE in their practice?
- c) Support by the caregiver that is tailored to individualized, dynamic neurobehavioural status during TNE may prevent the severe NBD that was observed. The recently published EVIN tool (Warren et al. Validity and reliability of the Evaluation of Intervention Scale: preliminary report. *Acta Paediatrica* 2016; 105:618) may be useful as a means of providing such facilitation, and will be the subject of further study.

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