MEASURE ANS
CONTROL NOCICEPTION
IMPROVE OUTCOMES

NIPE in the NICU

Newborn Infant
Parasympathetic Evaluation
Since conception, each new life starts to prepare itself to live. During the first 1000 days, the autonomic nervous system (ANS) develops to allow new life to cope with its environment (1). Adverse events may lead to epigenetic changes, with implications for health and disease.

The number of preterm infants is increasing; these babies are fragile as they are born with a weak parasympathetic system (2). Newborns in the NICU may undergo more than 12 painful procedures per day, which puts them in a state of continuous stress, worsening their outcomes (3,4). Babies who experience a lot of stress during the first 1000 days of life have been shown to be at higher risk for physical and psychological problems, such as hypertension (5), diabetes (6), or behavioral problems such as alcohol abuse (7) or mental health disorders.

The problem:
Epigenetic programming in the first 1000 days:
Stress caused by nociception is a major factor.

Hormones, neurotransmitters, growth factors, nutrients, Epigenetics (DNA methylation, histone modifications, microRNAs)

POTENTIAL EFFECTORS

PRECONCEPTION

GESTATION

POST NATAL

OFFSPRING PHENOTYPE

Brain morphology/function
Physiological function
Behavior

Egg/sperm development/maturation
Placental development/function
Organ development
Neuronal development

PROMOTE HEALTH

MATCHED ENVIRONMENT

PREDISPOSE TO PATHOLOGY/DISEASE

MISMATCHED ENVIRONMENT

Brain maturation/function
Immune function
Reproductive function

MATCHED ENVIRONMENT

MISMATCHED ENVIRONMENT
The NIPE (Newborn Infant Parasympathetic Evaluation) monitor measures inter-beat distances of the R-R intervals derived from the ECG. These distances vary due to heart rate variability (HRV): the influence of respiration on the vagus nerve. Analyzing the signal derived from HRV produces a metric (HFnu), indicating the relative of parasympathetic activity in the previous minutes.

The NIPE value shows continuously and objectively the parasympathetic activity of the patient. A NIPE of 53 corresponds to a Comfort Behavioral Scale (CBS) score > 17 (10).

The solution
Measuring the autonomic nervous system (ANS)

It is crucial to measure the well-being of these babies to allow them to be as comfortable as possible. However, pain assessment in neonates is extremely challenging, pain scales are subject to inter-observer differences, each neonate may display different signs of pain leading to different interpretations and different results among observers (9), in addition they are time consuming to perform. Hence, a more objective, fast, reliable and easy to use physiological measure is needed.

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Measuring the autonomic nervous system (ANS)

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Specificity
NIPE
AUC =0.83 (95 CI: 0.76 TO 0.90)

Sensitivity

Relationship of NIPE with CBS –
Assessment of Procedural Distress in Sedated/Intubated Children Under 3 Years Old Using the Newborn Infant Parasympathetic Evaluation: A Diagnostic Accuracy Pilot Study

Possibility to decrease opioids administration without any risks

Optimal range Adequate analgesia

Probability of a hemodynamic reaction in the next few minutes, possibility to anticipate analgesic’s needs

The solution
Measuring the autonomic nervous system (ANS)
The result

Dr. Walas validated the NIPE in an observational study, showing the NIPE value decreases more depending on the intensity of the stimulation (11). Faye et al proved that Low NIPE values corresponded to high EDIN scores and vice-versa (12).

Moreover, in NICU’s implementing the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) NIPE can be used to evaluate the favorable impact of cocooning (13) and skin to skin contact (14) on the preterm infant.

The Goldilocks principle, that means not too little, but not too much. NIPE and ANI help me optimize analgesedation in my patients.

Thanks to NIP we have an objective parameter to assess stress in our neonatal ICUs.

NIPE detecting different pain intensities

<table>
<thead>
<tr>
<th>Moderate pain</th>
<th>High impact</th>
<th>Severe pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIPE value</td>
<td>1.6</td>
<td>1.4</td>
</tr>
<tr>
<td>EDIN score</td>
<td></td>
<td></td>
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</tbody>
</table>

NIPE detecting the effects of saccharose during heel stick

Using NIPE will allow evaluation of the state of comfort/discomfort of the patient. This case study is an example where oral saccharose was given in advance to an infant increasing NIPE value and after the heel prick resulted in a decrease in the NIPE (15).

NIPE in assessing the impact of NICU maneuvers

Evaluation of comfort and discomfort with NIPE

Evaluation of prolonged pain with NIPE

Evaluation of acute nociception with NIPE

The main benefits of using NIPE technology

NIPE shows the sympathetic/pars sympathetic allowing taking better decisions to control nociception improving outcomes (17).
Bibliography:


(15) Internal case report

(16) JDe Jonckheere J et al NIPE is related to parasympathetic activity, is it also related to comfort?. 2019 Feb 13. Journal of Clinical Monitoring and Computing