ANI and NIPE in the PICU

Analgesia
Nociception Index
New born Infant
Parasympathetic Evaluation
The problem

In the pediatric intensive care unit (PICU) there are patients that require mechanical ventilation and sedation, where analgesia is key to supporting patients with a high respiratory drive to synchronize with the ventilator, preventing patient-ventilator asynchrony (PVA).

To achieve good patient-ventilator synchrony, optimal balance between sedation and analgesia is needed. The latter can be obtained more effectively by monitoring the effect of each procedure with:

An EEG monitor
To control the desired level of consciousness.

The ANI monitor
To detect noxious stimulation. ANI may help to guide analgesia [13].

Several publications have proven that, in mechanically ventilated patients, a protocol based on analgesia more than sedatives (analgosedation) will improve pain scores, reduce sedatives (54%) and related consequences of delirium, decrease length of stay (50.8 h), time on ventilation (45.5h) and associated medication costs [1]. However, overuse of analgesia, especially opioids, must also be avoided as 20% to 70% of patients receiving opioids during ARDS will experience side effects: respiratory depression (27%), gastrointestinal problems (41%), delayed emergence (28%) and tachyphylaxis (37%) [2]. Hence, it is of great value to be able to specifically titrate the analgesic needs of each patient with a monitor dedicated to guiding analgesia.

<table>
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<th>% of opioid-overdosing side effects</th>
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<td>Respiratory depression</td>
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<th>The benefits of an analgosedation protocol</th>
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Heart rate variability (HRV) is a well-known phenomenon that controls the regulation of the cardiovascular system via the ANS. By analyzing the HRV oscillations we can measure the activity of the sympathetic and parasympathetic nervous systems [3].

All mammals exhibit what is known as respiratory sinus arrhythmia. The latter process is controlled by the sympathetic and the parasympathetic branch of the nucleus accumbens and nucleus ambiguous, causing the heart to beat slower during expiration due to vagal activation and faster in inspiration because of sympathetic innervation [4].

The ANI and NIPE values express the relative parasympathetic activity of the patient.

The total energy of the ANS is shown on the screen of the monitor. An ANI or NIPE range between 50-70 relates to adequate analgesia, meaning that antinociception is adequate and parasympathetic activity is mildly predominant over sympathetic activity. When the ANI (or NIPE) value fall below 50, the occurrence of a hemodynamic response within the following 5 minutes is very likely [5]. This information can be used to predict and avoid a hemodynamic response by increasing the analgesia.

Our solution
Measure the autonomic nervous system (ANS)

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nb: the energy must be between 0.05 and 2.5 for an interpretable ANI.

Interpretation of ANI

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 result

ANI can detect nociception \(^{(6,7)}\) and may help to take the decisions \(^{(8)}\) to control the autonomic response improving patient outcomes \(^{(17)}\)

In Anesthesiology 2017, Funcke et al. showed that the ANI is the best in its class for detecting nociception versus other parameters, especially under opioid conditions \(^{(6)}\). Intensivists titrate analgesics based on heart rate (HR) and blood pressure, but Funcke et al., demonstrated that ANI is more sensible and specific than haemodynamics to detect nociception for adults \(^{(6)}\) and children \(^{(7)}\). NIPE is able to show the effect of the analgesic provided and detect nociception better than HR \(^{(8)}\).

Detecting nociception would allow improved titration of analgesics.
There are several publications indicating that ANI and NIPE can detect nociception and can be safely used in the PICU setting for guiding analgesia in deeply sedated patients [9][10][11].

**Analgesia nociception index for the assessment of pain in critically ill patients:**
A diagnostic accuracy study

In this context, ANI can differentiate the pain, and correlates with FLACC scores, in postsurgical patients [9]. A NIPE of 53 or higher correlates with adequate analgesia in children below 3 years [10]. NIPE is able to differentiate between different stimulation intensities in babies below 1 year [1].

**Clinical Guidelines**

ANI has been mentioned as an interesting technology for nociception detection in the 2018 Society of Critical Care Medicine clinical guidelines for sedoanalgesia in ICU [15], in the sedoanalgesia and ventilation protocol for Covid-19 from Hospital Puerta de Hierro de Madrid [16] by the SEMICYUC (Spanish Society of Intensive Care Medicine) [17] and in the guidelines from the Society for Pediatric Anesthesia recommendations for the use of opioids in children during the preoperative period [18]. MDoloris technology is being increasingly used worldwide for the detection and management of nociception.
The main benefits of using ANI/NIPE technology

- Predictivity of hemodynamic reactivity [5]
- Helpful to diagnose the etiology of a haemodynamic event [12]
- Refine opioids titration [13]
- Predict post-extubation pain [14]
Dr. David Lozano Diaz MD  
Pediatrician in Neonatal and Pediatric ICU. Pediatric Pulmonology at Hospital General La Mancha Centro, Ciudad Real

Using ANI and NIPE in my daily practice, I am able to titrate the analgesics more efficiently in my pediatric patients.

Dr. Rocio Tapia  
Pediatrician in Pediatric ICU. Hospital Ramón y Cajal, Madrid

I found the ANI and NIPE monitor in PICU extraordinarily useful in the following situations:  
a) to monitor easily and continuously the comfort/distress balance in children  
b) to detect nociception in those patients without any alternative with scales like in deep sedated patients and neuromuscular blocked patients. I recommend its use to the PICU professionals to improve their patients care.

Testimonials
Bibliography:


(3) European Heart Journal (1996) 17. 354-381 Guidelines Heart rate variability Standards of measurement, physiological interpretation, and clinical use Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology (Membership of the Task Force listed in the Appendix)


(16) Carlos Chamorro, Miguel Angel Romero and Sara Alcántara. ICU Department Hospital Universitario Puerta de Hierro. Protocolo de sedoanalgesia para los pacientes con COVID19.

(17) https://semicyuc.org/wp-content/uploads


ANI Monitor V2, ANI MOC-9, NIPE Monitor V1 and the ANI-MR are class IIa medical device, manufactured by MDoloris Medical Systems. CE evaluation was performed by Bureau Veritas Italy (1370) for the ANI Monitor V2, NIPE Monitor V1 and the ANI MOC-9. CE evaluation was performed by BSI (2797) for the ANI-MR. © 2021 MDoloris Medical Systems. All rights reserved. MD/QUA/EN4.1 v.03