MEDASENSE
PAIN INTELLIGENCE

NOL™ (Nociception Level) Technology

Intraoperative Pain Monitoring for Optimizing Analgesia

Accurate & Objective assessment of nociception

Optimization & Personalization of analgesic treatment

Faster Response Time through earlier detection of nociception

Standardization among physicians

THE CHALLENGE
Assessing Intraoperative Pain Reliably

Treating pain is at the heart of medicine. It is an essential role of every clinician, since unmanaged pain can delay recovery, increase morbidity and mortality, and overburden healthcare resources.

Nociception - Pain in Anaesthetized Patients

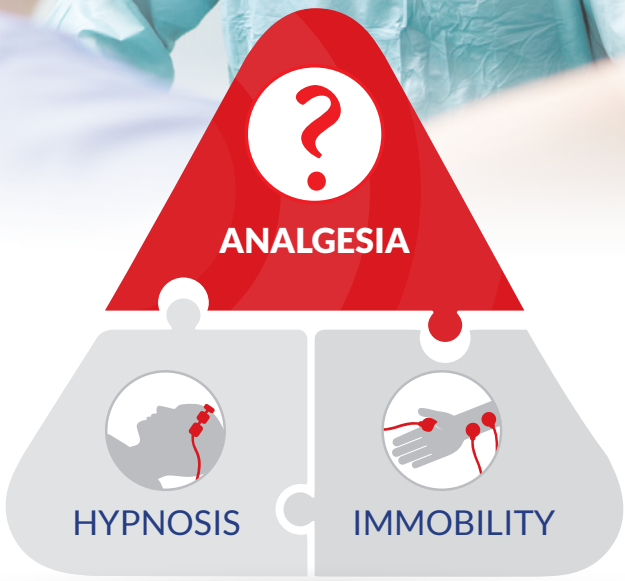
During general anaesthesia, a patient's body reacts to painful stimuli – although it is not consciously recognized. This intraoperative pain can stress the body[1-4] and worsen pain after surgery[4,5]. As the patient can't communicate – it is hard for clinicians to evaluate.

Missing a Piece?

While Hypnosis and Immobility are continuously and specifically monitored, analgesia is assessed indirectly through changes in hemodynamic and clinical parameters (Heart Rate, Blood Pressure, Sweating, Tearing, etc.).

These parameters are not specific to nociception, and may change in response to other causes as well.

Consequently, patients may be given insufficient analgesia, which may promote postoperative pain[4,5], or excessive analgesia, which may cause respiratory complications[1,6], nausea and vomiting[7], hyperalgesia[8,9], and other complications[1-11].



> *"Getting the right dose of anti-nociceptive medications matters. Too little, and patients wake up in pain. Too much, and patients are at risk of drug-related complications."*
>
> Dr. Daniel Sessler, Head of the Department of Outcomes Research, Cleveland Clinic, Ohio, USA. A member of Medasense's advisory board.

Each Year, Worldwide:

UP TO 50%
of surgical patients suffer from moderate to severe post-operative pain[12-13].

12%
of surgical patients suffer from adverse events due to analgesic medications, leading to[13]:

- **3.3** extra days of hospitalization
- **27%** extra cost per patient
- Increase in re-admissions

Monitoring the intraoperative nociception level may enable clinicians to personalize and optimize the analgesic administration, thus avoiding excessive use or under use of opioids, that may result in significant complications.

THE SOLUTION
NOL™ (Nociception Level) Technology

Multi-Parametric Approach

Recognizing the complex nature of pain, the NOL™ technology considers multiple nociception-related physiological parameters and its various derivatives.

Advanced Algorithms

Advanced algorithms process the multiple data streams, identify the pain-related patterns, and reflect a patient's nociceptive state[14-16].

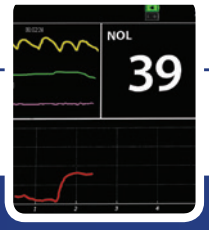
- *Heart Rate*
- *Heart Rate Variability*
- *Skin Conductance Level*
- *Skin Conductance Fluctuations*
- *Pulse Wave Amplitude*
- *Peripheral Temperature*
- *Motion*
- *Parameters Derivatives*

> *"Multi-variable approaches appear to be superior predictors of pain intensity and intra-operative nociception to any individual parameter alone."*
>
> Cowen R et al., (2015) Assessing pain objectively: the use of physiological markers. Anaesthesia 70(7):828-47.

NOL™ (Nociception Level) Index

- **An objective indicator** for the presence and severity of nociception.
- The only **multi-parameter nociception index**, based on the physiological integrated response to noxious stimuli.
- **Calibrated to an individual's baseline**.
- **Clinically validated** as superior to other nociception indicators [14-16].

The NOL™ index values are represented on a scale of 0 to 100



0 = Absence of Nociception → 100 = Extreme Nociception

PMD-200™
Intraoperative Nociception Monitoring

Leveraging patented NOL™ technology, the PMD-200™ is a non-invasive and continuous pain monitoring device.

By using the PMD-200™ in operating rooms, where patients under general anaesthesia are unable to communicate their pain, clinicians are able to assess nociception, and better titrate analgesic medications – avoiding excessive use or underuse, that may result in significant complications.

A Non-Invasive Finger Probe

The finger probe continuously acquires physiological signals through 4 sensors (Photoplethysmograph, Galvanic Skin Response, Temperature, and Accelerometer) and transmits them to the PMD-200™ for advanced processing.

PMD-200™ Bedside Monitor

Pattern recognition algorithms analyze dozens of measurable changes in the nociception-related physiological parameters, and reflect the information in a single nociception level index - the NOL™.

> *"I truly believe in the NOL™ technology. I am convinced it will improve the quality of our anaesthesia and impact on patients' recovery"*

Dr. Philippe Richebé, Professor and Anaesthesiologist at Maisonneuve-Rosemont Hospital, University of Montreal, Quebec, Canada. Principal Investigator. A member of Medasense's advisory board.

PMD-200™ is CE approved. Not available in the U.S.

CLINICAL EVIDENCE
Superior Nociception Assessment

Multiple studies conducted worldwide and key results published in peer reviewed medical journals, have validated the NOL™ Index to:

- Discriminate, with high sensitivity and specificity, between noxious and non-noxious stimuli[14-16].
- Grade different levels of nociception[14-16].
- Correlate with the analgesic state of the patient[15,17].
- Demonstrate superiority over commonly used nociception indicators[14-16].

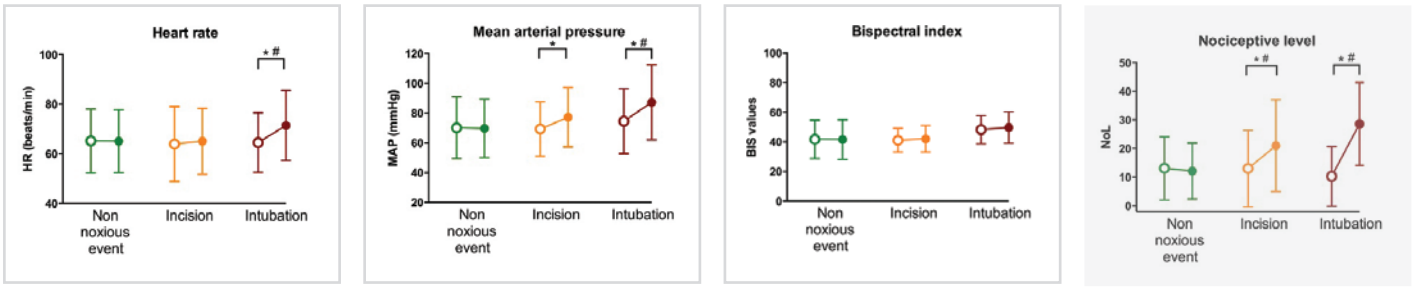
> *"Our study confirmed that the NOL™ gives a better assessment of the patient's nociceptive state than the parameters we currently use in the operating theatre."*
>
> Dr. Ruth Edry, Department of Anaesthesiology, Rambam Medical Centre, Haifa, Israel.

Medasense's updated publications, abstracts and presentations can be found at: **www.medasense.com/clinical-data/**

Superiority of the NOL™ index to detect and discriminate between various noxious stimuli, compared to commonly used parameters[15]

(N=71; ASA I – III; Ages 18-80; BIS target 45+/-5 ; Elective surgery under general anaesthesia)

Only NOL™ correctly scored the level of nociceptive reaction with:
non-noxious stimulus NOL™ < incision NOL™ < intubation NOL™ ($p < 0.05$).



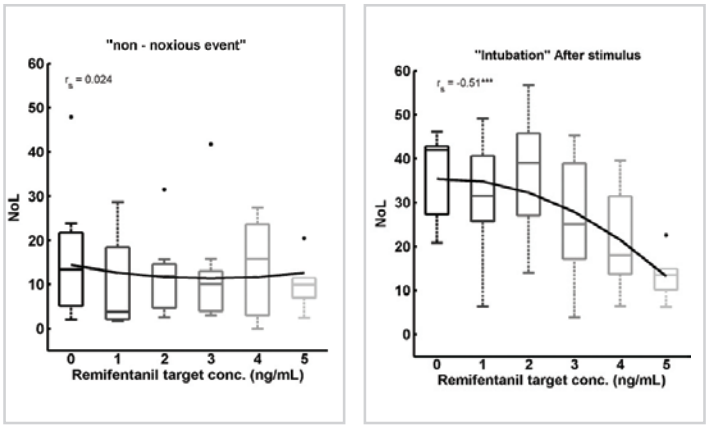
○ Prior to stimulation ● Following stimulation # Unpaired * Paired

The NOL™ index reliably measures the changes in the nociceptive response at different remifentanil concentrations (inter-patients)[15]

(N=71; ASA I – III; Ages 18-80; BIS target 45+/-5 ; Elective surgery under general anaesthesia)

The NOL™ index remains unaffected under non-noxious conditions, regardless of remifentanil concentration and decreases for the same noxious stimulus with increasing remifentanil concentrations.

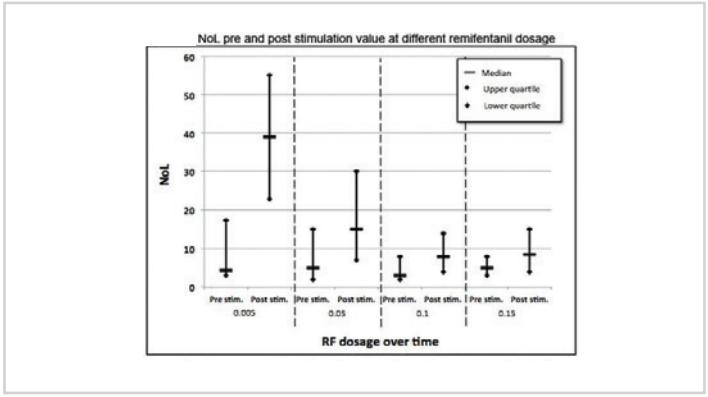
This analysis indicates that the NOL™ is a reliable measure of nociception and is not affected by the hemodynamic effects of remifentanil.



The NOL™ index correlates with increased dosage of analgesics (intra-patient)[17]

(N=40; ASA I – III; Age >18; Elective abdominal surgery under general anaesthesia and epidural analgesia)

The magnitude of the NOL™ index response to standardized nociceptive stimulus, decreases with higher doses of remifentanil.

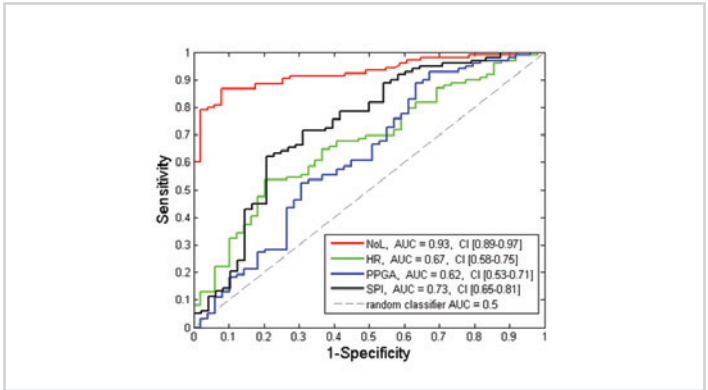


The NOL™ index outperforms commonly used parameters (HR, PPGA) and SPI (GE)[14]

(N=58; ASA I – III; Ages 18-75; Entropy target <60 ; Elective surgery under general anaesthesia)

In this ROC analysis NOL™ outperforms other parameters and indices to discriminate between noxious and non-noxious stimuli.

AUC for NOL™ absolute values were the highest: 0.93.



NOL™ Technology

Setting a New Standard in Nociception Assessment

"For the first time we are able to titrate analgesic medications to patients' needs."

"It is clear that current pain assessment approaches in the operating room are limited. The NOL™ index provides anaesthesiologists with a decision support tool to objectively assess and optimize the treatment of a patient's nociception pain."

Prof. Albert Dahan, MD, PhD, Department of Anaesthesiology, Leiden University Medical Center, The Netherlands. Principal Investigator.

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Medasense Biometrics Ltd. develops innovative systems and applications to objectively assess the physiological response to pain. Objective assessment of pain may personalize pain management, leading to optimized care and improved clinical outcomes.

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