

Detection of Pain under General Anesthesia: Performance Assessment of the

PMD-200

Virginia Horne, MD, Alex Friend, MS, Max Breidstein, MS, Borzoo Farhang, D.O.

Department of Anesthesiology, University of Vermont Medical Center, Larner College of Medicine, Burlington, VT



BACKGROUND

The evaluation of pain in patients under general anesthesia (GA) can be quite challenging in current clinical practice¹. This analgesic management is guided by clinical signs of sympathetic response to noxious stimulation, such as increase in heart rate (HR), mean arterial blood pressure (MAP), diaphoresis, or patient movement². Optimal analgesia is critical to avoid complications from activation of the sympathetic nervous system as well as minimizing the risk of opioid-induced hyperalgesia, hypotension, respiratory depression, or delay in discharge². To assess nociception during GA, we used a novel multidimensional measure of nociception—the nociception level (NOL) index. The NOL index is derived from the nonlinear composite of HR, HR variability, amplitude of the photoplethysmogram (PPG), galvanic skin response (GSR, fluctuations in skin conductance), and their time derivatives. The NOL ranges from 0-100: a NOL of 25-100 represents a high sympathetic activation suggesting a nociceptive response.

METHODS

Following IRB approval, 10 ASA II-III patients (4 male, 6 females, mean age 39.4) scheduled for elective laparoscopic surgery under GA were enrolled in this prospective, observational study; all subjects gave informed consent. GA was induced and maintained at the discretion of the anesthesiologist. Patients' PPG and GSR as well as the physiological parameters were extracted and compared to the NOL index. 4 events during surgery were examined: severe noxious stimuli (intubation); moderate noxious stimuli (incision or insertion of trocar); mild noxious stimuli (skin closure, scrubbing); and non-noxious stimuli.

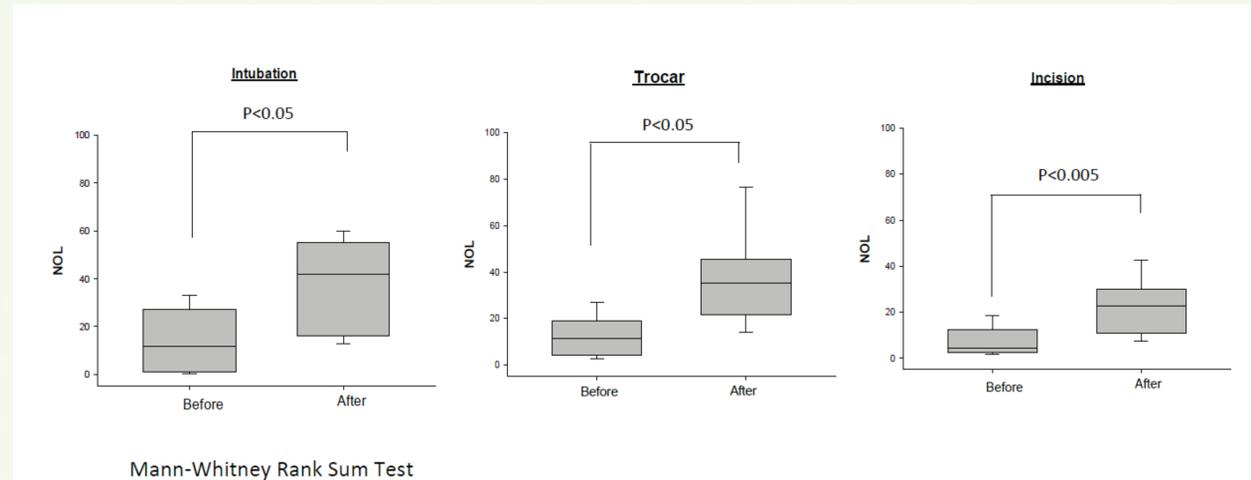


Figure 1. Comparison of NOL index before and after stimulation of varying intensities.: A. NOL values before and after intubation; B. NOL index before and after trocar insertion; C. NOL index before and after incision

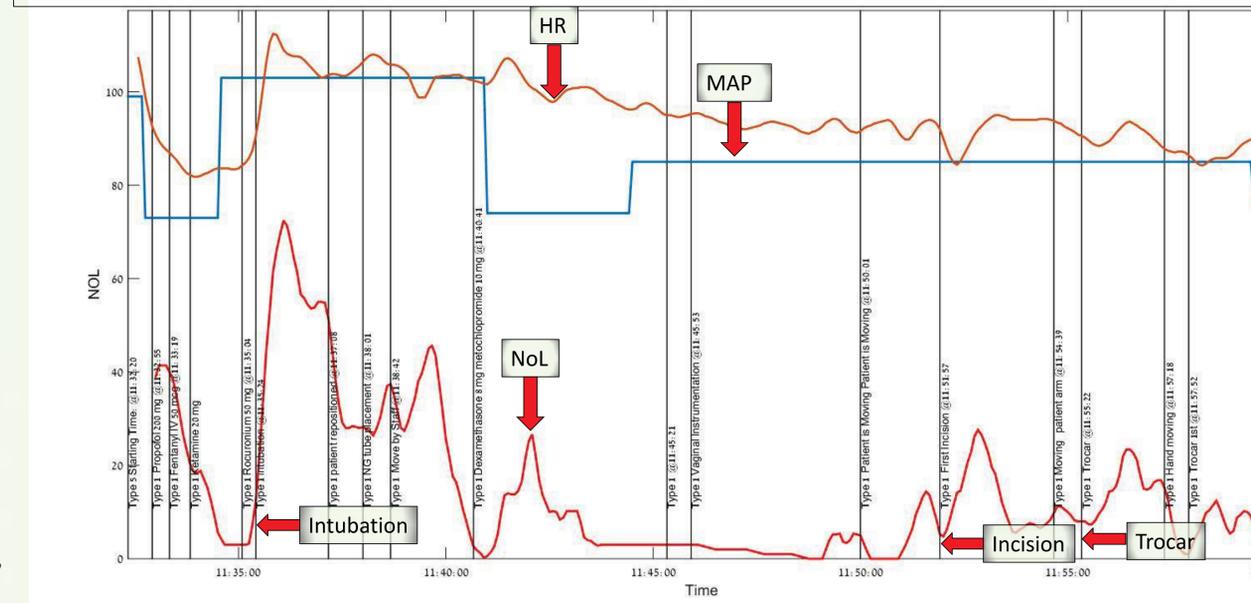


Figure 2. An example of patient's NOL index and physiologic parameters with types of stimulation and analgesic medications

RESULTS

The NOL index successfully differentiated noxious and non-noxious events ($P < 0.001$). The differences in the mean NOL values among the 4 event groups were statistically significant ($P = 0.03$), and significant increase in the median NOL index above the threshold of 25 was observed following severe (12 to 41.7, $p = 0.038$), moderate (11.4 to 35, $p = 0.007$), and mild noxious stimulation (4.3 to 22.7, $p = 0.003$) in patients. NOL index and MAP remained unchanged in response to non-noxious stimuli. Furthermore, in 1-3 occasions for each patient there were significant changes in NOL index, while the MAP increased above 100 mmHg or remained unchanged, and the NOL could provide differential and complimentary information about the nociceptive behavior.

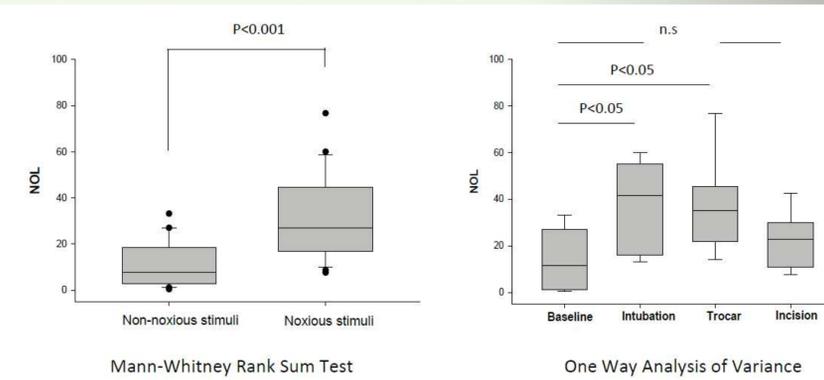


Figure 3. A. NoL index based on level of stimulation. B. NoL index comparison of noxious vs. non-noxious stimulation

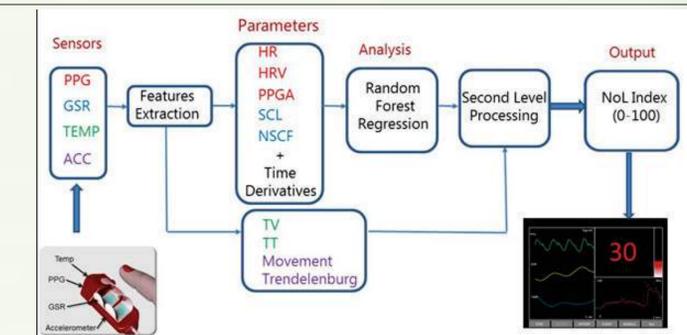


Figure 4. Schematic description of the algorithm for computing Medasense's Nociception Level (NoL) Index.

CONCLUSIONS

These preliminary results validated the NOL index in identification and discrimination of noxious/non-noxious stimuli and grading the nociception response by intensity of stimulus. Non-invasive monitoring of NOL reflected nociceptive response during GA and therefore may indicate the nociception/anti-nociception balance. Furthermore, in cases where the mean arterial pressure increased above 100 mmHg, NOL index could provide alternative and complimentary information about the nociceptive state of the patients under GA and guide the choice of opioids versus sympatholytic administration.

References

1. Treister R, Kliger M, Zuckerman G, Aryeh IG, Eisenberg E. Differentiating between heat pain intensities: The combined effect of multiple autonomic parameters. *Pain* 2012; 153:1807-1814.
2. Edry R, Recea V, Dikust Y, Sessler D. Preliminary intraoperative validation of the nociception level index. *Anesthesiology* 2016; 125:193-203.