

## Monitoring the Responses to Nociceptive Stimuli During General Anesthesia Based on Electroencephalographic Signals in Surgical Patients Undergoing General Anesthesia with Laryngeal Mask Airway (LMA)

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**Abstract :** Background: Monitoring the anti-nociceptive drug effect is useful because a sudden and strong nociceptive stimulus may result in untoward autonomic responses and muscular reflex movements. Monitoring the anti-nociceptive effects of perioperative medications has long been desired as a way to provide anesthesiologists information regarding a patient's level of antinociception and preclude any untoward autonomic responses and reflexive muscular movements from painful stimuli intraoperatively. To this end, electroencephalogram (EEG) based tools including BIS and qCON were designed to provide information about the depth of sedation while qNOX was produced to inform on the degree of antinociception. The goal of this study was to compare the reliability of qCON/qNOX to BIS as specific indicators of response to nociceptive stimulation. Methods: Sixty-two patients undergoing general anesthesia with LMA were included in this study. Institutional Review Board (IRB) approval was obtained, and informed consent was acquired prior to patient enrollment. Inclusion criteria included American Society of Anesthesiologists (ASA) class I-III, 18 to 80 years of age, and either gender. Exclusion criteria included the inability to consent. Withdrawal criteria included conversion to endotracheal tube and EEG malfunction. BIS and qCON/qNOX electrodes were simultaneously placed on all patients prior to induction of anesthesia and were monitored throughout the case, along with other perioperative data, including patient response to noxious stimuli. All intraoperative decisions were made by the primary anesthesiologist without influence from qCON/qNOX. Student's t-distribution, prediction probability (PK), and ANOVA were used to statistically compare the relative ability to detect nociceptive stimuli for each index. Twenty patients were included for the preliminary analysis. Results: A comparison of overall intraoperative BIS, qCON and qNOX indices demonstrated no significant difference between the three measures (N=62,  $p > 0.05$ ). Meanwhile, index values for qNOX ( $62 \pm 18$ ) were significantly higher than those for BIS ( $46 \pm 14$ ) and qCON ( $54 \pm 19$ ) immediately preceding patient responses to nociceptive stimulation in a preliminary analysis (N=20, \*  $p = 0.0408$ ). Notably, certain hemodynamic measurements demonstrated a significant increase in response to painful stimuli (MAP increased from  $74 \pm 13$  mm Hg at baseline to  $84 \pm 18$  mm Hg during noxious stimuli [ $p = 0.032$ ] and HR from  $76 \pm 12$  BPM at baseline to  $80 \pm 13$  BPM during noxious stimuli [ $p = 0.078$ ] respectively). Conclusion: In this observational study, BIS and qCON/qNOX provided comparable information on patients' level of sedation throughout the course of an anesthetic. Meanwhile, increases in qNOX values demonstrated a superior correlation to an imminent response to stimulation relative to all other indices.

**Keywords :** antinociception, bispectral index (BIS), general anesthesia, laryngeal mask airway, qCON/qNOX

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