The Nociception Index (qNOX) Correlated with Hypothermia During Cardiopulmonary Bypass

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Introduction: The depth of anesthesia is commonly assessed by the patient's clinical signs, based on surrogate parameters, which have low specificity in detecting nociceptive stimuli; this can result in under dosage or over-dosage of anesthetic agents [1]. The qNOX is a derived EEG index implemented in the Conox monitor (Fresenius Kabi, Bad Homburg, Germany) which measures the probability of the patient to respond to external noxious stimuli, providing an objective measurement of the patient's analgesia state [2].

The non-appreciable gain in blood pressure (BP), heart rate (HR) or even body movements during surgery, in particular during cardiopulmonary bypass (CPB) and hypothermia, suggest the difficult determination of nociception. The aim of this study is to evaluate the effectiveness of the qNOX index under induced hypothermia during the CPB.

Methods: The qNOX was recorded during general anesthesia for 39 patients with coronary atherosclerosis cardiopathy who were scheduled for elective on-pump coronary artery bypass graft (CABG) surgery under hypothermia and cardiopulmonary bypass (CPB) at the Xuanwu Hospital, after approval of the local IRB. Two depth of sedation EEG derived indexes, qCON and Bispectral Index (BIS) [3] were also recorded. The patients were ranging in age from 35 to 80 years, with an American Society of Anesthesiologists (ASA) Physical Status score of 1 to 3 and a body mass index (BMI) ranging from 18.5 to 35 kg/m2. Anesthesia was administered using etomidate 0.2 mg/kg; sulfentanyl 1 μg/kg; rocuronium 1 mg/kg. CPB was established when the nasopharyngeal temperature reached 31–32°C; α-stat acid-base management strategy during nasopharyngeal temperature of ≥30°C. The changes and correlation between qNOX and temperature were compared in different time points at basic state, during and after CPB.

Results: The qNOX values during CPB at 5, 10, 15 and 20 minutes after CPB was established were significantly lower than the values at Enter OR ($p < 0.01$), incision, ($p < 0.01$), induction ($p < 0.01$), at 5, 10, 15 min pre-CPB ($p < 0.01$) and at 5, 10 and 15 min Post-CPB time points ($p < 0.01$) (**Fig. 1A**). The temperature level also was significantly reduced compared to the previous time points at Enter OR ($p < 0.01$), incision, ($p < 0.01$), induction ($p < 0.01$), pre-CPB ($p < 0.01$) and Post-CPB (**Fig. 1B**). After CPB, both temperature and qNOX returned to baseline pre-CPB levels. From induction of anesthesia to CPB establishment, there was a little fluctuation of qCON (**Fig. 1C**), but BIS did not decrease much during this period (**Fig. 1D**). The correlations between the three EEG indexes (qNOX, qCON and BIS) and the nasopharyngeal temperature were estimated by linear regression (**Fig. 2**). The qNOX showed a strong positive correlation with temperature (R^2=0.71; *P*<0.01. **Fig. 2A**) with a low-to-moderate correlation between qCON and temperature (R^2=0.30; *P*<0.01. **Fig. 2B**). BIS exhibited a very weak correlation with the temperature during the whole operation (R^2=0.095; *P*<0.01**. Fig. 2C**).

Conclusion: The nociception index, qNOX, revealed a high positive correlation with the temperature, which was higher than the correlations of the temperature with the sedation indexes, qCON and BIS. The results suggest that hypothermia may potentiate the depth of analgesia and the nociception index qNOX, in combination with qCON, can effectively reflect the analgesia and hypnosis levels during the CPB surgery period.

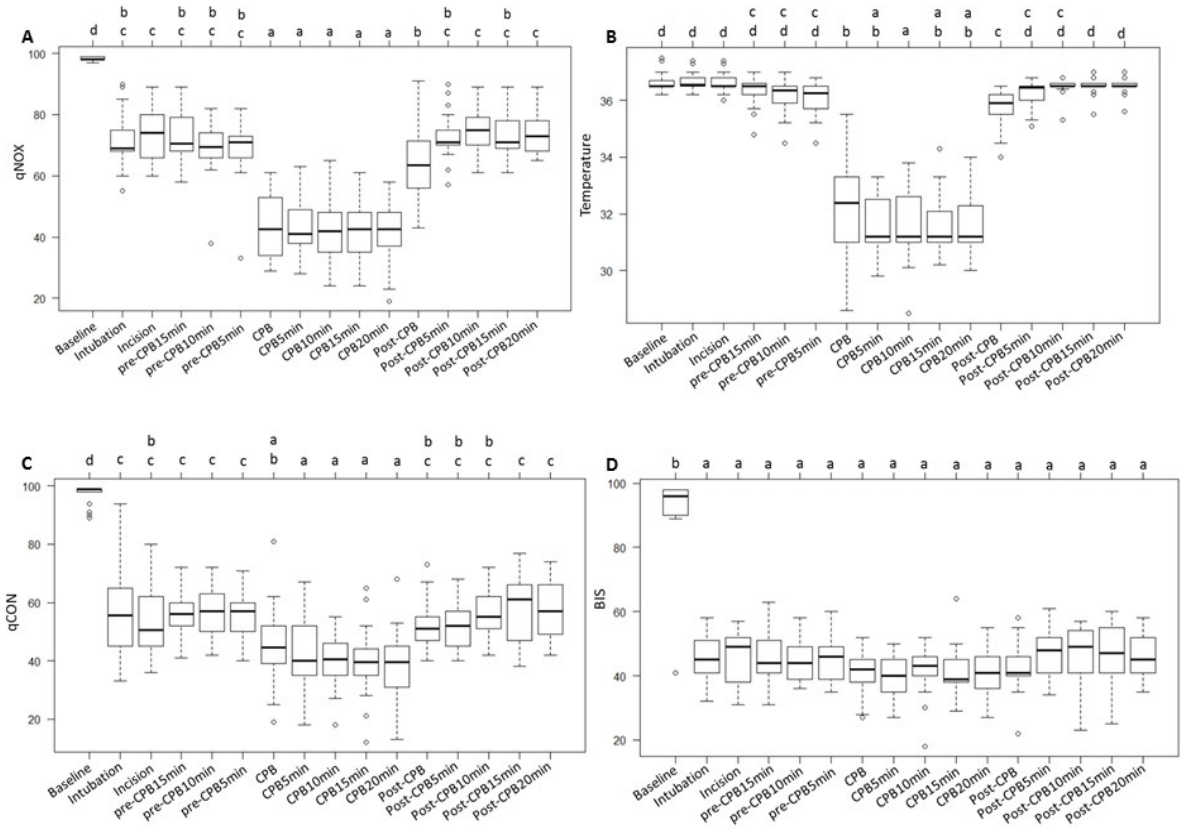

Figure 1. *Percentile boxplots of qNOX (A), qCON (B), Temperature (C) and BIS (D) during CABG surgery. Note: The letters (a, b, c, and d) on top of the boxplots*

represent the significant differences at distinct timepoints. There are no significant differences among timepoints with the same letters, while timepoints with different letters indicate significant differences.

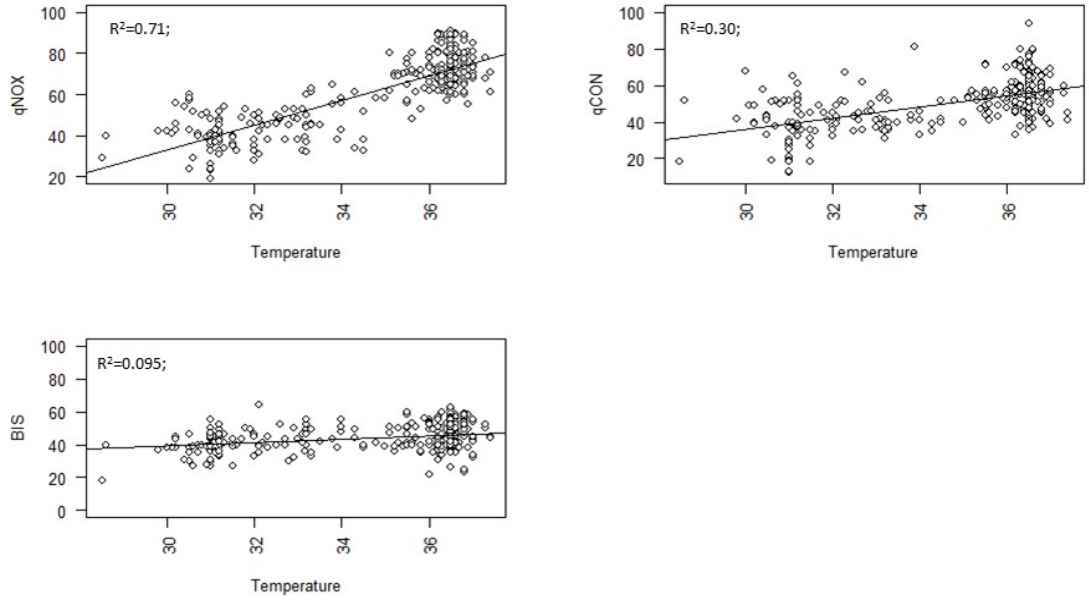

Figure 2. *Scatter plots for the correlation between qNOX and Temperature (A), qCON and Temperature (B), and BIS and Temperature (C).*

References

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