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Letter to Editor

Surgical Pleth Index: Do we need to know more

Sir,

The primary responsibility of anesthesiologist is to protect the patients from the surgical stress of surgery with balanced anesthesia, i.e. triad of hypnosis, analgesia, and muscle relaxation. In modern medicine, with short-acting anesthetic drugs and increase in high-risk patients for surgery, it becomes necessary to maintain anesthesia with judicial administration of anesthetic drugs using advanced monitors to avoid overdose or inadequate effect.

Electroencephalogram variable based monitors such as bispectral index and entropy enables anesthesiologists to maintain adequate depth by adjusting dose of hypnotic agents, and reducing probability of intraoperative awareness as well as hypnotic overdose. Neuromuscular monitors are an integral part of monitoring to precisely adapt muscle relaxation as well as to test for the residual neuromuscular blockade.

Similarly, optimal analgesic titration is desirable as intraoperative stress resulting from inadequate analgesia can influence the post-operative outcome. However, no gold standard exists for assessment of nociception/antinociception, and the administration of analgesics in a clinical setting is still based on anesthesiologist's experience and judged on clinical signs such as patient movement, changes in vital parameters, lacrimation, and pupillary reaction.

The newly developed surgical pleth index (SPI) monitors propose to quantify the intraoperative stress level or nociception during general anesthesia. It is based on two variables pulse photoplethysmographic amplitude (PPGA) and heart rate data from pulse oximetry. The SPI ranges from 0 to 100, high value being associated with high-stress level. The optimal range is not yet determined, but SPI of 50 is supposed to reflect mean stress level with balanced nociceptive and anti-nociceptive factors [Figure 1].

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Several studies support the correlation of SPI in detecting noxious stimuli and its clinical effectiveness on titration of analgesic requirement intraoperatively.

Struys[1] and Gruenewald *et al.*[2] proved that SPI appeared better measure of nociception-anti-nociception balance during propofol-remifentanil anesthesia to standardized noxious stimulus than SE, RE, or PPGA. Huiku *et al.*[3] estimated the surgical stress on patients undergoing gynecological or breast surgery determining SPI high when noxious stimulation was high and remifentanil concentration inadequate; while SPI low with high remifentanil concentration and stimulation low.

Chen *et al.*[4] studied correlation of SPI with stress hormones during propofol-remifentanil anesthesia and found moderate correlation of SPI to the stress hormones (ACTH, cortisol, epinephrine, and norepinephrine) during general anesthesia, but no correlation during consciousness. Ledowski *et al.*[5] found that SPI did not accurately reflect the time course of stress hormone changes, it significantly changed with increasing depth of analgesia after bolus doses of fentanyl.

Many studies compared the intraoperative administration of analgesics guided by SPI versus by conventional methods, its impact on hemodynamic stability, recovery, and side effects. Chen *et al.*[6] reported SPI-guided analgesia resulted in lower remifentanil consumption, more stable hemodynamics, lower adverse events, and comparable recovery times compared with standard analgesia practice. Bergmann *et al.*[7] used remifentanil for outpatient orthopedic operations similarly with faster recovery and no difference in post-operative pain intensity. Study by Won *et al.*[8] using SPI guided IV oxycodone bolus resulted in reduced oxycodone consumption during surgery and shortened extubation time without negative impact on pain scores and post-operative recovery during sevoflurane anesthesia in patients undergoing thyroidectomy, suggesting usefulness of SPI for analgesic titration during sevoflurane anesthesia, while earlier studies were performed using TIVA.

SPI reflects a change of the autonomic nervous system balance in the body. The increase of the sympathetic activity increases SPI. Potentially, any medication or therapy that affects the sympathetic nervous system balance is reflected in the value of the SPI. However, it does not necessarily change the reactivity of SPI to analgesic

Figure 1: Surgical pleth index(SPI) trends

medication or surgical stimulation. In fact, the reactivity is usually maintained, but the interpretation of the absolute SPI level is confounded.

Apart from medications, there are other factors demonstrated to confound SPI such as intravascular volume status, pacemaker action, arrhythmias, and posture changes.[9] SPI varied significantly in healthy volunteers with unimpaired autonomic regulation during trendelenburg and anti-trendelenburg tilt-table. However, in post-operative setting, it demonstrates only moderate sensitivity and specificity in identifying moderate to severe pain.

In pediatric age group, clinical usefulness of the SPI is doubtful as autonomic nervous system is not fully developed in children, and the variables used for SPI are based on adult data which cannot be applicable to children.[10]

To conclude, with the large armamentarium available today in anesthetists' kit and overlooking marketing strategies of equipment companies, SPI seems to be promising one-stop monitor for balanced anesthesia but needs more data in a variety of surgeries under different conditions to support its supremacy.

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