Both insufficient, as well as excessive administration of anesthetics during general anesthesia can compromise the outcome of the patient. Numerous studies have highlighted the fact that through pain-related stress due to inadequate analgesic management, critical patients can present a series of complications. Among these one can mention abnormal hemodynamic episodes, the increase of pro-inflammatory status, the increase of pro-oxidative status, all reflecting upon increased mechanical ventilation times and length of stay in the intensive care unit (ICU).\textsuperscript{1,2} Moreover, higher morbidity and mortality rates in the critically ill polytrauma patients have also been mentioned.

Opioids are used in the everyday practice for minimizing pain-related stress, opioids that are capable of reducing the transmittance of nociceptive stimuli towards the central nervous point. In order to insure an adequate analgesic management, the anesthetist must maintain a constant nociception-antinociception balance. At the time being in order to evaluate the pain status and the nociception-antinociception balance the anesthetist uses clinical signs and secondary hemodynamic changes, such as tachycardia, hypertension and hypotension.\textsuperscript{3}

As well-known as it is today, the critically ill polytrauma patient presents in most of the cases hemodynamic changes related to the traumatic impact, such as hypovolemic shock, centralization of blood flow and vasoconstriction. At this point in time, anesthesia guidance and analgesic management that only take into account the changes in vital signs do not have high enough specificity and accuracy.

For that purpose, a series of systems have been developed, that are used for adapting analgesia according to the individual necessities of each patient. One of these systems is represented by the Surgical Pleth Index\textsuperscript{™} (SPI) (GE Healthcare, Helsinki, Finland). SPI is calculated automatically through the analysis of the normalized heart beat intervals (HBIs) and plethysmographic pulse wave amplitudes. Both factors are given by the sympathetic and parasympathetic tone...
balance. Hence, SPI is a trustworthy parameter for the biological response to pain-related stress.4

Chen et al., have evaluated the remifentanil consumption in the case of patients that have benefited from SPI monitoring, comparing them with those who benefited from classical monitoring. The patients benefiting from SPI-guided anesthesia have reported a significant drop in the opioid consumption. Moreover, a significant drop in unwanted events has been reported in the case of patients in which analgesic managements was guided after the SPI.5 Furthermore, Bergmann et al., have reported a decrease in remifentanil and propofol consumption when using SPI in analgesia management. In addition, they have identified shorter recovery times in the SPI-guided analgesia group.6

Colombo et al., have also marked out the fact that SPI-modulated analgesia offers a more stable sympathetic modulation during laparoscopic cholecystectomy. However, this study did not show any statistically significant drops in remifentanil consumption or in the incidence of intraoperative or postoperative complications.7

A similar study has been conducted by Bonhomme et al., who addressed the hemodynamic effects and the correlations between SPI and the mean arterial pressure and heart rate. Following this prospective observational study they have reported statistically significant correlations between the hemodynamic changes and the SPI-guided analgesia control.8 From a bio-humoral point of view a series of changes due to painful stimuli can be seen, changes that can be quantified by determining the cortisol, epinephrine and norepinephrine levels. Chen et al. have carried out a study regarding the correlations between the changes in stress hormones values and the values of the SPI. They have reported strong statistically significant correlations between high SPI levels and the accelerated secretion of stress hormones. In this manner they have concluded that by modulating analgesia using SPI one can reduce the acute bio-humoral changes during general anesthesia.9

Struys et al. have carried out a study in which the compared changes that appear in SPI values, state entropy (SE), response entropy (RE), and heart rate (HR) following a noxious stimulus. They have shown a strong statistical correlation between the dynamic values of SPI correlated with target-controlled infusion of remifentanil (Ceremi) in comparison to SE, RE, and HR. Moreover, they have proven the fact that target-controlled infusion of propofol (Ceprop) is independent from the SPI, in comparison with SE, RE, and HR, where they have identified strong, statistically significant correlations. Following this study the concluded that SPI can be correlated with the nociception-antinociception balance, and therefore can be successfully used in the analgesia management during general anesthesia.10 A similar study was carried out by Ahonen et al., who have shown strong correlations between SPI dynamics and pain-related stress management during gynecological laparoscopy interventions.11

In conclusion, we can state that by implementing multimodal monitoring techniques in general anesthesia for controlled damage surgery can bring significant clinical benefits. Continuous noninvasive monitoring of the nociception-antinociception balance is responsible for adapting the analgesia management depending on the individual needs of each patient. Therefore, by individualizing the anesthesia practices according to the needs of each patient, adverse intraoperative and postoperative effects are reduced. Moreover, by ensuring a hemodynamic stability secondary to dosage tittering for anesthetic substances, molecular pro-inflammatory and pro-oxidative effects due to excessive volemic resuscitation can be reduced. Hence we can state that by implementing a complex monitoring system for general anesthesia one can ensure “the art of anesthesia” through the personalization of the therapeutic act dependent on each individual patient.

CONFLICT OF INTEREST

The author, Alexandru Florin Rogobete, is employed by GE Healthcare, holding the position of Clinical Intern. However, he has no conflict of interests to declare regarding this publication. Following the publication of this paper, Alexandru Florin Rogobete did not receive any bonuses, material compensations or other benefits from GE Healthcare. The other authors declare no conflict of interests.

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