Unexpected Entropy response to saline spraying at the end of posterior fossa surgery: a few cases report

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Minto (2)) and propofol (Master TCI®, Fresenius Kabi, Bad Homburg, Germany; model of Marsh (3)). A single 0.6 mg kg⁻¹ bolus dose of rocuronium was administered to facilitate tracheal intubation, and no further dose was administered before saline spraying. Patients were mechanically ventilated with a 50% oxygen-air mixture (end-tidal carbon dioxide partial pressure maintained between 4.0 and 4.7 kPa). During surgery, propofol concentration (Cpro) was adjusted to keep the Sate Entropy (SE) within the 40-60 range, while remifentanil concentration (Crem) was adjusted to keep stable mean arterial pressure (MAP) and heart rate (HR). Hemodynamic and Entropy parameters were recorded every 5 seconds throughout the surgical procedure using the Rugloop® II software (monitor only version, Demed, Temse, Belgium).

At the end of surgery, saline spraying at a temperature close to body temperature was performed by the surgeon under steady-state anesthetic infusion rates (ranges: 2 to 3.5 µg/ml for Cpro and 3 to 7 ng/ml for Crem) in all patients. The spraying was performed for hemostatic purposes and surgical wreckage elimination, and occurred 149 to 213 min after induction of anesthesia. It resulted in a sudden, abrupt, and sustained increase in RE and SE consecutive to spraying and involved all the six patients while Entropy value did not change in the two other ones. In the responding patients, this increase was of approximately 50 units amplitude. A dose of 0.1 mg kg⁻¹ rocuronium was then administered to one of the responders and substantially attenuated the Entropy increase. In the two non responders, repeated spraying maneuvers and administration of the same low dose of rocuronium did not change Entropy values. The sustained increase in RE and SE consecutive to spraying and its attenuation after a low dose rocuronium administration is illustrated in the Figure. The six patients recovered immediately after surgery and had an uneventful post-operative course. None of them complained of awareness upon interview in the post-operative period.

**DISCUSSION**

The reported observations show that in non-paralyzed patients, maneuvers of saline spraying performed during posterior fossa surgery may provoke a sudden, abrupt, and sustained increase in Entropy. They raise two main questions: what is the reason for such an increase and what is the underlying mechanism?

On a first analysis, an increase in Entropy should evoke a decrease in the depth of anesthesia. Indeed, an increase in RE indicates frontal EMG activation and may occur during painful stimulation with inadequate anesthesia (4). In the same way, RE has been shown to be useful at identifying inadequate balance between nociception and antinociception (5). Such a hypothesis seems unlikely for different reasons. The increase in Entropy was consecutive to a spraying maneuver which does not represent a noxious stimulus by itself. This spraying maneuver was performed under steady-state anesthetic perfusion rates, in patients having completely recovered from muscle relaxation, and in the absence of any other noxious stimulation. The Entropy increase was substantially attenuated by the administration of a low dose of rocuronium in one patient. None of the responding patients complained of awareness in the post-operative period. As far as this increase is partially resolved after rocuronium administration, it is most likely caused by an increase in facial muscle activity. It has already been shown that the RE response can be affected by muscle relaxation (6) and that this alteration is dose-dependent (7). In a recent study, the EMG arousal responsible for the RE response has been reported to be abolished by rocuronium at the train of four level 0/4 (8). This could explain why a low dose rocuronium did not abolish the RE response in all of the responding patients. We hypothesize that in our patients the RE response reflecting a modification of the electromyographic activity of the facial muscles could result from the spraying maneuver responsible for a direct stimulation of the facial nerve or for triggering a trigemino-facial reflex. However, we cannot exclude an arousal effect of spraying on the EEG activity, increasing the power of frequencies above 32 Hz, such as β frequencies. In that case, attenuation of the increase in Entropy by rocuronium could result from a direct influence of muscle relaxation on the depth of anesthesia through a decrease in proprioceptive afferences emerging from muscle spindles (9).

Investigation of our hypothesis deserves a randomized, double-blind, controlled study using rocuronium versus placebo as well as an appropriate measurement of the neuromuscular function, an electromyographic recording of facial muscle activity, and a direct recording of raw EEG activity. Whatever the underlying mechanism of the Entropy response, it appears that spraying maneuvers may confound the interpretation of Response Entropy as a useful index of nociception during posterior fossa surgery. Observing such an increase at the time of...
spraying in the absence of hemodynamic changes may prompt the anesthesiologist to administer a test dose of muscle relaxant instead of deepening anesthesia. This can help differentiating between inadequate depth of anesthesia and EMG contamination. Should the above-mentioned hypothesis be verified, Response Entropy could be considered as a monitoring of the facial nerve in non-paralyzed patients undergoing posterior fossa surgery.

Fig. 1. — Heart rate (dashed grey), mean arterial pressure (plain grey), RE (plain black), and SE (dashed black) in the series of 6 patients at the time of saline spraying. First black square corresponds to the beginning of spraying, and second one to the administration of 0.1 mg/kg rocuronium (patient 1, 5 and 6). R = responsive patient to saline spraying, NR = non-responsive patient to saline spraying.

References


