The Detection of A sympathetic response using Evidence-based monitoring

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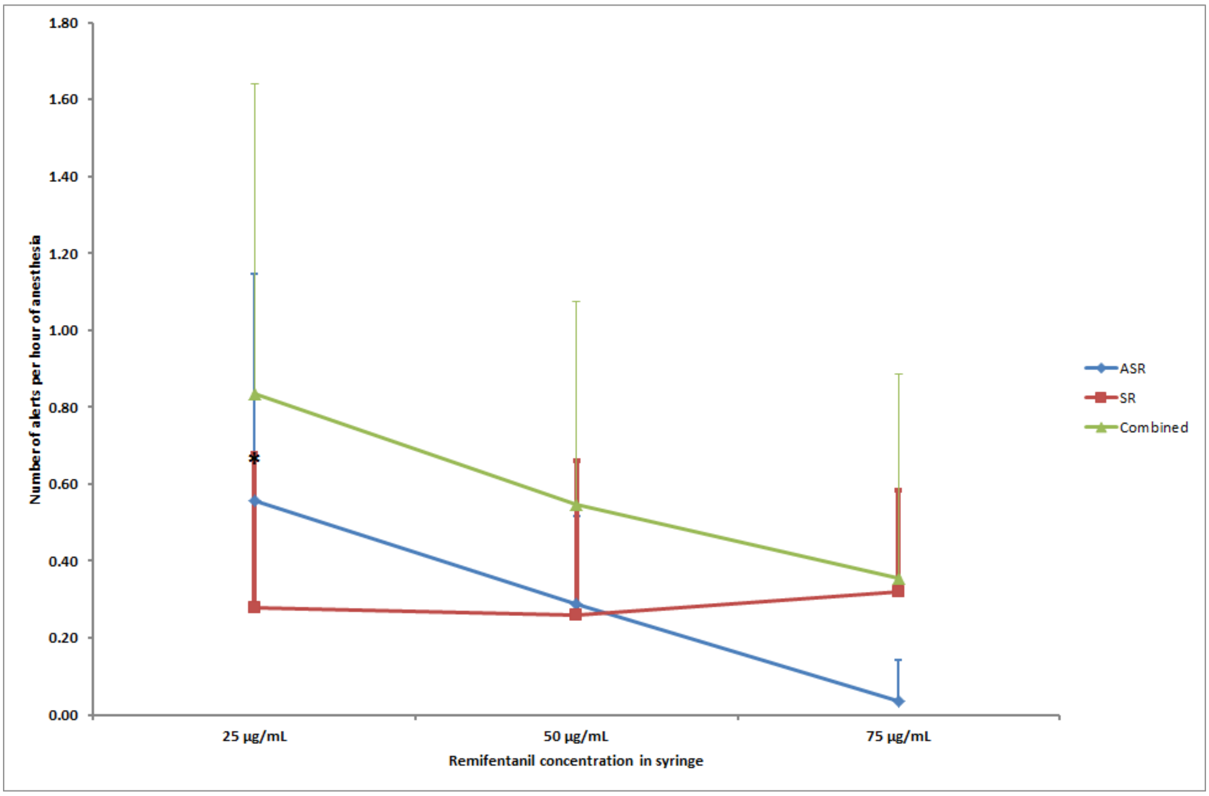
Introduction: Physiological responses to anesthesia and surgery are well documented and are a combination of changes in many variables. Pattern recognition techniques allow detecting these changes. Our software [1] uses changes in each variable as a piece of evidence to determine the pathophysiological change (the diagnosis). A sympathetic response may result in an increase in heart rate and blood pressure and a decrease in pulse volume. However, in the presence of β-blockers, fixed rate pacemakers and high dose opiate anesthesia, heart rate responses may be suppressed or absent.

This study aimed at detecting a full sympathetic response (SR) or the achronotropic response (ASR), i.e. an increase in blood pressure and a decrease in pulse volume without changes in heart rate. Using data from a previous study [2], we looked at the ability of the anesthesiologist in charge to adjust remifentanil administration adequately.

Method: The data were collected from GE AS5 monitors at 10s intervals and arterial pressure waveforms at 100Hz. The original data were modified to suit the needs of the software used, EBMi [1]. The modifications did not change the intrinsic values of the variables or their timing. The output files produced by the EBMi software were then analyzed for the incidence of both SR and ASR per hour of anesthesia. ASR occurs if SR occurs (because ASR is a subset of SR). Therefore, when they occurred simultaneously, ASR was not counted. False positive alerts were removed from the dataset. There were three groups of patients undergoing intracranial neurosurgery under propofol and rémifentanil TCI. Propofol effect-site concentration was adjusted to keep State Entropy between 40 and 60, and remifentanil effect site concentration to keep stable hemodynamic parameters, at the discretion of the anesthesiologist in charge, who was blind to the concentration in the syringe: 25, 50, or 75 µg/mL. Data were analyzed using Kruskal-Wallis, and Mann-Witney tests. The correspondence between incidence of alerts and effective concentration of rémifentanil in the syringe was assessed using prediction probability (PK).

Results: The low concentration patients (10) had a mean anesthesia duration of 166 [41], the medium group (9 patients) 182 [29], and the high group (9 patients) 187 [20] min. The figure shows the incidence of SR, ASR and combined responses per hour of anesthesia. The incidence of ASR only was significantly higher in the low concentration group than in the high concentration group (*; Kruskal-Wallis $H = 6.42$; $P = 0.04$; Mann-Witney $U = 20$; $P = 0.02$).The incidence of SR or combined responses was not significantly different between groups. The PK of ASR at predicting rémifentanil concentration in the syringe was 0.27 [95 % CI: 0.11 – 0.43]. SR and combined responses had no significant predictive ability.

Discussion It is possible to create software that recognizes the patterns of physiological change. These changes are pieces of evidence that, when combined, are suggestive of a diagnosis. This study shows that EBMi has ability to detect a sympathetic response that is intuitively correct with the nature of the anesthetic being given. It shows that practitioners adequately adjust remifentanil concentration to account for sympathetic responses when all signs are present, but are less efficient at avoiding achronotropic sympathetic responses. This pattern recognition software has shown that its output is appropriate for the anesthetic state produced by remifentanil infusions.



References

1. http://www.custos.co.nz/

2. V. Bonhomme, et al. Br. J. Anaesth. (2011); 106: 101-111, and Hans et al. Acta Anaesthesiol Scand 2012; 56: 787–796.