DETERMINANTS OF ALARM-RATE AND THE POTENTIAL OF INTELLIGENT MONITORING SYSTEMS IN ROUTINE ANAESTHESIOLOGICAL USE

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Background: We investigated the determinants and the implications of alarms for the further development of a monitoring system augmented with artificial intelligence techniques assisting the anaesthesiologists.

Methods: We observed anaesthetists responses to intraoperative monitoring alarms during various surgery. Alarm limits and frequency of alarm reports were documented including the parameters heart rate, blood pressure (invasive and non-invasive), SpO₂, etCO₂, FiO₂, PAW. The alarms were evaluated in qualities assigned to: 1) artifact / being ignored as a nuisance alarm, 2) change noticed before alarm report / functioning as a reminder, 3) alarm without requiring therapeutic consequences / corrective response and 4) alarm requiring therapeutic consequences / corrective response. All patients risk score ASA I-III were included, introduction and emergence from anaesthesia were excluded. Alarm limits, alarm frequency, ASA risk-score, observation-time and alarm-quality were documented using a blinded questionnaire. We created a „norm adjusted alarm index“ (fig. 1) to compare the alarm rate settings. The alarm limits defined as normal for the development of the „norm adjusted alarm index“ are listed in table 1.

Results: During 120 procedures with a complete operation time of 15640 minutes 237 alarms were observed. 130 (55 %) of these alarms were classified as quality 1 (artifact). 68 (52 %) of these artefacts were caused by pulsoxymetry, followed by 46 (35 %) caused by ECG. Other parameters were negligible (1 to 5 %). Regression analysis of „norm adjusted alarm index“ vs. alarm-frequency by time (fig. 2) failed (r = 0,113; p = 0,082; α = 0,05).

Conclusion: The technical management of artefacts is still a major problem. Pulsoxymetry in particular, followed by ECG, is a substantial reason for the appearance of artefacts. Actual or potential consequences of this research include the design of alarm systems that are more informative and more sensitive to operative context than current systems. On this basis a major goal would be the development of a computer system enhanced with artificial intelligence techniques for the identification of artefacts and the further detection of critical events. This might lead to an expert-based knowledge system capable for on-line and real-time analysis of patient data during surgery reducing the frequency of alarms and supporting the anaesthesiologist during critical events.