Towards an automated multimodal clinical decision support system at the post anesthesia care unit

Background: The aim of this study was to develop a predictive algorithm detecting early signs of deterioration (ESODs) in the post anesthesia care unit (PACU), thus being able to intervene earlier in the future to avoid serious adverse events. The algorithm must utilize continuously collected cardiopulmonary vital signs and may serve as an alternative to current practice, in which an alarm is activated by single parameters. Methods: The study was a single center, prospective cohort study including 178 patients admitted to the PACU after major surgical procedures. Peripheral blood oxygenation, arterial blood pressure, perfusion index, heart rate and respiratory rate were monitored continuously. Potential ESODs were automatically detected and scored by two independent experts with regards to the severity of the observation. Based on features extracted from the obtained measurements, a random forest classifier was trained, classifying each event being either an ESOD or not an ESOD. The algorithm was evaluated and compared to the automated single modality alarm system at the PACU. Results: The algorithm detected ESODs with an accuracy of 92.2% (99% CI: 89.6%–94.8%), sensitivity of 90.6% (99% CI: 85.7%–95.5%), specificity of 93.0% (99% CI: 89.9%–96.2%) and area under the receiver operating characteristic curve of 96.9% (99% CI: 95.3%–98.5%). The number of false alarms decreased by 85% (99% CI: 77%–85%) and the number of missed ESODs decreased by 73% (99% CI: 61%–85%) as compared to the currently used alarm system in the hospital. The algorithm was able to detect an ESOD in average 26.4 (99% CI: 1.1–51.7) minutes before the current single parameter system used in the PACU. Conclusion: In conclusion, the proposed biomedical classification algorithm, when compared to the currently used single parameter alarm system of the hospital, showed significantly increased performance in both detecting ESODs fast and classifying these correctly. The clinical effect of the predictive system must be evaluated in future trials.

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