Predictors of the accuracy of pulse-contour cardiac index and suggestion of a calibration-index: a prospective evaluation and validation study.

Abstract:
Cardiac Index (CI) is a key-parameter of hemodynamic monitoring. Indicator-dilution is considered as gold standard and can be obtained by pulmonary arterial catheter or transpulmonary thermodilution (TPTD; CItd). Furthermore, CI can be estimated by Pulse-Contour-Analysis (PCA) using arterial wave-form analysis (Clpc). Obviously, adjustment of Clpc to CItd initially improves the accuracy of Clpc. Despite uncertainty after which time accuracy of Clpc might be inappropriate, recalibration by TPTD is suggested after a maximum of 8 h. We hypothesized that accuracy of Clpc might not only depend on time to last TPTD, but also on changes of the arterial wave curve detectable by PCA itself. Therefore, we tried to prospectively characterize predictors of accuracy and precision of Clpc (primary outcome). In addition to "time to last TPTD" we evaluated potential predictors detectable solely by pulse-contour-analysis. Finally, the study aimed to develop a pulse-contour-derived "calibration-index" suggesting recalibration and to validate these results in an independent collective. In 28 intensive-care-patients with PiCCO-monitoring (Pulsion Medical-Systems, Germany) 56
datasets were recorded. Clpc-values at baseline and after intervals of 1 h, 2 h, 4 h, 6 h and 8 h were compared to Cltd derived from immediately subsequent TPTD. Results from this evaluation-collective were validated in an independent validation-collective (49 patients, 67 datasets). Mean bias values Cltd-Clpc after different intervals ranged between -0.248 and 0.112 L/min/m(2). Percentage-error after different intervals to last TPTD ranged between 18.6% (evaluation, 2 h-interval) and 40.3% (validation, 6 h-interval). In the merged data, percentage-error was below 30% after 1 h, 2 h, 4 h and 8 h, and exceeded 30% only after 6 h. "Time to last calibration" was neither associated to accuracy nor to precision of Clpc in any uni- or multivariate analysis. By contrast, the height of Clpc and particularly changes in Clpc compared to last thermodilution-derived Cltd(base) univariately and independently predicted the bias Cltd-Clpc in both collectives. Relative changes of Clpc compared to Cltd(base) exceeding thresholds derived from the evaluation-collective (-11.6%= 20% in the validation-collective. Recalibration triggered by changes of Clpc compared to Cltd(base) derived from last calibration should be preferred to fixed intervals.