ACCURACY OF CONTINUOUS NON-INVASIVE RESPIRATORY RATE DERIVED FROM PULSE OXIMETRY IN PATIENTS WITH HIGH RESPIRATORY RATES

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Introduction: Elevated respiratory rates are a leading indicator of impending cardiorespiratory complications, underscoring the need for continuous respiratory rate monitoring in hospital and acute care settings. RR_{oxi}, a recently developed algorithm, provides continuous non-invasive respiratory rate in conjunction with a standard pulse oximeter. To better characterize the clinical utility of this application, we sought to evaluate its performance in patients with tachypnea. In this analysis, we assessed the accuracy of RR_{oxi} in patients with initial respiratory rates at or above 20 breaths per minute.

Methods: We retrospectively analyzed data from 17 patients hospitalized on the general care floor (N=13) or presenting to the emergency department (N=4). All patients were breathing at a respiratory rate of 20 breaths per minute or more at the onset of the monitoring session. Photoplethysmogram data were acquired during a ~20 min monitoring period using a pulse oximetry finger sensor. Data were post-processed and respiratory rate values were determined offline by RR_{oxi}. Reference respiratory rates were established with nasal/oral capnography waveform data acquired simultaneously. Accuracy was calculated as both root mean square deviation (RMSD) between RR_{oxi} and the reference respiratory rate and mean error. Precision was calculated as standard deviation of the mean error measurement. Pearson correlation coefficients were computed to assess the relationship between the reference method and the algorithm output.

Results: Mean and range of the reference respiratory rate were 22.7 ± 2.4 and 16.6 to 32.0 breaths per minute, respectively. The mean difference between the measurements was 0.94 ± 1.55 breaths per minute. The accuracy of RR_{oxi} was 1.81 breaths per minute, as measured by RMSD. The agreement between RR_{oxi} and the reference was R^2=0.67. During the study period, RR_{oxi} computed a respiratory rate value 91% of the time patients were monitored, yielding a total of 3,746 paired observations (RR_{oxi} values and the capnography-base reference respiratory rate).

Conclusion: These results demonstrate that the RR_{oxi} algorithm is accurate to within 1.81 breaths per minutes (RMSD) in hospitalized and emergency department patients with respiratory rates greater than 20 breaths per minute at the onset of monitoring. Additionally, a respiratory rate was determined by the algorithm during 91% of the monitoring period. These results for RR_{oxi} suggest that this algorithm may be clinically acceptable to provide continuous non-invasive respiratory monitoring in patients with high respiratory rates.