# Performance of Masimo Rainbow Acoustic Monitoring for Tracking Changing Respiratory Rates Under Laryngeal Mask Airway General Anesthesia for Surgical Procedures in the Operating Room: A Prospective Observational Study.

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BACKGROUND: Accurate monitoring of respiratory rate may be useful for the early detection of patient deterioration. Monitoring of respiratory rate in the operating room under general anesthesia by spirometry is technically straightforward and demonstrates high fidelity. Accurate measurement of the respiratory rate of an unattended patient outside the operating room is fraught with challenges. Monitors such as capnometry and thoracic impedance pneumography have significant drawbacks. Respiratory acoustic monitoring (RRa™) is a new technology for respiratory rate monitoring, which has been demonstrated to provide accurate respiratory rates in patients recovering from anesthesia, but the performance of this RRa-enabled monitor under conditions of major respiratory rate variation has not been evaluated.

METHODS: We enrolled 53 patients undergoing urologic procedures in the operating room under general anesthesia with a laryngeal mask airway, spontaneous ventilation, and no muscle relaxation in an observational study. Respiratory signals (RRa and in-circuit pneumotachograph) were stored for later analysis. Artifacts were excluded based on visual inspection of the raw respiratory waveforms. Instantaneous respiratory rates were obtained from the pneumotachograph signal using the Hilbert-Huang Transform. Instantaneous rate estimates (IREs) were compared with RRa by 3 methods. First, the mean delay between IREs and RRa was determined. Second, precision was obtained by Bland-Altman analysis for repeated measures. Third, for all disparities in rates exceeding 4 breaths per minute (bpm), the probability of persistent error was determined as a function of time, with 95% confidence intervals estimated by bootstrap analysis.

RESULTS: Data were collected from 53 patients. Three patients were excluded due to missing data. There were no adverse events related to RRa monitoring. RRa demonstrated a median delay of 45 seconds (interquartile range 20 seconds) to detect a 1- bpm change in IREs. Bland-Altman revealed 95% limits of agreement of -2.1 to 2.2 bpm across the range of 7 to 48 bpm. Disparities in respiratory rate >4 bpm between the 2 methods did not persist beyond 160 seconds, and 90% of these differences resolved within 33 seconds (95% confidence interval 23-48 seconds).

CONCLUSIONS: The data demonstrate that, under conditions of general anesthesia with a laryngeal mask airway and spontaneous ventilation, the RRa rapidly detects changes in respiratory rate, demonstrates minimal bias, and when errors in rate occur, these do not persist. The utility of this monitoring technology in detecting rate changes in unattended patients will require further study.