Accuracy of Respiration Rate and Detection of Respiratory Pause by Acoustic Respiratory Monitoring in the PACU.

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Introduction

Respiratory rate is a neglected vital sign. [1] Current methods for monitoring ventilation have limitations including poor accuracy and low patient tolerance. The aim of this study was to evaluate a new acoustic monitoring technology and capnometry in postsurgical patients to determine respiration rate accuracy and ability to detect respiratory-pause events.

Methods

Following IRB approval and written informed consent, adult patients presenting to the post anesthesia care unit (PACU) were connected to a Pulse CO-Oximeter with acoustic monitoring technology (Rad-87, version 7804, Masimo, Irvine, CA) through an adhesive bioacoustic sensor (RRa, rev C) applied to the subject's neck, lateral to the cricoid cartilage. Each subject was also fitted with a nasal cannula connected to a bedside capnometer (Capnostream20, version 4.5, Oridion, Needham, MA). The acoustic monitor and capnometer were connected to a computer with software (ADC, Masimo) for continuous waveform and parameter recording. Acoustic and end tidal carbon dioxide (etCO2) waveform files were retrospectively analyzed by a trained technician using a specialized LabVIEW-based software program (TagEditor, Masimo) which allows simultaneous viewing of both waveforms while listening to the breathing sounds from the acoustic signal to determine inspiration and expiration reference markers within the respiration cycle without using the acoustic monitor- or capnometer-calculated respiration rate. An additional technician was used to validate the reference markers and if disagreement between technicians existed, a third technician was used to adjudicate. The reference respiration rate was then automatically calculated by the software program. The respiration rate from the acoustic monitor and capnometer was compared to the reference respiration rate and bias and precision were calculated. A respiratory-pause event was defined as no inspiration or expiration activity in the reference respiration cycle for ≥30 seconds. The acoustic monitor and capnometer were judged as sensitive if they indicated no respiration rate at any time during a respiratory-pause event and were specific if they indicated a respiration rate when there was no respiratory-pause event.

Results

Thirty four adults (74% female) with age of 45±14 yrs and weight 118±41.5 Kg were enrolled. A total of 3,712 minutes of monitoring time (average 109 minutes per subject) were analyzed. The performance characteristics of the acoustic monitor and capnometer compared to the reference method are shown in Table 1.

Conclusion

In this population of post-surgical patients, the acoustic monitor and capnometer both provided acceptable respiration rate accuracy when compared over all respiration rate cycles, but the acoustic monitor had superior sensitivity for detecting respiratory-pause events.

Performance Characteristics

Method	Bias (bpm)	Standard dev (bpm)	sensitivity = TP/(TP+FN)	Specificity = TN/(TN+FP)
Capnography	-0.6	2.6	62%	98%
RRa	-0.1	2.4	81%	99%

1. Cretikos, M.A., et al., Respiratory rate: the neglected vital sign. Med J Aust, 2008. 188(11): p. 657-9.

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