Respiration Rate Accuracy of Masimo Rainbow SET® Acoustic Monitoring and Capnography Monitoring

INTRODUCTION

Respiration rate is a critical vital sign in assessing the physiological status of hospitalized patients, yet limitations of current technologies prevent widespread use. Continuous monitoring of respiration rate is especially important for post-surgical patients receiving patient-controlled analgesia (PCA) for pain management as the sedation can induce respiratory depression and place patients at considerable risk of serious injury or death.[1-5]

Although the Anesthesia Patient Safety Foundation (APSF) recommends oxygenation and ventilation monitoring in all patients receiving opioids,[6] current methods for respiration rate monitoring can be limited by accuracy or patient compliance. Masimo Rainbow SET® Acoustic Monitoring™ for respiration rate (RRa™) was developed to overcome the limitations of current continuous respiratory rate technologies while maintaining or improving accuracy.

METHODS

This study was performed on healthy subjects under Institutional Review Board approval. Subjects were connected to a capnography monitor (Oridion® Capnostream™ 20) with nasal cannula (Oridion MicroStream®) and to a Masimo Rainbow SET Device with a Rainbow Acoustic Sensor attached to the side of the subject's neck. The capnography respiratory rate measurements are based on end-tidal CO_2 gas samples continuously drawn from the nasal cannula at a rate of 50ml per minute.

Masimo Rainbow SET Acoustic Monitoring utilizes an adhesive sensor with an integrated acoustic transducer that is applied to the patient's neck. The respiratory signal is separated and processed using signal extraction technology to display continuous respiration rate. All measurements were collected simultaneously from both instruments.

Subjects were instructed to breath at rates ranging from 4 to 30 breaths per minute (brpm). Waveform data were collected from both devices with time stamps to correlate breath data. The control reference was first obtained by a trained observer measuring respiratory rate based on listening and counting the number of respiratory inspirations and expirations. The reference was then verified visually with capnography waveforms and by listening to inspirations and expirations again (as done during auscultation). If the capnography respiration rate measured zero, the data were not included in this analysis, since the capnography monitor's automated calibration routine indicates a zero value during calibration.

Bias, standard deviation, and root mean square accuracy were calculated for both methods compared to the control respiration rate.

RESULTS

A total of 26 healthy volunteers were included: 8 were females (31%) and 18 were males (69%) with characteristics shown in Table 1.

Table 1. *Subject characteristics*

	Age (years)	**Height** (inches)	**Weight** (pounds)	**BMI**
Average	35.5 ±11.1	68.8 ±3.9	175.6 ±45.6	25.8 ±5.6
Range	23 to 60	61 to 75	102 to 278	18.3 to 43.5

Bias, standard deviation, and root mean square accuracy for Masimo RRa and capnography were similar, as shown in Table 2.

Table 2. *Study results*

Dataset	Number of Samples	Bias (brpm)	Standard Deviation (brpm)	Root Mean Square Accuracy (brpm)
Masimo RRa	21,369	0.18	1.31	1.33
Capnography Respiration Rate	21,405	0.22	1.62	1.63

CONCLUSION

These results indicate that Masimo RRa and capnography respiration rate provide similar accuracy when compared to control respiration rate.

REFERENCES

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