Accuracy of a Novel Bioacoustic Sensor in Adult Postoperative Patients

Macknet M, Norton S, Kimball-Jones P, Applegate R, Martin R, Allard M. Society for Technology in Anesthesia 17th Annual Meeting. Rosen Plaza Hotel, Orlando FL. January 17-20, 2007

Respiration monitoring provides an important clinical safety net for spontaneously breathing patients in the operating room, post anesthesia care unit (PACU) and general care ward. Current methods for monitoring respiration include cannula systems and impedance pneumography, both of which have limitations relating to reliability, accuracy and patient comfort. Cannula systems are prone to clogging and are frequently not tolerated by the patient, and impedance pneumography suffers from a high incidence of false alarms[1]. Researchers from the Department of Anesthesiology at Loma Linda University Medical Center used adult postoperative patients in the PACU to evaluate the accuracy of a prototype bioacoustic sensor from Masimo Corporation that is designed to continuously and noninvasively monitor patient respiration.

Methods

Ten adult postoperative PACU patients, with a mean age of 57.8 +/- 24.4 years, were monitored with a nasal cannula connected to a BCI capnometer (SIMS, Waukesha WI) and an adhesive bioacoustic sensor attached to the neck area and connected to an acoustic respiration monitor prototype (Masimo Corp, Irvine CA). Both the capnometer and the bioacoustic monitor from each patient were connected to computers for continuous data recording and analysis. To assess the accuracy of each monitoring system, bias, precision and ARMS were calculated by comparing data from both the bioacoustic sensor and capnometer to a reference respiratory rate from a manual scoring system. Respiratory rate varied 3 to 28 bpm in the patients during the monitoring time which was 55.2 +/- 38.9 min.

Results

n= 10 adults	Bias	Precision	ARMS
Capnography vs. Reference Value	-0.53	2.11	2.23
Masimo Bioacoustic Sensor vs. Reference Value	-0.15	2.23	2.36

There was no statistical difference in accuracy between capnography and the bioacoustical sensor method for measuring patient respiration.

Author's Conclusions

"The new prototype bioacoustic respiratory sensor demonstrates accuracy for respiratory rate monitoring as good as capnometry, in this population of patients in the PACU. This data suggests the new bioacoustic sensor may provide a system at least as accurate as capnometry for monitoring respiration in spontaneously breathing patients. This device offers multiple benefits over existing devices and has a potential to improve monitoring in a general care setting."

1 Folke M, Cernerud L, Ekstrom M, Hok B. Critical review of non-invasive respiratory monitoring in medical care. *Med Bio Engin Comp* 2003; 41: 377-383.

Accuracy of a Novel Bioacoustic Sensor in Pediatric Postoperative Patients

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Respiration monitoring provides an important clinical safety net for spontaneously breathing patients in the operating room, post anesthesia care unit (PACU) and general care ward. Current methods for monitoring respiration include cannula systems and impedance pneumography, both of which have limitations relating to reliability, accuracy and patient comfort. Cannula systems are prone to clogging and are frequently not tolerated by the patient, and impedance pneumography suffers from a high incidence of false alarms[1]. Researchers from the Department of Anesthesiology at Loma Linda University Medical Center evaluated the accuracy of the new Masimo bioacoustic sensor designed to continuously and noninvasively monitor respiration, compared to the capnometer cannula system in pediatric postoperative patients.

Methods

Six pediatric, PACU patients with a mean age of 11 +/-6.3 years were monitored with both a nasal cannula connected to a BCI capnometer (SIMS, Waukesha WI) and a Masimo adhesive bioacoustic sensor connected to an acoustic respiration monitor prototype (Masimo Corp, Irvine CA). The Masimo bioacoustic sensor was applied to the patient's neck lateral to the cricoid cartilage. Both the capnometer and the bioacoustic monitor were connected to a computer for continuous data recording and analysis. To assess the accuracy of each monitoring system, bias, precision and ARMS were calculated by comparing data from both the bioacoustic sensor and capnometer to a reference respiratory rate from a manual scoring system. Additionally, data on signal loss from the capnography system and the bioacoustic monitoring system were recorded from 15 more pediatric patients. When either monitoring system displayed a signal loss, the time was noted and the sensor from that system was checked for proper positioning and reattached if necessary. Data on signal loss was compared for the two monitoring systems using a paired t-test or Chi square analysis, as appropriate. Respiratory rate varied 3 to 35 bpm in the patients during the study duration which was 58.7 +/-39.6 min.

Results

n= 6 pediatric patients	Bias(bpm)	Precision(bpm)	ARMS (bpm)
Capnography vs. Reference Value	-1.17	3.74	3.92
Masimo Bioacoustic Sensor vs. Reference Value	-0.03	3.49	3.49

Signal Loss (n = 15 pediatric patients)	# of Dislodgements of Sensor	Time to Dislodgement of Sensor (min)
Capnography	14	15.2 $\pm$ 19.4
Masimo Bioacoustic Sensor	0	n/a

The CPO gave a zero reading in 6 cases, a low signal in 7 cases, no signal in 3 cases and erroneous saturation readings (more than 10% off compared to the ABG) in 3 cases. One case was not recorded.

Author's Conclusions

"The new prototype bioacoustic respiratory sensor demonstrates accuracy for respiratory rate monitoring as good as capnometry in this population of pediatric patients in the PACU. This device offers multiple benefits over existing devices, including increased connectivity, and has a potential to improve monitoring in a general care setting… This should lead to significantly more reliable monitoring of respiration rate."

1 Folke M, Cernerud L, Ekstrom M, Hok B. Critical review of non-invasive respiratory monitoring in medical care. *Med Bio Engin Comp* 2003; 41: 377-383.