Accuracy and Tolerance of a Novel Bioacoustic Respiratory Sensor in Pediatric Patients.

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Anesthesiology 2007; 107: A84.

Introduction

Monitoring respiration of spontaneously breathing patients is a concern in the operating room, post anesthesia care unit (PACU), and on general care wards. Present technology has focused on capnometry attached to the patient's airway via a nasal cannula as the best method of providing this monitoring.[1] There are multiple problems with this method of monitoring respiration including cannula dislodgement or occlusion leading to inaccurate data or complete loss of monitoring.[2] A novel bioacoustic sensor for monitoring respiration has been developed. We evaluated patient tolerance for the capnometer cannula system and the new bioacoustic sensor. We also compared the accuracy of the new system to the capnometer accuracy in pediatric postoperative patients.

Methods

Following institutional IRB approval and informed consent, 15 pediatric patients admitted to the PACU were monitored in the standard fashion. In addition, a nasal cannula was placed, secured with tape, and connected to a BCI capnometer (SIMS, Waukesha WI). An adhesive bioacoustic sensor connected to a breathing frequency monitor prototype (Masimo Corp, Irvine CA) was applied to the patient's neck just lateral to the cricoid cartilage. Both the capnometer and the bioacoustic monitor were connected to a computer for continuous data recording. The accuracy of the new bioacoustic sensor and the capnometer were compared to a reference respiratory rate from a manual scoring system. Bias, precision and A_{RMS} were calculated in the usual fashion, as either bioacoustic – reference or capnometer – reference. Additionally, when either signal was lost, the appropriate sensor was checked for proper positioning and attachment. Time was noted when either sensor was dislodged resulting in loss of data. Data on signal loss was compared using paired t-test or Chi square where appropriate, with $p<0.05$ considered significant.

Results

All data is expressed as mean ± standard deviation. 15 patients age = 6.6 ± 3.6 years, weight = 36.6 ± 26.2 kg were enrolled to date. Respiratory rate varied 2 to 45 bpm during this time. The resultant bias, precision and A_{RMS} for the capnometer was -3.12, 7.11, and 7.77 bpm respectively. The bias, precision and A_{RMS} for the bioacoustic sensor was -2.85, 6.18, and 6.80 bpm respectively. Duration of monitoring time in PACU was 58.7 ± 39.6 minutes. Premature cannula dislodgement occurred in 14 patients. Loss of signal due to dislodgement of the capnometer occurred after 15.2 ± 19.4 minutes. In no patient was the bioacoustic sensor dislodged before the end of stay in PACU ($p< 0.001$).

Discussion

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. In clinical settings where continuous and reliable monitoring of spontaneous respiration is important the new bioacoustic sensor provides equivalent accuracy; however, does not require a cannula system. This should lead to significantly more reliable monitoring of respiration rate.

References:1) Pediatrics 2006;117;1170-1178; 2) Medical and Biological Engineering and Computing.