Detection of Respiratory Pauses by Clinical Observation: Capnography and Acoustic Monitoring

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Introduction

Patient monitoring that allows for the timely detection of hypoventilation is necessary during procedures being performed under sedation. Clinician observation, pulse oximetry and capnography are used individually or in combination for this purpose, but each method has known limitations. Clinician observation is unreliable due to competing priorities during procedures, pulse oximetry may be a late indicator of hypoventilation and capnography can have a high rate of false alarms. Rainbow acoustic monitoring is a relatively new method of monitoring respiration rate. The purpose of this study was to compare the accuracy of rainbow acoustic monitoring and capnography for detection of respiratory pauses during sedation compared to the retrospective analysis of waveform files by a clinician.

Methods

A convenience sample of adults patients, scheduled to undergo total knee arthroplasty receiving regional anesthesia with sedation, were enrolled. All patients were connected to a Pulse CO-Oximeter (Rad-87, sw 7805 with RA sensor, rev C; Masimo, Irvine CA) with rainbow acoustic monitoring (RRa), a study capnograph with nasal cannula (Capnostream20, sw 02.53, Covidien, Bedford, MA) and a standard of care capnograph (Draeger Apollo) connected to the same nasal cannula. A stethoscope was attached to the patient's neck on the contralateral side to the acoustic sensor. All study devices were connected to a computer for continuous recording of waveform and parametric data. When the standard of care capnograph indicated a respiration rate of zero for at least 10 sec, the clinician confirmed the absence of airflow with the stethoscope and noted a respiratory pause. To determine the number of true positive and false positive respiratory pauses of ≥10 sec recorded by each method, a clinician retrospectively reviewed the waveform files of both the RRa and capnography simultaneously, while listening to the breathing sounds from the acoustic signal. Only file segments with respiratory pauses recorded by any method were retrospectively analyzed so any respiratory pause events missed by all methods were not included in this analysis.

Results

Fifty-one respiratory pauses from 20 enrolled patients were validated as true positives by retrospective analysis. True positives and false positives of recorded respiratory pauses by each method are shown in Table 1. Clinician observation of capnography missed the most events while capnography detected the most events but had many false positives. Of the respiratory pauses detected by a single method, acoustic monitoring had the highest percentage of true positives and the lowest percentage of false positives.

Conclusion

When compared to clinical observation or capnography, rainbow acoustic monitoring may provide the best method for detection of respiratory pause during procedures requiring sedation because it has acceptable accuracy for detection of respiratory pause with a low rate of false alarms.

		RETROSPECTIVE ANALYSIS	
N=51 respiratory pauses	**Respiratory Pauses Recorded, n**	**True Positives (percentage)**	**False Positives (percentage)**
Clinician Observation of EtCO2, n (%)	11	8 (73%)	3 (27%)
Acoustic Monitoring, n (%)	37	28 (76%)	9 (24%)
Capnography, n (%)	110	47 (43%)	63 (57%)

Figure 1