Introduction

Post-operative respiratory depression (PORD) and sleep disordered breathing, including obstructive sleep apnea (OSA) are well-established risk factors for post-operative respiratory complications, with increased prevalence in the obese population. Current post-operative monitoring does not provide quantitative measurements of ventilation, and the true incidences of PORD and post-operative apnea (POA) remain unknown. Because these incidences often overlap with opioid-induced respiratory depression, it is especially important given the prevalent use of opioids and other respiratory depressants in post-operative analgesia.

Unfortunately, respiratory monitoring options for obese patients are limited. Current practice relies on tools such as the STOP-Bang (SB) questionnaire to identify patients at increased risk for disordered breathing and straiten them into higher-acuity protocols. These patients are often monitored more vigilantly, placed on a lower opioid regimen or require additional respiratory interventions (e.g. CPAP, BiPAP, supplemental oxygen). Such stratifications are not based on real-time, quantitative evaluation of respiratory status, and can often result in increased cost and length of stay with negligible improvement to patient outcomes. To address these issues, a non-invasive, impedance-based respiratory volume monitor (RVM) that provides accurate, continuous, real-time, quantitative measurements of minute ventilation (MV), tidal volume (TV), and respiratory rate (RR) was used to track patients’ respiratory status during post-operative care. We here quantified the incidence of PORD and POA in an obese population and evaluated the association between STOP-Bang scores and other potential risk factors.

Methods

Following IRB approval and written informed consent, a bio-impedance based RVM (ExSpiron, Respiratory Motion Inc,Walnut, CA) was used to collect continuous digital respiratory traces from 80 obese patients (BMI≥35kg/m²) undergoing elective surgery with general anesthesia, via an electrode Padlet placed on the thorax (Figure 1). This cohort comprised four post-operative groups of obese patients with an average age of 47 ± 12 years and an average BMI of 43 kg/m². Monitoring begin pre-operatively and continued until PACU discharge. Demographic data, medical history, and STOP-Bang scores were collected in each patient, along with a pre-operative screening score (MV) with a sensitivity of only 54%, a positive predictive value (PPV) of 28% and a negative predictive value (NPV) of 89%.

Figure 1: A non-invasive Respiratory Volume Monitor (RVM, Exspiron, Respiratory Motion Inc) that provides continuous, real-time, non-invasive measurements of MV, TV and RR. Figure shows standard electrode placement. One electrode is placed at the internal mid axillary, another is placed on the epidural and the third is placed in the right mid axillary line at the level of the epithor.

Results

PORD: Thirteen of 80 patients in this cohort (15%) displayed post-operative respiratory depression (PORD), as defined by the lowest minute ventilation over a 5 minute stretch in the PACU being below 40% of MVBASELINE. Further analysis revealed no significant association between incidence of PORD and either STOP Bang score risk stratification or pre-existing OSA diagnosis (Table 1, row 1). Additionally, none of the potential risk factors variables examined in our multivariate analysis showed association with the incidence of PORD.

POA: Twenty-five of 80 patients (31%) in this cohort demonstrated post-operative apnea (POA), as defined by 5 apnec events per hour over the course the PACU stay. The better fidelity of the RVM system led to identification of more apneic events in the PACU and the more conservative definition of post-operative apnea as a single episode over the entire PACU period was even more sensitive. Further analysis revealed no significant association between incidence of POA and any STOP Bang score risk stratification. The STOP-Bang (SB) questionnaire identified age as the only variable tested that showed significant association with POA incidence (p=0.01). None of the additional risk factors examined (BMI, sex, diabetes, asthma, CHF and CAD) showed significant association.

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Figure 4: Post-operative apnea (POA) as a predictor of post-operative respiratory depression (PORD). POA was a poor predictor of PORD (defined here as low MV) with a sensitivity of only 54%, a positive predictive value (PPV) of 28% and a negative predictive value (NPV) of 89%.

Figure 5: Pre-op MV below 75% as a predictor of post-operative respiratory depression (40% MVpred for 2 minutes) in obese patients. Sensitivity is 99% and specificity is 71%. Positive predictive value is 50%, and negative predictive value is 95%.

Conclusions

• RVM technology allows for direct, quantitative monitoring of respiratory compromise in the PACU/ICU setting, providing a more accurate assessment of the need for respiratory interventions or OSA diagnosis. • OSA diagnosis and STOP Bang scores were not useful predictors of PORD or POA. • Risk stratification according to OSA diagnosis or STOP-Bang score may not be an effective patient management strategy.

References:

1. Schumann R, George E, Ladd D, Bonney I, Ianchulev S, Ladd D, Diane Ladd, diane_ladd@msn.com


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