Opioid-induced respiratory depression (OIRD) and post-operative apnea (POA) are difficult to accurately diagnose and often go undetected by current monitoring technology. Patients with a known diagnosis of obstructive sleep apnea (OSA) or risk factors for OSA are considered to have an increased risk for post-operative respiratory complications; however, we have found that OSA patients are only a small fraction of the patients who require additional respiratory monitoring. A novel, non-invasive respiratory volume monitoring system has demonstrated the ability to provide continuous, real-time, accurate, quantitative measurements of minute ventilation (MV), tidal volume (TV) and respiratory rate (RR) in non-intubated patients. Since hypercapnia and hypoventilation are usually preceded by hypoxemia, the ability to non-invasively monitor changes in minute ventilation can give a real-time assessment of true respiratory status and enable the clinician to make informed patient care decisions regarding effective pain management, readiness for discharge or need for additional monitoring.

A first-order risk assessment algorithm based on pre-opioid MV was evaluated in this cohort. The algorithm aimed to predict incidences of OIRD in postoperative patients and provide a conceptual framework in which real-time monitoring can be combined with risk stratification to reduce the incidence of respiratory complications. This algorithm was also compared to preoperative diagnosis of OSA for sensitivity as a predictor for POA and OIRD.

**Methods**

An impedance-based RVM (ExSpiron, Respiratory Motion, Inc., Waltham, MA) used a three electrode PadSet placed on the thorax to collect digital respiratory traces from 176 patients undergoing elective orthopedic surgery (age: 56 ± 11.3 yrs; BMI: 29.4 ± 6.2 kg/m²). Respiratory status was monitored per PACU protocol. Patient care staff was blinded to the RVM measurements but the respiratory trace was kept visible to confirm the patient's functional status in real-time.

Digital data, including HR, BP, SpO2 and medications were also recorded.

**Results**

Of the 176 elective joint replacement patients, only 21 (12%) had an OSA diagnosis. Of those with an OSA diagnosis, only 6 were among the 21 (29%) patients experienced OIRD. In fact, these 6 patients accounted for just 17.5% (6 of 34) of the patients who experienced episodes of POA. This highlights the dangers of relying on an OSA diagnosis, since the other 84% of POA patients were more likely to have their respiratory compromise go unobserved. Overall, OASA was only 165 sensitive and 85% specific for predicting POA, with a positive predictive value (PPV) of 25% and negative predictive value (NPV) of 79%.

**Conclusion**

RVM can be used to inform caregivers and promote the development of protocols for the safe use of opioids for pain management and that patient safety can be improved with individualized care based on real-time objective measurements of ventilation.