

## Commentary

### \*Corresponding author

**Ashish K. Khanna, MD**

Assistant Professor of Anesthesiology  
Center for Critical Care  
Departments of General Anesthesiology  
and Outcomes Research  
Anesthesiology Institute  
Cleveland Clinic, 9500  
Euclid Ave # G58  
Cleveland, OH 44195, USA  
Tel. 216-308-4948  
Fax: 216-444-7360  
E-mail: [khannaa@ccf.org](mailto:khannaa@ccf.org);  
[ashish@OR.org](mailto:ashish@OR.org)

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## Respiratory Depression on the Wards: Why Better Monitoring may be the Answer?

**Ashish K. Khanna, MD\***

*Departments of General Anesthesiology and Outcomes Research, Anesthesiology Institute, Cleveland Clinic, 9500 Euclid Ave # G58, Cleveland, OH 44195, USA*

Although, deaths during anesthesia are rare, deaths in the post-operative period are not.<sup>1</sup> The third leading cause of death in the United States is mortality after surgery, during the 'recovery and rehabilitation' period.<sup>2</sup> The most common cause of 30-day post-operative mortality unsurprisingly, is cardiorespiratory complications.

The Agency for Healthcare Research and Quality (AHRQ) rated post-operative respiratory failure as the fourth most common patient safety event in its 2015 report. Unfortunately, there is no consensus on a true definition of respiratory depression. The incidence of respiratory depression, based on varied definitions and criteria ranges from as little as 0.3% to 17%.<sup>3</sup>

While residual anesthetic gases, muscle relaxants, and narcotics may be common offenders in the post-anesthesia care unit (PACU), poor respiratory mechanics, baseline respiratory diseases, poor respiratory physiology, and secondary insults with ventilatory manifestations are big players for respiratory depression in the intensive care unit (ICU). Most clinicians feel that respiratory depression needs to be addressed most aggressively while in the critical care areas such as the PACU and ICU. However, these are extensively monitored areas. Every vital sign is tracked continuously and every deviation from the norm results in a physician or nursing intervention. The bottom line is that we understand the reasons for respiratory impairment in these areas. Additionally, we know when it happens in real time. We can intervene, we can tackle specific causes, we can escalate care. It would stand to reason then, that patients rarely die of respiratory depression as an immediate and direct cause in the PACU and ICU.

The ward (regular nursing floor) is usually a place of comfort for clinically stable patients. Continuous post-operative oxygen saturation in non-cardiac surgical patients was monitored for upto 48 hours after surgery. This monitoring started once the patient left the PACU or the ICU and reached the regular nursing floor. Importantly, bedside care providers were blinded to this oximetry. The nurses continued their routine checks on vital signs every 4 hours per protocol. Post-operative hypoxemia was common, serious, and prolonged. For example, 20% of patients demonstrated an average of 10 minutes of saturation <90% per hour over their entire hospitalization. And soberingly and rather shockingly, 90% of serious hypoxemic episodes (saturation <90% for ≥1 full hour) were completely missed by nurses conducting routine vital sign monitoring at 4-hour intervals.<sup>4</sup>

Patients continue to decompensate on the ward, resulting in emergency medical team activation and transfer to higher levels of care. Not only is post-operative hypoxemia common, unforeseen and persistent but unfortunately it remains difficult to predict. Surprisingly, a closer look at a vulnerable population, that with obstructive sleep apnea using the STOP-Bang scores (a validated measure of obstructive sleep apnea risk) showed that these scores were not associated with the amount of post-operative oxygen desaturation.<sup>5</sup> Narcotics, are the stated culprit for a lot of emergent floor to ICU transfers. A recent closed claims analysis examined post-operative opioid induced respiratory depression.<sup>6</sup> Sadly, atleast 77% of patients suffered death or severe brain damage. As our work has suggested previously, only 9% had abnormal STOP-BANG scores. We examined the association of the type of narcotic (long- vs. short-acting) in patient controlled analgesia (PCA) systems and saw that the risk of hypoxemia was not reduced

by using short-acting opioids.<sup>7</sup> Using easily available information, it is not possible to reliably predict which post-operative inpatients will desaturate, or the severity of their hypoxemia.

Lee et al<sup>6</sup> also showed that almost all of opioid induced respiratory depression events were deemed preventable with better monitoring and response. Importantly, 42% of these episodes occurred within 2 hours of the last nursing check. Monitoring may thus be the answer, but what, who and how to monitor are important facets as well. Manually recorded oxygen saturation data were, on average, 6.5% higher than those recorded *via* automated systems in a large tertiary care medical center patient cohort.<sup>8</sup> While continuous pulse oximetry on the regular ward prevents ICU transfers and decreases rescue events, it is certainly not the be all and end all of respiratory monitoring.<sup>9</sup> The American Society of Anesthesiologists (ASA) recommends continuous monitoring of patients with neuraxial blocks and extended monitoring of those with obstructive sleep apnea. In addition, the guidelines from the ASA stress monitoring a combination of oxygenation and ventilation.

Either tachycardia or hypoxemia may occur early on in a struggling patient, or the two may co-exist, and they often progress to hypotension, which is strongly associated with myocardial injury and death.<sup>10,11</sup> As a corollary, it is well established that vital signs deteriorate 6-12 hours before cardiac and respiratory arrests occur<sup>12-14</sup> — which is the basis for having hospital rapid-response teams which undoubtedly save lives.<sup>15</sup>

The problem of respiratory depression on the wards (regular nursing floor) is common and dangerous. It causes many surgical patients to be transferred from the floor to the ICU – sometimes once, sometimes repeatedly. The PRediction of Opioid-induced Respiratory Depression In Patients Monitored by capnoGraphY (PRODIGY) trial [ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT02811302) Identifier: NCT02811302 is a global trial that is currently underway and may help answer some of those questions. For now, though, continuous automated cardiorespiratory monitoring appears to be the only real answer. A combination of oxygenation, ventilation and a minimum hemodynamic parameter should be monitored on everyone across the board. Moving forward, optimal handling of monitors and prevention of alarm fatigue are certainly important educational pieces for our colleagues on the regular nursing floors. As anesthesiologists and intensivists, we know respiratory depression too well. Eternal vigilance is also the motto behind sound anesthesia training and care. Continuous and improved monitoring practices on the wards will help ensure a safe and secure recovery environment for our patients.

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