

Oxygen reserve index – A new paradigm in patient safety

Madam,

Pulse oximetry is a standard ASA monitor which enhances hypoxia detection and prevents perioperative adverse events.^[1] However, it provides no indication of falling PaO₂ until saturation begins to decrease. Oxygen Reserve Index (ORI) is a novel real-time pulse oximeter based non-dimensional index that ranges from 1 to 0 as PaO₂ decreases from 200 mmHg to 80 mmHg. It is measured by optically detecting changes in venous oxygen saturation (SvO₂) after arterial oxygen saturation (SaO₂) saturates to the maximum.^[2] ORI may thereby provide a clinically important warning of impending desaturation ahead of standard pulse oximetry in high risk procedures such as bronchoscopy.

A three-year-old, male child weighing 11 kg, was brought by parents with complaints of cough since 10 days and increased respiratory activity with retraction since 4 days. CT scan showed patchy consolidation in left middle and lower zone with soft tissue density in left main bronchus suggestive of foreign body bronchus. Patient was posted for rigid bronchoscopy SOS flexible bronchoscopy. After informed consent and intravenous Midazolam premedication, patient was taken inside the operating room (OR). Standard monitors were attached along with Masimo SET rainbow pulse oximeter (Masimo, Irvine, CA) with the ORI probe on the right index finger. Anesthesia was induced using Inj. Propofol 3 mg/kg and Inj. Atracurium 0.5 mg/kg and a 4.5 mm ID rigid bronchoscope was inserted, and was subsequently ventilated through the side port of ventilating bronchoscope.

The baseline ORI was 0.38 which increased to 0.68 after preoxygenation. The ORI dropped progressively to 0.28 to 0.18 during the apneic periods when instrumentation was

done, and improved to 0.33 when ventilation was resumed. The pulse oximeter showed 100% saturation during this period. The ORI dropped to 0 after the final instrumentation and suctioning was done to remove mucus plugs from the left mainstem and lobar bronchi [Figure 1]. The oxygen saturation decreased from 100% to 97% 2 minutes after ORI came down to 0. Following the procedure, the patient was intubated with 4.5 mm ID uncuffed endotracheal tube and ventilated with 100% Oxygen. The saturation rose to 100% and ORI gradually increased to 0.33. The child was then extubated and shifted to the ICU.

Pulse oximetry is a sensitive indicator of desaturation, but it delays detection of hypoventilation or hypoxemia in children when oxygen supplementation is provided as oxyhemoglobin saturation remains 100% over a wide range of oxygen partial pressures >80 mmHg.^[3,4] Hence, it is difficult to predict when desaturation will start in an apneic patient or during procedures like bronchoscopy. ORI serves to indicate PaO₂ trends (rising or falling PaO₂) when Spo₂ is over 98%. It also reflects oxygenation in the moderate hyperoxic range (PaO₂ 100–200 mmHg).

In our patient, SpO₂ remained at 100% during the period of preoxygenation and apnea. However, ORI showed changes in either direction with maximum value at preoxygenation (0.68) and decreasing gradually during apnea (0.2) when instrumentation was done. It improved when ventilation was resumed. Only after ORI dropped to zero did the SpO₂ value decrease. Monitoring ORI detects impending desaturation before evident changes in SPO₂ occur. This gives the clinician an important warning ahead of time to take corrective measures in vulnerable population. However, ORI cannot replace pulse oximetry or PaO₂ measurements, but only act as a complementary tool. The measurements and calculation of ORI are affected by temperature, pH, PaCO₂ and low perfusion states.^[2]

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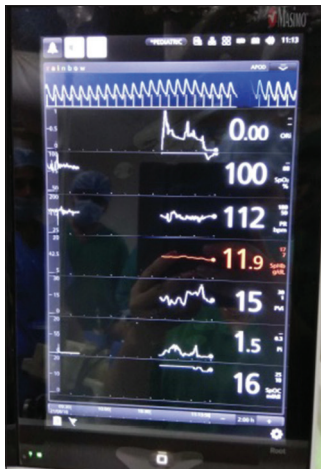


Figure 1: Masimo SET Rainbow monitor showing ORI zero at SpO₂ of 100%

Once desaturation starts during airway instrumentation, which is likely in procedures like bronchoscopy, it typically progresses at an exponential rate more so in premature babies, infants, young children, and also those with respiratory pathology/respiratory tract infections. Obtaining PaO₂ values from ABG is not practical in such situations as it is time consuming and also invasive.^[2] So during such situations, having a reliable estimate of time before hypoxemia becomes critical and helps us guide management.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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