

Oxygen Reserve Index: An early warning for desaturation in critically ill patients.

Presented During:

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Introduction:

Pulse oximetry (SpO₂) monitoring has revolutionized anesthetic practice and improved perioperative patient safety. Expansion of this technology to use more than two wavelengths provides additional information shown to correlate with arterial oxygen concentrations (PaO₂) values in the moderately hyperoxic region.¹ This information is characterized as the Oxygen Reserve Index (ORI), a unit-less scale between 0 and 1, which correlates with PaO₂ between 100 and 200mmHg. Preliminary studies have shown ORI to be a clinically useful advanced warning of arterial hemoglobin desaturation in pediatric patients.²

This study was designed to evaluate the potential clinical utility of ORI as an early warning of arterial hemoglobin desaturation in critically ill patients.

Methods:

This prospective observational study of ORI in adult critically ill patients included those scheduled for elective surgical procedures requiring endotracheal intubation and planned arterial pressure monitoring catheter placement prior to induction of general anesthesia. To evaluate ORI as an early warning for arterial desaturation, we measured the time elapsed for various events following the start of intubation. These included the time from the start of the ORI alarm (triggered by a decrease in the absolute value and rate of change of ORI) to 94% saturation and the time from a saturation of 98% to 94% (Figure 1). The average increase in warning time provided by the ORI was considered to be the time interval between the ORI alarm start to a saturation of 98%.

Results:

Written informed consent was obtained from 40 patients. In one patient the automatic data collection program failed. In two patients the ORI sensor failed initial calibration. Of the remaining 37 patients, four had ORI alarm durations and times from ORI alarm start to 94% saturation that were over 3 times the standard deviation of the average values of the remaining patients. These four patients were labeled as outliers and considered separately from the remaining 33 patients (Table 1). The average time from the start of the ORI alarm to a saturation of 94% was 80 ± 38 seconds (range 29 to 227 seconds). In comparison, the average time from a saturation of 98% to a saturation of 94% was 46 ± 23 seconds (range 12 to 108 seconds). The average increase in warning time provided by the ORI was 34 ± 23 seconds (range 4 to 119 seconds). The average increase in warning time provided by the ORI on a percentage basis was $96 \pm 92\%$ (range 5% to 479%).

Conclusion:

This study demonstrates the potential utility of ORI as an advanced warning of arterial desaturation and as an adjunct to SpO₂. This additional warning time can potentially translate to improved patient safety by allowing earlier calls for help, assistance from a more experienced person, or modification of airway management. For this analysis we defined the advance warning to end at 98% SpO₂. In clinical situations this SpO₂ might not be considered to be critical. Using a lower SpO₂ as the alarm level would increase the advance warning provided by ORI. Further analysis of the correlation of ORI and PaO₂, the use of ORI as a guide to pre-oxygenation, and its utility in the morbidly obese are areas for future study.

IARS Abstract Category:

Technology, Computing and Simulation, Equipment Monitoring

[Figure1.pdf \(https://files.aievolution.com/ars1701/abstracts/abs_1406/Figure1.pdf\)](https://files.aievolution.com/ars1701/abstracts/abs_1406/Figure1.pdf)

[Table1final.pdf \(https://files.aievolution.com/ars1701/abstracts/abs_1406/Table1final.pdf\)](https://files.aievolution.com/ars1701/abstracts/abs_1406/Table1final.pdf)

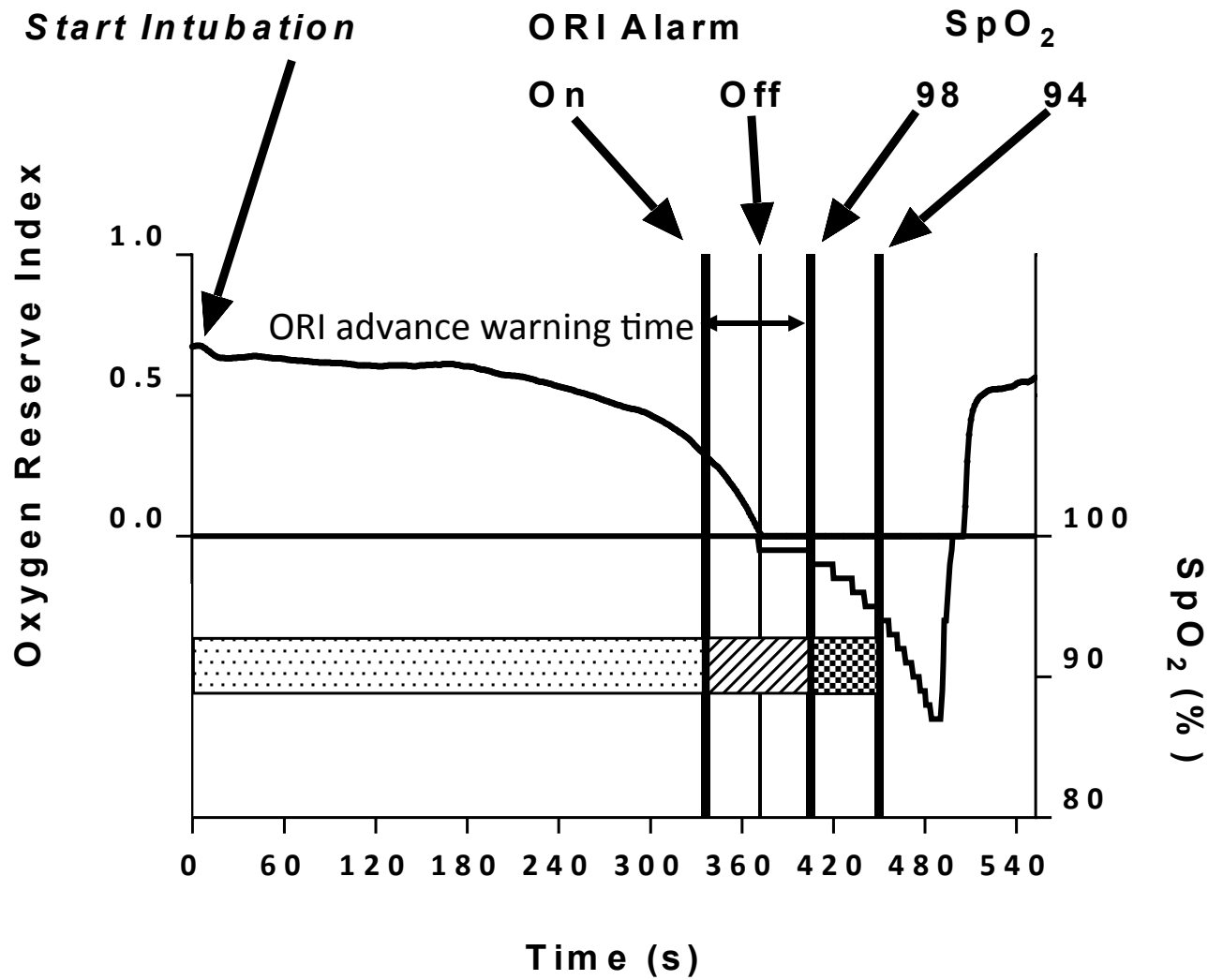


Figure 1. Summary of typical patient with the increase in warning time provided by the ORI denoted as the time elapsed from ORI alarm ON to 98% saturation.

Table 1. Patient demographics.

Enrolled and analyzed	N = 33	
Gender	Male	Female
	22	11
Age (years) \pm SD	60.5 \pm 7.9	63.5 \pm 9.9
BMI \pm SD	30.2 \pm 6.7	29.4 \pm 5.3
Baseline ORI value at start of intubation \pm SD	0.52 \pm 0.24	0.64 \pm 0.24
Procedure Type		
Valvular Repair/Replace	14	6
CABG	4	4
Miscellaneous	4	1
ASA Classification		
3	2	2
4	20	9