F&P Optiflow

Flow Matters

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New evidence continues to emerge showing how Optiflow™ Nasal High Flow contributes to **improved patient care and outcomes.**

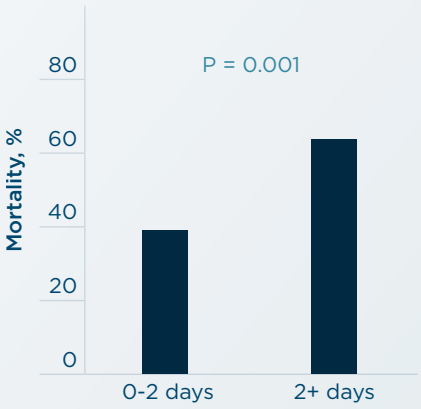
Predicting the outcome of nasal high flow therapy using the Respiratory-Rate-Oxygenation (ROX) index

Author*: Stanislav Tatkov, M.D., Ph.D.

Background

In the last decade, nasal high flow (NHF) has become a first-line therapy for patients with acute hypoxemic respiratory failure.[1]

NHF is a powerful oxygenation tool.[2] However, a high FiO_2 can potentially mask deterioration and delay escalation of care.



1. Patients who were intubated after more than 2 days on NHF had a higher mortality rate.[5]

The risk of delayed intubation

The risk of invasive mechanical ventilation is well understood, although delaying intubation can result in a lengthened hospital stay and increased mortality.[3,4] In a retrospective study by Kang *et al.*, patients receiving NHF therapy who were intubated earlier had lower mortality, improved extubation success, and fewer days on a ventilator.[5]

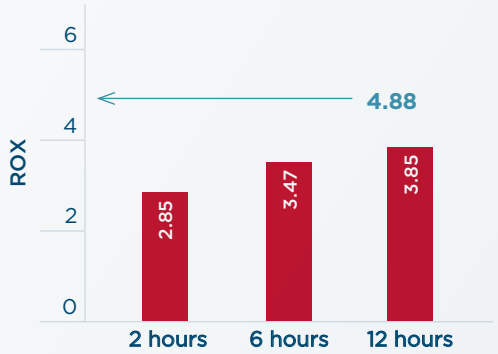
* Clinical Research Manager, Fisher & Paykel Healthcare

How to predict success and failure of NHF using ROX

$$\text{ROX} = \frac{SpO_2/FiO_2}{RR}$$

$$\text{Healthy } 30.2 = \frac{95/0.21}{15}$$

$$\text{Patient } 3.0 = \frac{95/0.85}{37}$$



2. The ROX that predicts failure shown in red at 2, 6 and 12 hours and the ROX that predicts success above 4.88.

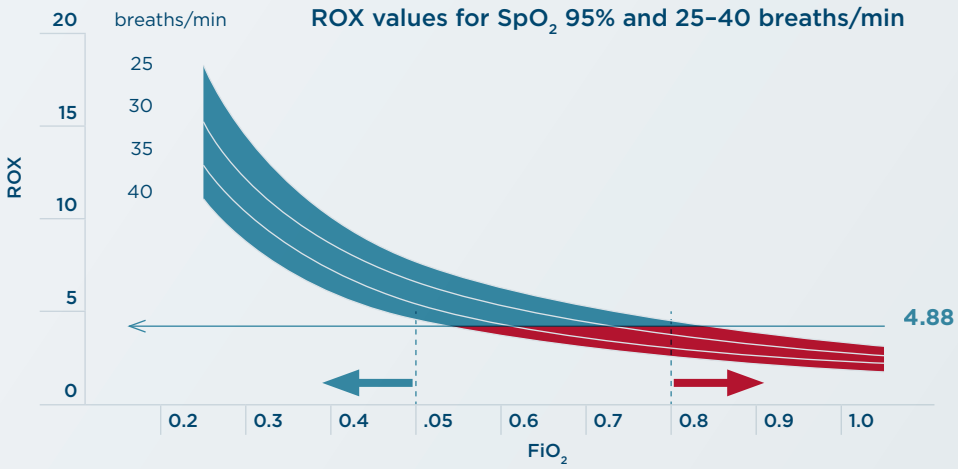
What is ROX?

Roca and colleagues (2016) first established the ROX index to predict the success of NHF therapy.[6] The ROX index combines three common measurements: FiO_2, SpO_2, and respiratory rate. **NHF of 50 L/min and higher** in adults exceeds inspiratory flow and reduces the entrainment of air. This makes delivered FiO_2 more precise and it can be used for the ROX calculation. The index is based on two well-known facts: sicker patients require more oxygen and have a higher respiratory rate.[7]

Validating ROX

The index has been validated in a multi-center prospective study on 191 patients with pneumonia.[8] The authors confirmed that a ROX value of ≥ 4.88 predicted the success of NHF. In addition, ROX values were provided that predict NHF failure with a high specificity (98–99%): ≤ 2.85 at 2 hours, ≤ 3.47 at 6 hours, and ≤ 3.85 at 12 hours of NHF use.

"The authors confirmed that a ROX value of ≥ 4.88 predicted the success of NHF"



3. ROX values above 4.88 are shown in blue and below 4.88 are shown in red. FiO_2 below 0.50 predicts higher ROX and above 0.80, lower ROX for breathing rates between 25 and 40 breaths/min and SpO_2 of 95%.

The importance of FiO_2

Among components of the index, SpO_2/FiO_2 had a greater weight than the respiratory rate.[8] This is reflected in Figure 3[7]: an FiO_2 of 0.80 or above will predict a ROX index of less than 4.88, shown in red, and an FiO_2 of 0.50 or below will predict a higher ROX, shown in blue.

What do changes in the ROX mean?

If the respiratory rate and/or FiO_2 requirement is increasing, then the patient is clearly deteriorating. The continuous monitoring of ROX may be particularly helpful when the patient is in an unstable condition.[8]

For example, two patients begin NHF treatment and both have a ROX value of 4.0 – see table below and Figure 4. Because this is only the start of the therapy, the ROX value can be monitored to see whether the index improves. During the first 6 hours, the first patient has a decrease in respiratory rate and the FiO_2 has been lowered; patient 2 has an increase in respiratory rate and the FiO_2 has been increased. As a result, the ROX value at 6 hours for patient 1 is 6.0 and for patient 2 is 3.0. Based on the values provided by Roca et al.,[8] patient 1 has a high likelihood of NHF therapy success and can be maintained on NHF. However, patient 2 has a trending decline and low ROX; therefore, escalation of care should be considered.

Patient 1						Patient 2					
No.	Date/Time	SpO_2 (%)	FiO_2	RR (min-1)	ROX	No.	Date/Time	SpO_2 (%)	FiO_2	RR (min-1)	ROX
1	initiation	95	0.70	34	**4.0**	1	initiation	95	0.75	32	**4.0**
2	2	95	0.60	32	**5.0**	2	2	95	0.80	34	**3.5**
3	6	95	0.50	32	**6.0**	3	6	95	0.85	37	**3.0**
4	12	95	0.45	30	**7.0**	4	12	-	-	-	**-**

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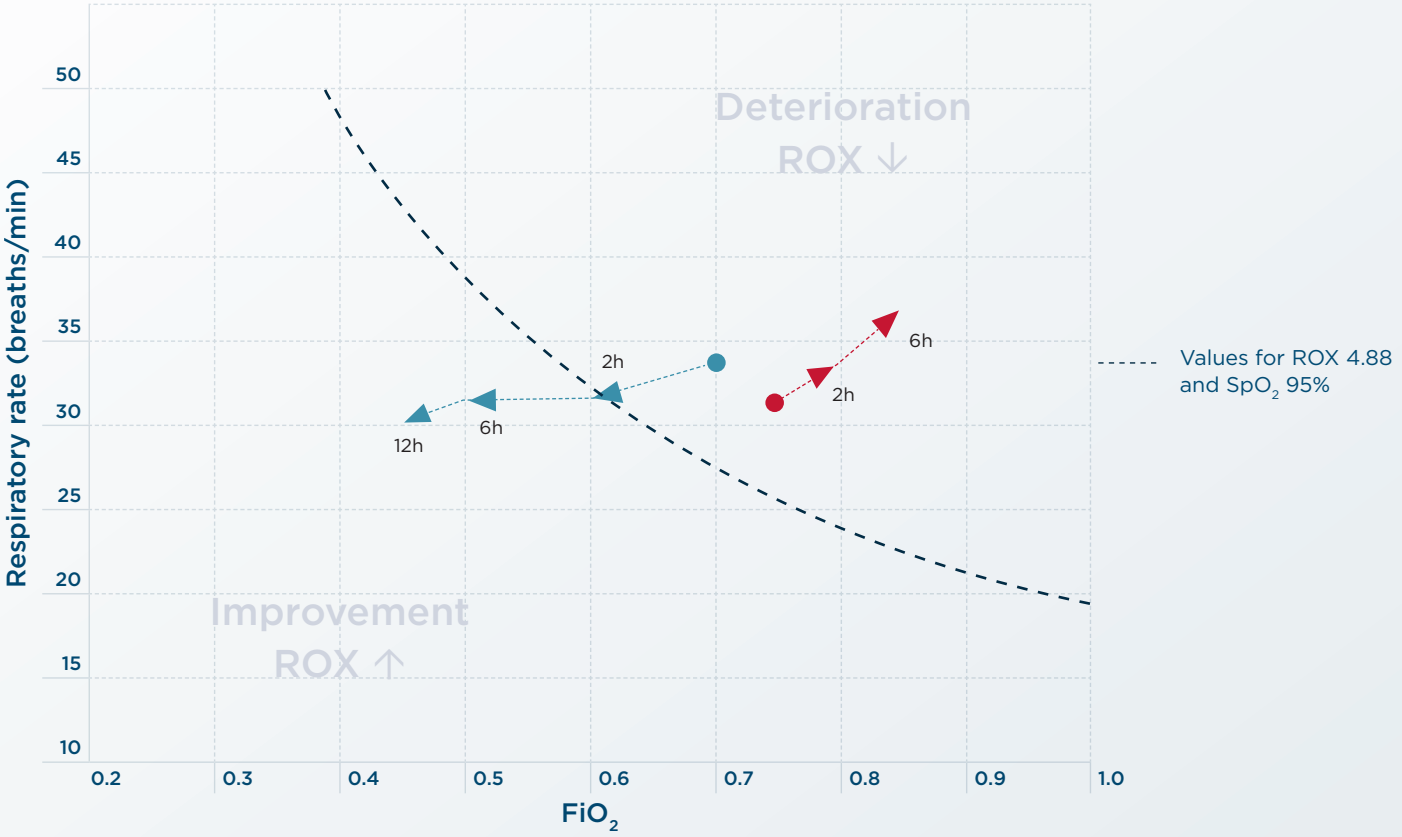

4. XY plot between respiratory rate and FiO_2. The blue arrows in a vector form demonstrate a change towards NHF success and the red arrows demonstrate the change towards NHF failure. The dotted line shows the values for ROX at 4.88 and the SpO_2 of 95%.

ROX vector

Combining the ROX values with the change in the respiratory rate and FiO_2 can indicate whether escalation is required. A proposed XY plot of the key components of ROX may show the direction of changes in vector form – see arrows in Figure 4 above.[9] Vectors towards the upper right indicates a deterioration and towards the lower left, an improvement.

Putting ROX into practice

The ROX index is a useful tool because it requires only a few data points and can be measured at the patient's bedside. The index can be used to monitor the patient and predict the likelihood of success or failure of NHF therapy. Furthermore, ROX highlights the importance of the required FiO_2; if the required FiO_2 is high, then the patient may be at greater risk of failure.

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