Effects of spontaneous episodes of hypoxemia on hemodynamics and cerebral oxygenation in preterm infants

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Background

Preterm infants often present with spontaneous hypoxemia episodes (HE) which are at times associated with bradycardia .

The hemodynamic effects of HE as well as their impact on cerebral oxygenation have not been fully explored.

Objective

To assess the effects of spontaneous HE on cerebral oxygenation ($CrSO_2$) in preterm infants and to determine if those effects are influenced by simultaneous changes in hemodynamics.

Methods

Fifteen preterm infants, GA 25 (23-29) weeks (median and range), with HE were studied at a median age of 22 (9-73) days. Four infants were receiving IPPV, 4 nasal IPPV, 5 nasal CPAP and 2 infants were on oxygen by hood. Twelve of these infants were on supplemental oxygen (0.25 – 0.45).

Arterial oxygen saturation (SpO_2) by pulse oximetry (Radical, Masimo) $CrSO_2$ by near infrared spectroscopy (INVOS 5100, Covidien) and cardiac output (CO), stroke volume (SV) and heart rate (HR) by non-invasive electrical cardiometry (Aesculon, Cardiotronic) were measured continuously during 4 hours.

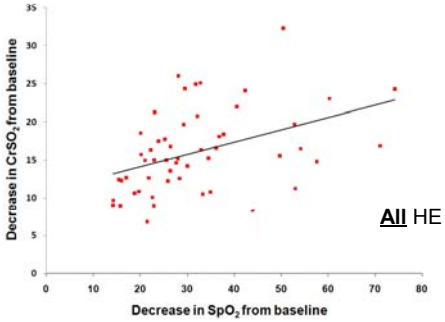
HE were defined as a decline in SpO_2<80% for >30 s. Baseline (BL) values were obtained from the preceding 3-10 minutes for each HE.

Results

Four (2-8) HE were analyzed for each infant for a total of 53 HE.

HR declined (> 20% from BL) in 15 HE and fell <100 b/min in 10 HE.
SV decreased (> 20% from BL) in 11 HE and increased in another 11 HE. A decline and a subsequent increase were observed in 2 HE.

CO declined (>20% from BL) in 20 HE, remained near BL in 28 HE and increased in 5 HE.

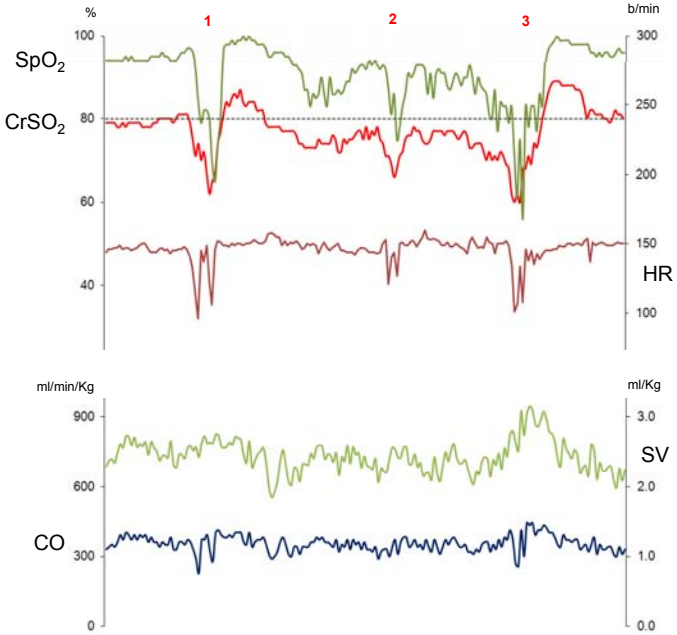


All HE were associated with a reduction in $CrSO_2$.

Stepwise multivariate regression analysis showed the reduction in $CrSO_2$ during HE was determined by the decline in SpO_2 ($p<.001$), the baseline $CrSO_2$ ($p<.001$), baseline CO ($p=.004$) and the change in CO ($p=.025$):

$$\Delta CrSO_2 = -12.5 + 0.27 \cdot \Delta SpO_2 + 0.194 \cdot BL\ CrSO_2 + 0.023 \cdot BL\ CO + 0.031 \cdot \Delta\ CO$$

	SpO_2	$CrSO_2$	CO	SV	HR
	%	%	ml/min/Kg	ml/Kg	b/min
Baseline	94± 2	59 ± 13	343 ± 72	2.2 ± 0.5	157 ± 10
HE nadir	64 ± 10	47 ± 12	272 ± 85	1.9 ± 0.6	145 ± 21
Δ from baseline	31 ± 11	16 ± 4	71 ± 32	0.2± 0.3	25 ± 27



Example shows decreasing SpO_2, $CrSO_2$ and HR while SV and CO increase during the 3rd HE. Although the decline in SpO_2 is greater in the 3rd HE, because of the increase in CO the reduction in $CrSO_2$ is similar to the 1st HE.

Conclusion

These preliminary results indicate that in preterm infants, spontaneous episodes of hypoxemia are frequently associated with hemodynamic changes, but only a fraction elicit a protective response.

The reduction in cerebral oxygenation during spontaneous hypoxemia episodes was influenced by the severity of the hypoxemia and the hemodynamic response.