

Oxygenation of the Newborn

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ABSTRACT

Newborn infants in need of positive pressure ventilation at birth should initially be given 21% O₂ from term to gestational age 33 weeks. Gestational ages 29-32 weeks could be given initially FiO₂ of 0.21-0.30. For ≤ 28 weeks FiO₂ of 0.30 or more should be given initially. FiO₂ should then be adjusted according to the oxygen saturation response assessed by pulse oximetry.

After delivery room stabilisation oxygen saturation targets of 85-89% increases the risk of mortality and necrotizing enterocolitis. In spite an oxygen target of 90-95% increases the risk of ROP this is presently the recommended range.

Keywords: Newborn resuscitation, Oxygen, Oxygen saturation targets.

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RESUSCITATION AND STABILIZATION IN THE DELIVERY ROOM

In term and near term newborn infants in need of positive pressure ventilation, ILCOR and WHO state that it is best to start with air rather than with supplementary oxygen. Fraction of inspired oxygen (FiO₂) could be increased in response to the development of arterial oxygen saturation (SpO₂) the first minutes of life and follow the nomograms by Dawson et al.¹ In a recent meta-analysis of newborn infants < 33 weeks gestational age, there was a strong tendency to lower mortality when FiO₂ is started low (0.21–0.30) vs high (0.60–1.00) in such babies.² These data therefore indicate it is reasonable to start ventilation with 21 or 30% oxygen and adjust FiO₂ according to pulse oximeter readings.^{3,4} If a blender is not available, it is recommended to start with air. However, very few data regarding babies <29 weeks gestational age (GA) are published. Such immature infants might need a higher concentration of supplemental oxygen initially.⁵ Until more studies are published in this field, this author

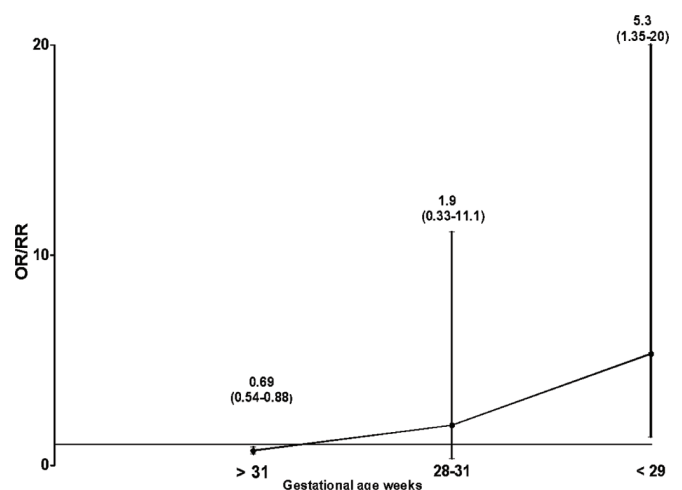
recommends starting with at least 30% O₂ FiO₂. Fraction of inspired oxygen is then adjusted according to the response in heart rate and/or SpO₂ from pulse oximetry readings.

The following suggestions for newborn resuscitation/stabilization are recommended (Graph 1):^{2,5,6}

- 33 weeks GA to term: Initial FiO₂ 0.21
- 29–32 weeks GA: Initial FiO₂ 0.21–0.30
- <28 weeks GA: Initial FiO₂ at least 0.30 (optimal level is not known)
- Adjust according to the need assessed by pulse oximetry (if available).

OXYGENATION OF EXTREMELY LOW BIRTH WEIGHT INFANTS BEYOND THE DELIVERY ROOM

The optimal oxygen saturation targets in extremely low birth weight infants after initial stabilization and the next weeks to minimize death and complications as retinopathy of prematurity (ROP) are not known. For that reason, five multicenter studies were organized with the aim to answer whether extremely premature infants after delivery room handling should be kept at a low or a high oxygen saturation target. These studies are the SUPPORT trial, the BOOST 2 trial (UK, Australian, and New Zealand branches), and the COT trial.⁷⁻⁹ Premature



Graph 1: High vs low initial FiO₂ for newborn resuscitation. Odds ratio (OR) or Relative risk (RR) with 95% confidence interval vs GA. <1 favors low initial FiO₂; >31 weeks: Significant lower mortality rate starting with a low FiO₂; 28–31 weeks: No significant difference whether you start low or high; <28 weeks: Significant higher mortality if initial FiO₂ is 0.21

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infants <28 weeks GA were randomized to low (85–89%) or high functional SpO₂ targets (91–95%). Because of the similarities between these trials, it was decided to combine all data in a final meta-analysis called the NEOPROM (Neonatal Oxygenation Prospective Meta-analysis) project.¹⁰

Totally, 4,908 infants were enrolled, 2,454 in each group. Mean GAs were around 26 weeks and mean birth weights between 820 and 850 gm. There was an exposure of antenatal steroid use between 90 and 96%.¹¹

Mortality

At 18 to 22 months, corrected age mortality for all studies combined was 19.3% in the low and 16.2% in the high saturation groups, respectively, giving a summary relative risk (RR) = 1.18 (95% confidence interval: 1.04–1.34).¹¹

Morbidities

Severe ROP was found in 10.7% in the low saturation group *vs* 14.5% in the high saturation group, summary RR 0.74 (0.51–1.03).

Necrotizing enterocolitis (NEC) was significantly higher in the low *vs* the high saturation target group.¹¹

DISCUSSION

The optimal initial FiO₂ for resuscitation of very low birth weight infants and especially extremely low birth weight infants is not yet known. Therefore there is an urgent need for large clinical studies in this field.

CONCLUSION

The reason for why a low saturation target beyond the delivery room handling may increase mortality and necrotizing enterocolitis is not known or understood. Until more evidence is established it is recommended in 28 weeks gestational age or less to target oxygen saturation between 90 and 95% the first weeks after birth, knowing this may increase retinopathy of prematurity. These data illustrate present dilemmas regarding oxygen therapy of the newborn. We are still far from understanding how to carry out optimal oxygen therapy in these patients.

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