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Maternal Oxygen Administration for Fetal Distress - An Update

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Abstract

Oxygen is routinely administered either prophylactically during second stage or in response to a non-reassuring fetal heart rate (FHR) tracings. The current evidence on benefits and risks of supplementary oxygen questions this practice and latest guidelines have recommendations on indications for maternal oxygen therapy. This review article focuses on the latest evidence and guidelines.

Keywords: Category II FHR tracing, caesarean section, hypoxia, lipid peroxides

Introduction

Estimates show that up to two third of women in labour are given oxygen in response to a category II fetal heart rate (FHR) tracing.[1] This practice came into vogue after a few studies done several decades back showed an improvement in fetal oxygen saturation (FSpO₂).[2,3] But the recent evidence challenges this dogma and fails to show improved fetal outcomes with random oxygen supplementation. Reviewing the physiological principles of oxygenation in a normal mother and fetus makes us understand the futility of this practise. Critical evaluation of the recent trials further throws light on the lack of benefit and plausible adverse effects of maternal oxygen administration. [4]

Physiology of oxygenation in mother and fetus

A normal adult is already operating on the plateau portion of oxygen dissociation curve (ODC) and arterial partial pressure of oxygen (PaO₂) can be minimally increased with further oxygen administration. The fetal haemoglobin (HbF) has much higher affinity for oxygen as compared to adult haemoglobin. Fetal oxygen supply is much higher than the demand and compromise does not occur unless the supply drops by 50%. Maternal hyperoxia shifts the carbon dioxide dissociation curve downward reducing the ability to transport carbon dioxide. Though an increase in maternal PaO₂ can increase umbilical PaO₂, because of the significant shunting at placental level and high oxygen consumption of placenta, fetal PaO₂ fails to increase proportionally.[5]

Does maternal oxygen supplementation increase fetal saturation?

The studies done forty years back had shown a beneficial effect on FSpO₂ with oxygen administration, but these studies had several limitations of having small sample size, being nonrandomised and including mothers with hypoxia. Recent studies show alternate results. A Cochrane systematic review concluded that there was insufficient evidence to support the use of oxygen as prophylaxis or for fetal distress in laboring women.[6] Raghuraman et al,[7] conducted a noninferiority trial to compare oxygen and room air for resuscitation in mothers who developed Category II FHR tracings and measured the umbilical artery lactate levels at birth. They concluded that room air was noninferior to oxygen for resuscitation in Category II FHR tracings. A secondary analysis of the same study monitored the FHR tracings 60 minutes prior to and after oxygen or room air administration. The primary outcome was a composite of high-risk category II features. The time to resolution of deceleration and total time spent in deceleration was also measured. They concluded that intrapartum maternal oxygen administration was not associated with an improvement in high-risk category II FHR tracings or resolution of recurrent decelerations as compared to room air.[8]

Does maternal oxygen supplementation increase fetal brain oxygenation?

Improving the fetal brain oxygenation is the ultimate aim of maternal oxygenation. Though oxygen supplementation does increase the fetal PaO₂, does it really improve oxygen supply to the brain. Blood oxygen level dependent magnetic resonance imaging (BOLD MRI) can show increase in signals in proportion with the oxygenation level of each tissue. Sorenson et al,[9] studied the fetal BOLD MRI in sheeps given oxygen and found that increased oxygenation was observed in fetal side of placenta and several other organs, but brain oxygenation did not increase. These findings were confirmed by the study done in humans by Huen et al,[10] and these results can help explain why fetal pulse oximetry has been unreliable at predicting fetal well being and outcomes.

Does maternal oxygen supplementation improve fetal acidosis?

The effect of maternal oxygenation on fetal acidosis is a controversial matter with studies showing mixed results. Some studies have shown no effect and some have shown a worsening of acidosis with oxygen. The time dependent placental vasoconstriction induced by oxygen might explain the worsening of acidosis observed in some studies.[11,12]

Does maternal oxygen supplementation decrease rate of caesarean / operative vaginal deliveries?

A meta-analysis included 5 studies which looked into the effect of intrapartum oxygen on rate of caesarean sections (CS). They concluded that when compared to room air intrapartum oxygen was not associated with a reduction in rates of caesarean for non-reassuring FHR, operative vaginal delivery, APGAR score <7, Newborn Intensive Care Unit admissions and cord blood acid base values.[13]

Does maternal oxygen supplementation cause any adverse maternal effects?

McHugh et al,[14] measured the hemodynamic parameters before, at completion and 10 minutes after cessation of hyperoxygenation. They included both pregnant and nonpregnant females. They observed a fall in cardiac index and rise in systemic vascular resistance which did not recover even after oxygen was stopped. Concomitantly there was a dip in stroke volume and rise in heart rate which recovered once oxygen was stopped. These changes were not observed in nonpregnant patients. These adverse hemodynamic changes could negate the beneficial effect contributed by the small increase in fetal PaO₂.

Does maternal oxygen supplementation cause oxidative stress to fetus?

One major adverse effect of supplemental oxygen is the generation of reactive oxygen species which can cause maternal and fetal cellular damage. The antioxidant mechanisms are not fully developed in fetuses which makes them more vulnerable to the oxidative damage. Khaw et al,[15] observed an increase in lipid hydroperoxides both in maternal and fetal blood in patients given oxygen at the time of CS.

Does deimplementing the practice of maternal oxygen administration worsen outcomes?

From the era of studies looking into the benefits and harms of supplemental oxygen, we are now moving to studies focused at the deimplementation of this practice. In a recent study, a change in the institutional practice was implemented to reduce the use of oxygen in mothers. They found no difference in maternal and fetal outcome despite a major reduction in the use of oxygen for mothers. [12]

What do the latest guidelines say?

The guidelines published by the American College of Obstetrician and Gynecologists and International Federation and the International Federation of Gynecology and Obstetrics recommend against the routine use of oxygen supplementation in individuals with normal oxygen saturation and is not recommended for fetal intrauterine resuscitation.[16,17] Oxygen should be reserved for situations with Category II FHR tracing with high risk features, maternal hypoxia and category III FHR tracing while preparing for CS.

Conclusion

This review shows that supplemental oxygen cannot increase fetal PaO₂ significantly as long as mother is normoxic and normal physiology is maintained. The recent studies on the impact of oxygen administration for laboring women have shown worrying results with doubtful benefits. The guidelines published after 2022 recommend against routine use of oxygen for intrauterine resuscitation. Maternal oxygen should be reserved for hypoxic mothers, Category III and high-risk category II features on FHR tracings.

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