Abstract

Background: Delayed cord clamping is usually defined as ligation of the umbilical cord 2–3 minutes after birth or when cord pulsations stop, which will result in a larger placental transfusion than early cord clamping performed immediately after delivery. **Aim of the work:** The aim of the study is to assess the effect of maternal oxygenation on neonatal oxygen saturation in women undergoing normal delivery. Patients and methods: **Patients and Methods:** This randomized controlled clinical trial (parallel group study with 1:1 randomization) was conducted on 220 women in labor or in prodroma of labor; the patients comparing delayed cord clamping with and without maternal oxygenation. **Results:** There is a statistically insignificant difference between Group I (Maternal oxygenation) and Group II (Without Maternal oxygenation) regarding oxygen sauration ($P>0.05$); where the mean oxygen saturation in group I is (97.85 + 1.35) while the mean oxygen saturation in group II is (97.83 + 1.25). Also a highly statistically significant difference between Group I (Maternal oxygenation) and Group II (Without Maternal oxygenation) regarding APGAR 1min & 5 min ($P<0.01$); where the mean APGAR 1min in group I is (8.77 + 0.44) while the mean APGAR 1min in group II is (8.53 + 0.83) & the mean APGAR 5min in group I is (9.87 + 0.33) while the mean APGAR 5min in group II is (9.60 + 0.69). **Conclusion:** Maternal oxygen administration in small dose for short duration in addition to delayed cord clamping in normal term vaginal delivery has significant effect on the newborn Apgar score; in addition to that; administration of small doses of oxygen was proved to have insignificant effect on maternal blood gases which rules out the idea of having a harmful effect on mothers “Elaboration of harmful oxygen free radicals causing tissue damage”; and hence the proces had a mutual benefit to both the mother and the baby.

Key words: deferred cord clamping, maternal oxygenation, neonatal oxygen saturation

Introduction

Delayed cord clamping is usually defined as ligation of the umbilical cord 2–3 minutes after birth or when cord pulsations stop, which will result in a larger placental transfusion than early cord clamping performed immediately after delivery ***(McDonald and Middleton, 2008).***

Over the past decade, seven randomized controlled trials documented significant beneficial hematological and circulatory effects of delayed cord clamping (DCC) in low or very low-birth-weight (VLBW) infants. The effects include higher mean blood pressure, lower systemic vascular resistance, higher hematocrits, and a decreased number of transfusions required up to 4 and 6 weeks of age *(**Judith et al., 2003**).*

Delayed umbilical cord clamping has been suggested as a measure to prevent infant iron deficiency, but we lack data concerning its health benefits and possible adverse effects, especially in high income countries ***(Van Rheenen and Brabin, 2006).***

The routine administration of supplemental, low-dose oxygen via a nasal cannula has potential benefit in terms of a decreased incidence of maternal desaturation. Maternal desaturation definitions have varied from <95% to <90% ***(De Castro et. al., 2009)*** and it has also been defined as a decrease of

oxygen saturation of more than 4 percentage points from baseline ***(Palacio et al., 2008).***

The use of supplemental oxygen in all elective cesarean sections was indicated in clinical practice for fetal well being. Supplemental oxygen via a low flow oxygen system, that is, providing oxygen via a nasal cannula at 3 liters per minute (LPM), is felt to be acceptable in our practice. Nasal cannulae are more likely to remain in position than face masks because they can be better tolerated by patients and they can remain in situ in the case of vomiting. However, many questions on the benefits of routinely administering low-dose supplemental oxygen have arisen ***(Arunotai et al., 2014).***

The Apgar score is the very first test given to the newborn, immediately after the birth of the baby in the delivery or birthing suite. The test was designed to quickly evaluate a newborn's physical condition and to determine any immediate need for extra medical or emergency care. The Apgar score is usually assessed twice: Once at 1 min after birth and again at 5 min after birth. Sometimes, if there are concerns about the baby's condition or the score at 5 min is low, the test may be scored for a 3rd time at 10 min after birth. Five criteria are used to evaluate the baby's condition and each criterion is scored on a scale of 0-2, with 2 being the best score. Newborns with scores of 7 and above are generally normal. A score of 4-6 is considered fairly low and 3

and below are generally regarded as critically low ***(Casey et al., 2001).***

A study carried out by ***Arunotai et al., 2014***on two groups an oxygen group who received 3 LPM oxygen via a nasal cannula; and a room-air group who were assigned to breathe room air; the study showed that the umbilical venous partial pressure of oxygen was significantly higher in the oxygen group. The other blood gas measurements and Apgar scores were not significantly different between the two groups.

Aim of the Work

The aim of the study is to assess the effect of maternal oxygenation on neonatal oxygen saturation in women undergoing normal delivery.

Research Hypothesis

In women undergoing normal delivery; maternal oxygenation may increase neonatal oxygen saturation.

Research Question

Does maternal oxygenation increase neonatal blood oxygen saturation in women undergoing normal delivery?

Normal labor

Definition

Labor is a physiologic process during which the products of conception (ie, the fetus, membranes, umbilical cord, and placenta) are expelled outside of the uterus. Labor is achieved with changes in the biochemical connective tissue and with gradual effacement and dilatation of the uterine cervix as a result of rhythmic uterine contractions of sufficient frequency, intensity, and duration ***(ACOG, 2003).*** Labor is a clinical diagnosis. The onset of labor is defined as regular, painful uterine contractions resulting in progressive cervical effacement and dilatation. Cervical dilatation in the absence of uterine contraction suggests cervical insufficiency, whereas uterine contraction without cervical change does not meet the definition of labor ***(Norwitz et al., 2003).***

Stages of Labor

Obstetricians have divided labor into 3 stages that delineate milestones in a continuous process.

First stage of labor

The first stage begins with regular uterine contractions and ends with complete cervical dilatation at 10 cm. In Friedman's landmark studies of 500 nulliparas, he subdivided the first stage into an early latent phase and an ensuing active phase. The latent phase begins with mild, irregular uterine contractions that soften and shorten the cervix. The contractions become progressively more rhythmic and stronger. This is followed by the active phase of labor, which usually begins at about 3-4 cm of cervical dilation and is characterized by rapid cervical dilation and descent of the presenting fetal part. The first stage of labor ends with complete cervical dilation at 10 cm. According to Friedman, the active phase is further divided into an acceleration phase, a phase of maximum slope, and a deceleration phase ***(Sarah & Christine, 2017).***

Characteristics of the average cervical dilatation curve is known as the Friedman labor curve, and a series of definitions of labor protraction and arrest were subsequently established. However, subsequent data of modern obstetric population suggest that the rate of cervical dilatation is slower and the progression of labor may be significantly

different from that suggested by the Friedman labor curve ***(Zhang et al., 2002).***

Second stage of labor

The second stage begins with complete cervical dilatation and ends with the delivery of the fetus. The American College of Obstetricians and Gynecologists (ACOG) has suggested that a prolonged second stage of labor should be considered when the second stage of labor exceeds 3 hours if regional anesthesia is administered or 2 hours in the absence of regional anesthesia for nulliparas. In multiparous women, such a diagnosis can be made if the second stage of labor exceeds 2 hours with regional anesthesia or 1 hour without it ***(ACOG, 2003).*** Studies performed to examine perinatal outcomes associated with a prolonged second stage of labor revealed increased risks of operative deliveries and maternal morbidities but no differences in neonatal outcomes. ***(Cheng et al., 2003; Myles & Santolaya, 2004)***

Maternal risk factors associated with a prolonged second stage include nulliparity, increasing maternal weight and/or weight gain, use of regional anesthesia, induction of labor, fetal occiput in a posterior or transverse position, and

increased birthweight. ***(O'Connell et al., 2003 & Senecal et al., 2005)***

Third stage of labor

The third stage of labor is defined by the time period between the delivery of the fetus and the delivery of the placenta and fetal membranes. During this period, uterine contraction decreases basal blood flow, which results in thickening and reduction in the surface area of the myometrium underlying the placenta with subsequent detachment of the placenta ***(Herman et al., 2002).*** Although delivery of the placenta often requires less than 10 minutes, the duration of the third stage of labor may last as long as 30 minutes.

Expectant management of the third stage of labor involves spontaneous delivery of the placenta. Active management often involves prophylactic administration of oxytocin or other uterotonics (prostaglandins or ergot alkaloids), cord clamping/cutting, and controlled cord traction of the umbilical cord. Andersson et al found that delayed cord clamping (≥180 seconds after delivery) improved iron status and reduced prevalence of iron deficiency at age 4 months and also reduced prevalence of

neonatal anemia, without apparent adverse effects ***(Andersson et al., 2011).***

A systematic review of the literature that included 5 randomized controlled trials comparing active and expectant management of the third stage reports that active management shortens the duration of the third stage and is superior to expectant management with respect to blood loss/risk of postpartum hemorrhage; however, active management is associated with an increased risk of unpleasant side effects ***(Prendiville et al., 2000).***

The third stage of labor is considered prolonged after 30 minutes, and active intervention, such as manual extraction of the placenta, is commonly considered ***(Norwitz et al., 2003).***

Mechanism of Labor

The ability of the fetus to successfully negotiate the pelvis during labor involves changes in position of its head during its passage in labor. The mechanisms of labor, also known as the cardinal movements, are described in relation to a vertex presentation, as is the case in 95% of all pregnancies. Although labor and delivery occurs in a

continuous fashion, the cardinal movements are described as 7 discrete sequences, as discussed below.

Engagement

The widest diameter of the presenting part (with a well-flexed head, where the largest transverse diameter of the fetal occiput is the biparietal diameter) enters the maternal pelvis to a level below the plane of the pelvic inlet. On the pelvic examination, the presenting part is at 0 station, or at the level of the maternal ischial spines ***(Norwitz et al, 2003).***

Descent

The downward passage of the presenting part through the pelvis. This occurs intermittently with contractions. The rate is greatest during the second stage of labor ***(Norwitz et al, 2003).***

Flexion

As the fetal vertex descents, it encounters resistance from the bony pelvis or the soft tissues of the pelvic floor, resulting in passive flexion of the fetal occiput. The chin is brought into contact with the fetal thorax, and the presenting diameter changes from occipitofrontal (11.0 cm) to

suboccipitobregmatic (9.5 cm) for optimal passage through the pelvis ***(Norwitz et al, 2003).***

Internal rotation

As the head descends, the presenting part, usually in the transverse position, is rotated about 45° to anteroposterior (AP) position under the symphysis. Internal rotation brings the AP diameter of the head in line with the AP diameter of the pelvic outlet ***(Norwitz et al, 2003).***.

Extension

With further descent and full flexion of the head, the base of the occiput comes in contact with the inferior margin of the pubic symphysis. Upward resistance from the pelvic floor and the downward forces from the uterine contractions cause the occiput to extend and rotate around the symphysis. This is followed by the delivery of the fetus' head ***(Norwitz et al, 2003).***

Restitution and external rotation

When the fetus' head is free of resistance, it untwists about 45° left or right, returning to its original anatomic position in relation to the body.

Expulsion

After the fetus' head is delivered, further descent brings the anterior shoulder to the level of the pubic symphysis. The anterior shoulder is then rotated under the symphysis, followed by the posterior shoulder and the rest of the fetus ***(Norwitz et al., 2003).***

Intrapartum Management of Labor

First stage of labor

Cervical change occurs at a slow, gradual pace during the latent phase of the first stage of labor. Latent phase of labor is complex and not well-studied since determination of onset is subjective and may be challenging as women present for assessment at different time duration and cervical dilation during labor. In a cohort of women undergoing induction of labor, the median duration of latent labor was 384 min with an interquartile range of 240-604 min. The authors report that cervical status at admission for labor induction, but not other risk factors typically associated with cesarean delivery, is associated with length of the latent phase ***(Grobman & Simon, 2007).***

Most women experience onset of labor without premature rupture of the membranes (PROM); however,

approximately 8% of term pregnancies is complicated by PROM. Spontaneous onset of labor usually follows PROM such that 50% of women with PROM who were expectantly managed delivered within 5 hours, and 95% gave birth within 28 hours of PROM ***(Hansen et al., 2002).*** Currently, the American College of Obstetricians and Gynecologists (ACOG) recommends that fetal heart rate monitoring should be used to assess fetal status and dating criteria reviewed, and group B streptococcal prophylaxis be given based on prior culture results or risk factors of cultures not available. Additionally, randomized controlled trials to date suggest that for women with PROM at term, labor induction, usually with oxytocin infusion, at time of presentation can reduce the risk of chorioamnionitis ***(ACOG, 2007).***

The rate of cervical dilation should be at least 1 cm/h in a nulliparous woman and 1.2 cm/h in a multiparous woman during the active phase of labor. However, labor management has changed substantially during the last quarter century. Particularly, obstetric interventions such as induction of labor, augmentation of labor with oxytocin administration, use of regional anesthesia for pain control, and continuous fetal heart rate monitoring are increasingly common practice in the management of labor in today's

obstetric population ***(Martin et al., 2006).*** Vaginal breech and mid- or high-forceps deliveries are now rarely performed ***(Chinnock & Robson, 2007; Powell et al., 2007)***. Therefore, subsequent authors have suggested normal labor may precede at a rate less rapid than those previously described ***(Zhang et al., 2001).***

Data collected from the Consortium on Safe Labor suggests that allowing labor to continue longer before 6-cm dilation may reduce the rate of intrapartum and subsequent cesarean deliveries in the United States. In the study, the authors noted that the 95th percentile for advancing from 4-cm dilation to 5-cm dilation was longer than 6 hours; and the 95th percentile for advancing from 5-cm dilation to 6-cm dilation was longer than 3 hours, regardless of the patient's parity ***(Zhang et al., 2010)***.

On admission to the Labor and Delivery suite, a woman having normal labor should be encouraged to assume the position that she finds most comfortable. Possibilities including walking, lying supine, sitting, or resting in a left lateral decubitus position. Of note, ambulating during labor did not change the progression of labor in a large randomized