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Delayed Cord-clamping in Term and Preterm Infants: Nursing Strategies to Facilitate Implementation

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This independent study, submitted by Nancy Finnegan in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the faculty advisor under whom the work has been done and is hereby approved.

Karen Semmens

Faculty Advisor

PERMISSION

Title: Delayed Cord-clamping in Term and Preterm Infants: Nursing Strategies to Facilitate Implementation

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Abstract

Newborns have been shown to benefit from delayed umbilical cord clamping after birth by the extra transfusion of placental blood. Enhanced placental transfusion is known to increase blood volume, red blood cells and improve the oxygenation of vital organs in both term and preterm infants. There continues to be however, a need for further research including issues such as optimal timing of the delay, eligibility and appropriateness of those newborns requiring resuscitation, and the ideal position to hold the infant prior to cord clamping. Changes in clinical practice have been slow to take hold because of these issues, along with lingering opinions about personal practice and resistance to change. This paper reviews the literature for gaps in research and knowledge, and examines the barriers to practice change. Nurses can contribute to facilitating delayed cord clamping by understanding the research, providing education, advocating for patients and collaborating with care providers and staff. Labor and delivery staff education is included in the form of a PowerPoint presentation which outlines the research, known barriers to change and practical ways that nurses can continue to be leaders in patient care.

Introduction

In our most current history, immediate clamping of the umbilical cord within 10-15 seconds of birth has been routine practice in labor and delivery. Long held beliefs that active management of the third-stage of labor would decrease the risk of maternal bleeding, are now known not to be supported by the evidence and in some ways may disadvantage the newborn's transition to life outside the uterine environment. More recently, studies have shown that delaying the cutting of the umbilical cord by as little as 30-60 seconds can increase placental transfusion of blood volume and red blood cells. In premature infants, delayed cord clamping has been shown to reduce the risk of intracranial hemorrhage and improve other vital capacities (McDonald, Middleton, Dowswell, & Morris, 2013; Rabe, Diaz-Rossello, Duley, & Doswell, 2012).

Changes in practice, however, have been slow to take hold. The American College of Obstetricians and Gynecologists (American College of Obstetricians and Gynecologists [ACOG], 2012) issued an opinion statement that supports delayed cord clamping of 30-60 seconds in preterm infant, but later qualitative studies (Jelin, Kuppermann, Erickson, Clyman, & Schulkin, 2014) have shown that the practice in the U.S. is not widespread.

While the benefits of delayed cord clamping is supported in the literature, there are few recommendations for practice for the staff nurse present at newborn deliveries. The nurse plays an essential role in labor and delivery and can be crucial in influencing the change in practice of delayed cord clamping by patient education, knowledge and dissemination of the latest research and recommendations.

Systematically reviewing the literature will clarify the evidence of benefits and risks of delayed cord clamping and will reveal how staff nurses can contribute to clinical practice changes.

The clinical question in this paper is: Does delayed umbilical cord clamping at newborn delivery provide neonatal benefits as opposed to immediate or early cord clamping?

Purpose

Delayed cord clamping represents a change in current clinical practice. This paper, along with providing evidence to the benefits of delayed cord clamping will discuss the clinical barriers to change. Labor and delivery is a collaborative practice between the patient and their family, midwives, obstetricians, nurses and other staff. While the provider performs the actual cord clamping, nurses can set the stage to promote and support its occurrence by advocating for their patient and her child, educating patients and staff, and reducing any physical or environmental barriers to its implementation. Research supports the use of education, communication and other targeted strategies such as role modeling and leadership to facilitate implementation of new practice guidelines (van Achterberg, Schoonhoven, & Grol, 2008).

Staff education using a PowerPoint presentation is the proposed strategy to influence practice change. The PowerPoint will highlight the research, discuss gaps in the literature and give practical suggestions that nurses can employ to support delayed cord clamping.

Significance

There were more than 3.9 million babies born in the U.S. in the year 2013, of which 11.39% were less than 37 weeks gestation. Early preterm babies at less than 34 weeks were 3.4% of the total births (Martin, Hamilton, Osterman, Curtin, & Matthews, 2015). This paper and proposed strategies for change will influence nursing practice and add to the literature by educating nurses how to recognize and remove barriers to the use of evidence-based research. Newborns will reap the benefits by improved clinical and morbidity outcomes. When nurses set the stage in the delivery room to facilitate delayed cord clamping, care providers may be willing to follow recommendations with more confidence, ease and clarity.

Theoretical Framework

The theoretical framework of this paper is based on selected concepts of Nola Pender's Heath Promotion Model (HPM) (Gonzalo, 2011). The model supports the practice of nursing as being the primary source of interventions and education that promote healthy behavior. Behavior change comes from the nurse initiating the interaction of person and environment in order to support health (Pender, 2011). In the case of facilitating delayed cord clamping, the nurse's role is integral in assisting and supporting behavior change. Influences in the labor and delivery environment based on the nurse's commitment and actions can increase or decrease the likelihood of participation in delayed cord clamping (Pender, 2011).

Factors that influence health-promoting behavior are perceived self-efficacy, perceived benefits and perceived barriers of action (Kelley, Sherrod, & Smyth, 2009). A qualitative study regarding obstetricians' attitudes and beliefs regarding delayed cord

clamping showed many practices were based upon personal beliefs and not on the evidence (Jelin, et al., 2014). There is no doubt that competing demands of the caregiver in the critical moment of new birth also act as a barrier to practice change. Through the framework of the HPM, nurses can facilitate the identification of a caregiver's personal beliefs and help to change the environment to make delayed cord clamping a positive and beneficial experience for not only the provider, but for the patient and family. The actions undertaken by nurses can modify the interpersonal and situational influences that act as barriers to implementation (Gonzalo, 2011).

There are many examples of perinatal and neonatal nurses who have successfully used scientific evidence to change everyday clinical practice including the use of sucrose for pain management, skin-to-skin contact, infant feeding practices and comfort measures in labor. Some common obstetrical nursing practices have also been abandoned because there was no evidence to support them, such as routine enemas and perineal shaving (Gennaro, 2009). Making these changes requires a belief in self-efficacy and belief in the benefit of change, as greater self-efficacy and commitment reduces the perception of barriers (Pender, 2012).

Patient and family preferences also influence the implementation of evidence-based care and health-promoting behaviors (Gennaro, 2009, Pender, 2012). Through nursing education, patients and families can become aware of the benefits of delayed cord clamping. Health-care providers exert influence upon the interpersonal environment of the patient and play a positive role in making positive choices for patients and families (Gonzalo, 2011).

Definitions

Hyperbilirubinemia: Excess bilirubin in the blood from increased red blood cell breakdown, resulting in jaundice. If untreated, may cause kernicterus with seizures and brain damage. It is routinely treated by phototherapy.

Hyperviscosity syndrome: Increased blood viscosity that may be caused by red blood cell excess in the newborn. It can be diagnosed with the presence of polycythemia (hematocrit >65%) and clinical signs such as lethargy, rapid respiration rate, irritability, and decreased muscle tone. May be asymptomatic.

Introitus: The opening of the vagina.

Newborn anemia: Defined as a hematocrit <45% in the normal term newborn.

Nuchal cord: A description of the umbilical cord when it is wrapped around the infant's neck, which is seen or felt when the head is delivered. If it is tightly wrapped, it may require clamping and cutting prior to the delivery of the body.

Perinatal Practice: A description including prenatal maternity care, labor and delivery, postpartum, routine newborn care and neonatal intensive care.

Phototherapy: Treatment for newborn jaundice that involves exposure to light in the blue-green spectrum that breaks down the bilirubin into easily excreted compounds.

Polycythemia: A hematocrit >65% in the normal term newborn.

Third stage of labor: The time period between the delivery of the baby and the complete expulsion of the placenta.

Umbilical cord milking: Stripping a length of umbilical cord several times prior to clamping in order to facilitate movement of placental blood into the infant in a

rapid manner. This is done in lieu of delayed cord clamping.

Process

An extensive literature search was conducted using PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Cochrane Collaboration databases using the keywords and their combinations, *umbilical cord, delayed and early cord clamping, umbilical cord clamping, placental transfusion, timing of umbilical cord clamping, neonatal outcomes, clinical practice, barriers to change, knowledge translation, evidence-based practice.*

The Johns Hopkins Nursing (EBP) model (Newhouse, Dearholt, Poe, Pugh, & White, 2007) was used for this paper by providing guidelines for framing the clinical question, review and critical analysis of the literature, including the identification of strengths and gaps, and finally giving insight to what needs to change in clinical practice in order to benefit from the research. The process of EBP assimilates the evidence into health-care practices in order to guide decision-making. Translation or implementation science is the study of how to support the adoption of evidence-based research into practice by studying the methods and other variables that influence the movement of evidence into actual practice (Titler, 2011).

Articles were selected on the basis of their contribution to the research and knowledge of the benefits and risks of delayed cord clamping. Barriers, interventions and gaps in the research literature were also considered. Randomized control trials, qualitative research, systematic literature reviews, and expert opinions were included from 2005 to 2015. For this paper, a total of 15 articles were reviewed to provide a comprehensive summary of the research.

Review of the Literature

Delayed cord clamping is considered to be from about 30 seconds after delivery of the infant or up until the cord ceases to pulsate, which may take up to five minutes. Early cord clamping is completed immediately after delivery or within 10-15 seconds.

The research has been done on either term infants at 37 or more weeks of gestation or premature infants of less than 37 weeks. Because of not only the different research trials but also the differences in risk factors and post delivery care, the literature review is divided into delayed cord clamping in term and preterm infants.

Term Infants

Salari, Rezapour, & Khalili (2014) completed a randomized controlled trial of term, vaginally delivered newborns. Fifty-six newborns were assigned into one of two groups for either early, within 10 seconds or late, within 3 minutes cord clamping after delivery. The groups were similar in maternal and gestational age, birth weight, and placental characteristics. The infants were held at the level of the introitus during the allotted time period prior to cord clamping.

The results of the trial showed that the delayed cord-clamping group had significantly higher hemoglobin and hematocrit levels as compared to the early clamping group at both 2 hours and at 18 hours of birth. The early clamped group had a significant higher prevalence of anemia. Neither group had laboratory findings of polycythemia. There was no additional follow-up to this study after 18 hours following delivery (Salari et al., 2014).

Ceriani-Cernadas et al. (2006) conducted a study with similar methods as Salari et al. (2014). Their research was on 276 women with uncomplicated, low risk vaginal or

cesarean deliveries. Three interventions were compared, including early cord clamping at 15 seconds and delayed cord clamping at both 1 minute and 3 minutes. The infants in the delayed clamping groups were either held in the maternal arms or placed on the maternal lap prior to cutting. The three study groups were similar demographically and by several clinical variables.

The results showed no significant difference between the three groups in regards to hematocrit at six hours after birth. There was however, a significant difference in the presence of anemia in the early clamping group compared to the two late clamping groups at both six hours and 24-48 hours after delivery. There were no significant differences in serum bilirubin levels. This study confirmed the data from the Salari et al. (2014) report, which had similar findings.

It is interesting to note that the infants in the Ceriani-Cernadas et al. (2006) study were held either in the mother's arms or on her lap prior to clamping as opposed to at the level of the introitus. This may explain the lack of difference in the 6-hour hematocrit, as gravity presumably did not play a role to increase the transfusion. Maternal bonding may also have been enhanced with this intervention.

Another study confirming the increase in hematocrit or hemoglobin levels with delayed cord clamping is Chaparro, C., Neufeld, L., Tena Alvez, G., Eguia-Líz, R., and Dewey, K. (2006). Their objectives were to assess infant hematological and iron status at birth and six months of age. The research occurred with 476 mothers randomly assigned to a delayed clamping group of two minutes or an early clamping group of 10 seconds. All women delivered vaginally with healthy term infants who were held at the level of the introitus prior to clamping.

Results showed hematocrit and hemoglobin levels at seven hours significantly higher in the delayed clamping group. There were no differences between the two groups regarding clinical jaundice up to 14 days after birth. At 6 months of age, infants in the delayed clamping group had a significant increase in iron status as measured by multiple parameters including ferritin and stored iron. Hemoglobin levels however, were not different (Chaparro et al., 2006).

Not only does this research verify increased hemoglobin and hematocrit levels as a result of delayed clamping similar to the above-mentioned studies, but it also provided evidence of increased iron stores that persisted well into the infant's early life. This is of particular interest as iron-deficiency is a known cause of cognitive and developmental delays in children (Jáuregui-Loberan, 2014; Lozoff et al., 2006) and remains a significant problem throughout the world, especially in countries with poor resources.

A similar study by Andersson, Hellström-Westas, Andersson, and Domellöff (2011) confirmed early and longer-term benefits of delayed cord clamping in a randomized control trial of 400 infants following a healthy low risk pregnancy. Delayed cord clamping occurred at 180 seconds and early clamping at 10 seconds or less. With delayed clamping, the newborn was held 20 centimeters below the vulva for 30 seconds, and then placed on the maternal abdomen. In caesarean sections, the newborn was directly placed on the maternal abdomen.

At 48-72 hours after delivery, there were significantly higher hemoglobin levels in the delayed cord clamping group, but no differences in the iron status. At four months of age, there was no significant difference in hemoglobin between the two groups, but all indicators of iron status were significantly higher in the group that received delayed cord

clamping. Through a three-day food diary, they found that exclusively breastfeeding did not result in any differences in the outcomes. There were no infants with polycythemia or those receiving phototherapy (Andersson et al., 2011).

Research by van Rheenen, de Moor, Eschbach, de Grooth, and Brabin (2007) also studied whether delayed cord clamping is an effective way to reduce anemia in term infants up to the age of six months. This randomized control trial of term vaginal deliveries took place in Zambia with 105 hospitalized women similar in a number of obstetrical, medical and social factors. Early clamping took place at15 seconds, and delayed clamping occurred when the cord stopped pulsating or around five minutes. The newborn was held 10 cm below the introitus prior to clamping.

Results at 24 hours showed significantly higher hematocrit levels and no differences in hyperviscosity syndrome or hyperbilirubinemia. At four months and six months, there were no differences in hematocrit or hemoglobin between the groups. However, the parameters of iron stores were not studied, which may limit the results of this trial and is difficult to compare the Andersson et al. (2011) and Chaparro et al. (2006) studies.

Of note, the infants were held below the introitus for at least five minutes until the cord stopped pulsating. Not only would this be difficult, but also it could be a safety issue, impractical and may interfere with maternal-infant bonding.

A follow up to the Andersson et al. (2011) study was completed after 12 months (Andersson, O., Domellöff, Andersson, D., & Hellström-Westas, 2014) and based on the hypotheses the delayed cord clamping would continue to show improvements in iron status and in neurodevelopment at twelve months. Using the same cohort as the original

research, infants returned for blood sampling and developmental assessment.

There were no significant differences between the two groups in either hemoglobin levels or in any iron status indicators at 12 months. The neurodevelopment was assessed by the Ages and Stages Questionnaire (Schonhaut, Armijo, Schönstedt, Alvarez, & Cordero, 2013), which is well validated and also showed no significant differences between the two groups. Reporting bias could be a factor in that the parents completed the Ages and Stages Questionnaire. This research overall, was an appropriate follow-up to the original study, as the evidence continues to be limited on long-term effects of delayed cord clamping.

There has also been research that does not confirm the findings of increased hematocrit or hemoglobin after birth with delayed cord clamping. Jahazi, Kordi, Mirbehbahani & Mazloom (2008) showed no significant differences in hematocrit levels between late and early cord clamping groups at two hours and at 18 hours of life in their randomized controlled trial of 64 healthy, term infants. All babies were delivered vaginally and held at the level of the introitus prior to clamping. Early clamping was done at 30 seconds and late clamping at three minutes after delivery. An unknown number of infants were excluded from the analysis after randomization, which could introduce bias and affect the results.

What is of compelling interest is the early clamping occurred at 30 seconds, as opposed to 10-15 seconds in the Salari et al. (2014) study, which is a more typical time for early cord clamping. Perhaps a 30 second delay is adequate enough to benefit from extra placental transfusion and could explain why there were no differences between the two groups. This information could be particularly helpful in cases where the practitioner

is concerned about the newborn and prefers to hand it off to a pediatric group for assessment or resuscitation as quickly as possible, while continuing to allow for some placenta transfusion. This raises some questions and reveals the need for additional research on the ideal timing for delayed cord clamping.

As mentioned, there were different protocols for the position of the baby prior to cord clamping in each clinical trial discussed. Little is known about the optimal position for placental transfusion and has been considered a possible barrier to the practice. The prevailing idea is that gravity is necessary to assure adequate transfusion. Research by Vain et al. (2014) addressed this barrier by studying the effect of gravity on placental transfusion in a randomized, non-inferiority trial done in three university-affiliated hospitals in Argentina. The study included 546 mothers assigned to two intervention groups of either the infant being held at the level of the introitus or placed on the maternal abdomen prior to cord clamping. All cord clamping was delayed at two minutes.

The babies were weighed immediately after birth at the level of the introitus and then weighed after cord clamping. The primary outcome was the difference between the weight immediately after birth and at two minutes after cord clamping. Change in infant weight was a proxy for volume of placental transfusion (Vain et al., 2014).

Results showed that the volume of placental transfusion for infants placed on the maternal abdomen was not inferior to those held at the introitus. There were also no differences in the hematocrit and bilirubin levels. There was no attempt to record the time between birth and the first infant weight. An earlier pilot study by the authors (data unavailable), measured this time at around 15 seconds, but there is a possibility that the

transfusion volume was either over or underestimated (Vain et al., 2014).

Vain et al., (2014) questions the assumption that gravity affects placental transfusion and provides evidence to the contrary. It may be particularly helpful to the provider who is hesitant to hold the newborn at the introitus for two or more minutes. Nurses can advocate for the mother holding her newborn and enhancing bonding between the two, while allowing for placental transfusion (Hill & Fontenot, 2014).

Discussion for Term Infants

Overall, the literature provides ample data that supports delayed cord clamping in term infants by increasing hemoglobin and hematocrit levels after delivery and increasing iron stores for four to six months. These benefits may decrease blood transfusions and possibly prevent developmental delays due to iron deficiency. Evidence of risk of hyperbilirubinemia and phototherapy (McDonald et al., 2013) was not seen in these studies. The World Health Organization (2012) considers the evidence as having a high value especially in countries with a higher prevalence of iron deficiency anemia.

The studies did reveal some interesting points that may be addressed by staff nurses, such as the need to promote bonding while determining the optimal position of the infant prior to clamping. Additionally, there is no consensus as to the best time for delaying the cord clamping and warrants further research.

Premature Infants

Newborns that deliver less than 37 weeks gestation are considered premature. Approximately 444,210 premature deliveries occur in the U.S. each year, which represents 11.39% of all births (Martin, Hamilton, Osterman, Curtin, & Matthews, 2015).

There have been a number of studies regarding the benefits of delayed cord

clamping in premature or very low weight newborns. It should be mentioned that studies on the effects of milking the umbilical cord in lieu of delayed clamping in preterm infants have also been done, but for the purposes of this paper that particular intervention will not be included in the discussion as the data is more limited (ACOG, 2012).

Preterm infants are at an increased risk of requiring blood transfusions, intracranial hemorrhaging, retinopathy, infection, and necrotizing enterocolitis (Muthusamy et al., 2012). Typically, the umbilical cord is immediately clamped in premature infants because of concerns surrounding the need for resuscitation. Hypothermia is another concern in prematurity and the cord is clamped early to facilitate moving the newborn to a bedside warmer. It is thought that immediately clamping the umbilical cord denies the infant the placental transfusion, contributing to circulatory compromise and poor tissue perfusion affecting multiple organs (Mercer et al., 2006). Consequently, research has been conducted to assess the benefits of delayed cord clamping to the unique risks that challenge the morbidity and mortality of preterm infants.

Strauss et al. (2008) conducted a randomized clinical trial to study the increase in red blood cell volume in delayed cord clamping in 105 premature infants 30-36 weeks gestation. The cord was clamped at 60 seconds in the delayed group with the newborn held in a blanket 10-12 inches below the introitus in a vaginal birth or placed beside the mother's thigh in a cesarean section.

Lab results showed hematocrit levels in the delayed clamping group were significantly higher than those in the early clamping group beginning on the 7th day of birth and persisting through 28 days. This implies a larger volume of red blood cells was

present. There was no significant difference in the number of red blood cell transfusions in either cord-clamping group (Strauss et al., 2008).

There were also no differences in intraventricular hemorrhage between the two intervention groups, and while a significantly higher number of infants in the delayed clamping group required phototherapy for elevated bilirubin levels, there were no differences as to the bilirubin level at the start of phototherapy, days of treatment and number of treatment courses (Strauss et al., 2008).

There was a risk of attrition bias as there was only data on 66 infants at 28 days. Additionally, the intervention groups were of different sizes. While these may affect the results, the research contributes to the evidence of a prolonged positive effect on hematocrit levels up to 28 days of life (Strauss et al., 2008).

Aladangady, McHugh, Aitchison, Wardrop, and Holland (2006) performed a similar study also on the effect of delayed cord clamping on the premature newborn's blood volume. Forty-six preterm infants were randomized into a delayed group at 30-90 seconds or an early group of immediate clamping. The infants were held as low as the length of the cord permitted prior to clamping.

The mean blood volume at four hours of vaginally delivered infants was significantly higher in the delayed group as compared to the early group. This did not occur in those delivered by cesarean section (Aladangady et al., 2006), and was confirmed by Strauss et al. (2008). Interestingly, all of the infants in the Aladangady et al., 2006 study had their lungs expanded prior to cord clamping, either by crying spontaneously or by facemask or endotracheal tube ventilation. This was done to increase pulmonary blood flow and facilitate a reduction of pulmonary vascular resistance.

Baenziger et al. (2007) additionally researched cerebral oxygenation levels of premature infants with delayed cord clamping as compared to early clamping. The study included 39 newborns delivered at 24-32 weeks gestation. They were a part of a larger RCT that was not identified, so it was not possible to assess the quality of randomization and intervention assignment although the clinical data of the two groups was similar. Delayed clamping occurred at 60-90 seconds while the infants were held 15 centimeters below the placenta in vaginal deliveries or as low as possible in cesarean births.

Results showed those with delayed clamping had significantly higher hematocrit levels that persisted to 72 hours of age, and increased mean arterial blood pressure at four hours. Cerebral hemoglobin concentrations and tissue oxygenation of the brain were significantly higher in the delayed clamping group as measured by infrared spectrometry (Baenziger et al., 2007).

While Aladangady et al. (2006) showed an overall increase in blood volume in newborns with delayed cord clamping, the Baenziger et al. (2007) study did not confirm these findings, but suggests there is an increased volume by the increased oxygen delivery to the tissues. There is also evidence that hematocrit levels persist up to three days, similar to the results of the Strauss et al. (2008) study.

An observational study by Aziz, Chinnery, and Lacaze-Masmonteil (2012) also confirms significantly higher hemoglobin levels in premature infants with delayed cord clamping. They observed best practice implementation of a new protocol on delayed cord clamping in preterm infants in a Canadian hospital as part of a quality improvement project to study compliance and to measure clinical outcomes.

Delayed clamping occurred at 45 seconds with the baby held 20 centimeters below the introitus for vaginal deliveries or on the mother's lap for cesarean sections. The baby was wrapped in a warm, sterile towel. Gentle stimulation was provided if there was poor respiratory effort (Aziz et al., 2012).

Babies that received delayed clamping had significantly higher hemoglobin levels and lower rates of necrotizing enterocolitis than those with early clamping. They were also less likely to have a lower temperature (Aziz et al., 2012). There were no differences in the need for red blood cell transfusions, which also confirms the findings of the Strauss et al. (2008) study.

Incidentally, compliance with the new protocol averaged around 60% in an 18-month period. Reasons for non-compliance were the choice of the delivery provider, unfamiliarity of the protocol and not having the NICU staff available at delivery.

This study was strictly observational, so the evidence is not as strong as a randomized controlled trial. The authors concluded with a suggestion that some resuscitation efforts could be accomplished prior to cord clamping and warrant additional research (Aziz et al., 2012). Aladangady et al. (2006) did execute resuscitation efforts by ventilating infants prior to cord clamping with either a bag-mask or endotracheal tube, but there were no additional details given.

Kaempf et al. (2012) also did an observational study regarding a new delayed cord clamping protocol in premature infants <35 weeks. Designed as a before-after investigation, they evaluated 249 singleton infants undergoing early cord clamping in the year prior to instituting the new protocol, and then evaluated the same number of infants delivered with the delayed clamping protocol in place.

Immediate clamping was done within five seconds, while delayed clamping took place after 45 seconds while the infant was held 10-20 cm below the introitus, in a warm towel and dried, stimulated and bulb suctioned. Cesarean deliveries were treated the same and the infant was placed between the mother's legs (Kaempf et al., 2012).

All infants in the delayed clamping groups had significantly higher initial hematocrits and higher first day blood pressures compared to early clamping which confirms the Baenzinger et al. (2007) study. No differences were found in total bilirubin and phototherapy use, and no significant differences in infection and intraventricular hemorrhage (Kaempf et al., 2012).

While the Kaempf et al. (2012) study found no differences in infection rates and intraventricular hemorrhage (IVH) with delayed clamping, Mercer et al. (2006) found significantly lower rates in both categories in their randomized controlled study of the effects of delayed cord clamping. Seventy-two infants, < 32 weeks with similar baseline demographics and clinical characteristics were studied. While the primary outcome of the research was to compare the incidence of bronchopulmonary dysplasia between the intervention groups, no significant differences were found in that outcome. The results of decreased IVH and sepsis was not expected. There were also no other differences detected in bilirubin levels. Interestingly, when the data was analyzed by gender only, the male infants had fewer incidences of IVH, sepsis and necrotizing enterocolitis than the female infants. Decreased IVH seen in the delayed clamping group is well supported and consistent with nine out of 15 studies reviewed for the Cochrane Collaboration (Rabe et al., 2012).

There has been little research on the prevention of sepsis with delayed cord

clamping. Cord blood of newborns, especially those premature, contains a high volume of hematopoietic stem cells. With early cord clamping, the transfusion of these stem cells is limited and thought to increase the susceptibility to infection and resulting sepsis (Kugelman et al., 2009). The findings of the Mercer et al. (2006) research was not anticipated, and other studies (Kugelman et al., 2009) detected no differences between the intervention groups in regards to the immunological or infectious status of newborns at < 35 weeks gestation.

Mercer, Vohr, Erickson-Owens, Padbury, and Oh (2010) completed a seven-month follow-up study to their work published in 2006 (Mercer et al., 2006). The cohort of premature infants in the original study was evaluated for neuro-developmental and motor function, hypothesizing that those infants with delayed cord clamping would have better motor function at seven months. This is based on the premise that infants with delayed cord clamping have increased blood flow to the motor cortex region of the brain resulting in better oxygen delivery, as seen in Baenziger et al. (2007).

There were no differences in the Bayley Scales of Infant Development –II (Harris, Megens, Backman, & Hays, 2005) between infants in the two intervention groups. When the data was reanalyzed using regression analysis, they found that the male infants with delayed clamping had significantly higher motor scores as compared to those in the early clamping group. These findings are at odds with other studies that show premature males have a tendency towards increased neurodevelopmental issues (Hintz, Kendrick, Vohr, Kenneth Poole, & Higgins, 2006).

This is one of the very few studies exploring the long-term effects of delayed cord clamping on motor function and neurological development in premature infants, although

there were similar findings in the study by Andersson, O., Domellöff, Andersson, D., & Hellström-Weatas (2014) on term infants. Additional research is needed on long-term effects of delayed cord clamping.

Discussion for Premature Infants

In preterm infants, a delay in cord clamping results in a higher hemoglobin level, although it is not consistent in terms of duration or necessarily benefit to the newborn, as a decrease in blood transfusions was generally not found. Rabe, Fernandez Alvarez, Lawn, Seddon, and Amess (2009) suggested that a decrease in transfusions is achieved not only by a delay in cord clamping but also by early introduction of protein and iron supplements. There was no information regarding supplementation in any of the research reviewed.

There was no consensus in the literature regarding increased bilirubin levels and the need for phototherapy. A recent systematic review (Backes et al., 2014) concluded the evidence did not support worsening infant outcomes from elevated bilirubin levels, although they felt there could be a relationship in countries that had fewer financial resources and limited access to phototherapy.

There is always a concern that delayed cord clamping could delay required resuscitative efforts in the premature infant. There are no current recommendations on delayed cord clamping in a newborn requiring resuscitation. The American Academy of Pediatrics states the data on benefits or risks is too limited (Perlman et al., 2010) to guide a change in practice. Others say that the first steps of resuscitation to include initial drying, warmth, clearing the airway and providing tactile stimulation could provide that brief delay in cord clamping prior to the continued steps required in resuscitation (Wyllie

& Niermeyer, 2008). The extra blood and red cell volume provided in the placental transfusion may protect the neurological and cardiac function that is depressed in a compromised infant (Aladangady et al., 2006; Mercer & Erickson-Owens, 2012). Indeed, the transfusion of the placental blood from a delay in cord clamping may be considered the first step in the resuscitation of a preterm infant (Raju, 2013). While the Aladangady et al. (2006) study mentioned that some of the infants were resuscitated with bag mask or endotracheal ventilation, no further information was shared as to how this was successfully done with an intact cord. Additional research is needed (Hutchon, 2013).

Discussion

Outcome/Dissemination

Introducing staff nurses to the research and educating them on the benefits of delayed cord clamping will increase personal knowledge that can be shared with peers, providers and most importantly women and their families. It also gives the opportunity to introduce evidence-based research to a nursing unit and show how it benefits patients (Gennaro, 2010). Work-based learning has been shown to increase quality of patient care and create opportunities to change practice (Chapman, 2006). A PowerPoint presentation is a viable educational tool that is convenient to use on a busy nursing unit with limited time, perhaps at the end of shift report for the oncoming staff; where as a more traditional inservice presentation is difficult for staffing purposes and may interrupt the workflow (Haggard, 2011).

An outline of the PowerPoint presentation is as follows:

- Benefits to term and preterm infants
- Possible risks to term and preterm infants
- Current recommendations and other considerations
- The role of labor and delivery nurses to promote delayed cord clamping
  - Our role as advocates of change and evidence-based practice
  - Advocating and collaborating with patients, staff and providers
  - Discussing contraindications and alternatives for delayed clamping
  - Issues regarding cesarean sections, cord blood banking, positioning
  - Documentation strategies
- Evaluation of strategies and implementation.
- Designating a "champion" in the staff to further promote and educate.
- Discussing the need for additional research.

Interpretation

In labor and delivery, the decision as to when to clamp the umbilical cord is done by a physician or midwife. While substantial research, current practice guidelines and opinion statements (ACOG, 2012; Perlman et al., 2010; WHO, 2012) support the practice, many institutions in this country lack corresponding policies with limited adoption of the practice (Jelin et al., 2014). As seen in the research, there is no consensus on the best time to clamp the cord or how the newborn should be held while waiting to clamp the cord. This may very well contribute to the lag in practice change. Additionally, some physicians' opinions about the risks and benefits of the practice discovered in the

Jelin et al. (2014) study were not based on the research evidence, but on personal opinions suggesting additional educational interventions are needed. A similar study in the United Kingdom found that when delayed cord clamping was not done, it was because of inconsistent policy, concerns of how to fully assess newborn eligibility, and persistent uncertainty or anxiety regarding the optimum time of the delay (Oddie & Rhodes, 2014).

There are no studies that specifically addresses how care providers can successfully adopt the new practice of delayed cord clamping, but it is known that simply increasing knowledge is not enough. Change requires organizational support, leadership, analysis of opinions and beliefs and a practical means to gain success (Purdy & Melwak, 2009).

Nurses may sit on the sidelines and watch the challenges that care providers face in implementing a new guideline; after all, it isn't the nurses' job to actually clamp and cut the umbilical cord. What nurses do know, however, is the patient. Asking the question, "What is best for the patient?" is the very core of nursing. The evidence is clear that delayed cord clamping benefits newborns. Nurses are the frontrunners in assuring each patient is given the best care by knowing the research and available options. This means collaborating, educating and keeping the practice transparent for everyone involved including the patient, family, providers and other staff. Sustaining the conversation, enlisting support from organizational management and knowing the barriers and supportive elements will eventually help to change the culture (Purdy & Melwak, 2009) that embraces research and new evidence that can improve patient care.

Implications for Nursing

Teamwork is required to provide safe and evidence-supported care for our patients. Delayed cord clamping requires a team of physicians, midwifes, nurses and other staff. Nurses can facilitate the process through advocacy, education, support and practical use of time and equipment. The process is not limited to labor and delivery, but nurses can contribute in other practice settings when situations arise and require teamwork to make changes in care. Enhanced professional outcomes come from improved patient care and bring satisfaction to everyone on the team.

Documentation gives evidence of practice change. Nursing documentation on the time of cord clamping, position of the baby prior to clamping, reasons why the cord was clamped immediately or milked, and other factors will provide information regarding the change in practice and how effective is the implementation (Smith, Moore, & Peters, 2012). Documentation can help to drive home the need to communicate and collaborate to get the job done along with giving information for additional research.

This paper has identified the need for further research in several areas of nursing practice. This includes the need to know more about resuscitation of infants with the cord intact. It is possible to begin the steps of resuscitation with the baby between the mother's legs with stimulation, drying, positioning, and clearing the airway if the team is prepared and practiced (Scheans, 2013; van Rheenen, 2011).

Additional research is also needed on the optimal timing for the delay in cord clamping and the best position to hold the newborn while waiting to clamp the cord. There has been no research on delayed cord clamping in multiple gestations. Specific needs for research are also seen in cesarean sections, especially regarding positioning of

the baby. Raju (2013) also mentions the need to know more about timing of cord clamping for high-risk mothers such as those HIV positive or with hepatitis B and C. Other recommendations for research include finding appropriate patient education strategies needed for practice changes.

Evidence-based research and interventional science require education on every level from patients and families, colleagues and peers, and up to organizational management. Finding the best way to educate also involves research and inquiry, which nurses are well poised to undertake. Research and educational tools can be found in multiple databases and other online resources.

Nurses can contribute to policy by research, implementation and evaluation of new practices. Professional nursing organizations can facilitate changes in policy through evidence-based programs, along with nursing participation on hospital-based committees. Practice and policy changes are not done in a vacuum, but require interdisciplinary input and collaboration.

Summary/Conclusions

It turns out that something as simple as the many thousands of years-old practice of clamping and cutting the umbilical cord has vital implementations for infant morbidity and mortality. The latest research evidence has shown that even a brief delay in clamping the cord after birth can increase blood volume, iron stores, and in premature infants decrease the risk of intraventricular hemorrhage and improve other vital capacities. Much more research is needed to identify optimal infant positioning, the ideal timing of the

delay, special considerations for high-risk mothers and infants and best implementation practices.

Nurses assure patients and families receive the best care available. In labor and delivery, they have a fundamental role in the process by educating and advocating for the patient, and collaborating with the team to assure success with a healthy mother and healthy baby.

Delayed cord clamping is not being widely practiced in this country because of deficits in knowledge, misunderstanding and confusion regarding protocols, and opinions or beliefs that are not supported by the research. Nurses are positioned at the bedside and can impact the use of delayed cord clamping by educating the patient, their peers and colleagues, and reducing barriers to the practice. Simple evidence-based education and implementation strategies can work to champion the practice.

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