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RESEARCH ARTICLE

COMPARING DELAYED AND EARLY CORD CLAMPING: A SYSTEMATIC REVIEW OF BENEFITS AND RISKS

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Abstract

Background: The timing of umbilical cord clamping has long been debated in obstetric care, with implications for both maternal and neonatal outcomes. Early cord clamping (ECC), traditionally performed within 15–30 seconds after birth, was once believed to reduce postpartum hemorrhage and facilitate neonatal resuscitation.

Objective: This systematic review aims to compare the neonatal and maternal outcomes of DCC versus ECC, evaluating recent evidence to determine best practices in obstetric and neonatal care.

Methods: A comprehensive search of PubMed, Cochrane Library, and Scopus was conducted to identify randomized controlled trials (RCTs), cohort studies, and meta-analyses published in English between 2008 and 2023. Studies reporting neonatal hemoglobin levels, iron stores, neonatal jaundice, postpartum hemorrhage, and placental retention were included.

Results: The review found that DCC is associated with significantly higher neonatal hemoglobin levels and iron stores, reducing the risk of anemia in infancy. DCC also improves cardiovascular stability and reduces the need for blood transfusions, particularly in preterm infants. While DCC slightly increases bilirubin levels, the need for phototherapy remains comparable between DCC and ECC groups. On the maternal side, evidence indicates no significant difference in postpartum hemorrhage or placental retention between the two practices.

Conclusion: DCC offers substantial neonatal benefits, including enhanced hematological status and improved cardiovascular adaptation, without increasing maternal risks. These findings support current recommendations from WHO and ACOG advocating for DCC in both term and preterm births. Further research is needed to assess the long term developmental impacts of DCC.

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Introduction:-

The optimal timing of umbilical cord clamping remains a subject of ongoing discussion within obstetric practice, given its implications for both maternal and neonatal health outcomes. Traditionally, early cord clamping (ECC) defined as clamping the umbilical cord within 15 to 30 seconds post-delivery was the standard of care, based on assumptions that it might mitigate the risk of postpartum hemorrhage and facilitate prompt neonatal resuscitation [1].

However, a growing body of evidence now supports delayed cord clamping (DCC), typically defined as a delay of at least 30 to 60 seconds, as a practice that confers substantial benefits to neonates without increasing adverse outcomes for mothers [2,3]. Current guidelines from the World Health Organization (WHO) and other professional organizations, including the American College of Obstetricians and Gynecologists (ACOG), advocate for DCC in all deliveries, with particular emphasis on its importance in preterm births [4,5]. DCC permits continued placental transfusion, thereby enhancing neonatal blood volume by up to 30%, which in turn improves hemoglobin concentrations and iron stores [6].

Conversely, ECC disrupts this physiological process, potentially resulting in reduced neonatal blood volume and a heightened risk of anemia an outcome that may have long-term developmental implications, especially in resource-limited settings [7]. Delayed cord clamping (DCC) offers several neonatal advantages, particularly for preterm infants. These include enhanced cardiovascular stability, improved regulation of blood pressure, and a decreased requirement for blood transfusions [8,9].

Moreover, DCC has been linked to a reduced incidence of serious complications associated with prematurity, such as intraventricular hemorrhage (IVH) and necrotizing enterocolitis (NEC) [10]. Despite these benefits, some concerns have been raised regarding the potential for increased neonatal jaundice and hyperbilirubinemia due to the augmented blood volume following DCC.

However, current evidence indicates that these risks are generally manageable through vigilant monitoring and timely clinical intervention [11,12]. On the maternal side, concerns regarding postpartum hemorrhage (PPH) and placental retention with DCC have largely been disproven. Multiple studies indicate no significant difference in the rates of PPH or retained placenta between DCC and ECC[13].

This has led to a paradigm shift in clinical practice, with DCC becoming the preferred approach in many settings, particularly as part of delayed newborn care practices like skin-to-skin contact [14]. Despite these findings, ECC is still practiced in certain situations, particularly in emergencies requiring immediate neonatal resuscitation, although evidence suggests that even in such cases, brief DCC may still be beneficial [15].

AIM: This review aims to systematically compare the neonatal and maternal outcomes of DCC versus ECC based on the most recent evidence, offering insight into current best practices in obstetric and neonatal care.

Methodology:-

A systematic review was conducted using databases like PubMed, Cochrane Library, and Scopus. Studies were included based on the following criteria:

1. Randomized controlled trials (RCTs), cohort studies, and meta-analyses comparing DCC and ECC.
2. Studies reporting neonatal and maternal outcomes.

Studies published in English between 2008 and 2023. The primary outcomes assessed include neonatal hemoglobin levels, iron stores, and incidence of neonatal jaundice, while secondary outcomes focus on maternal health, such as postpartum hemorrhage.

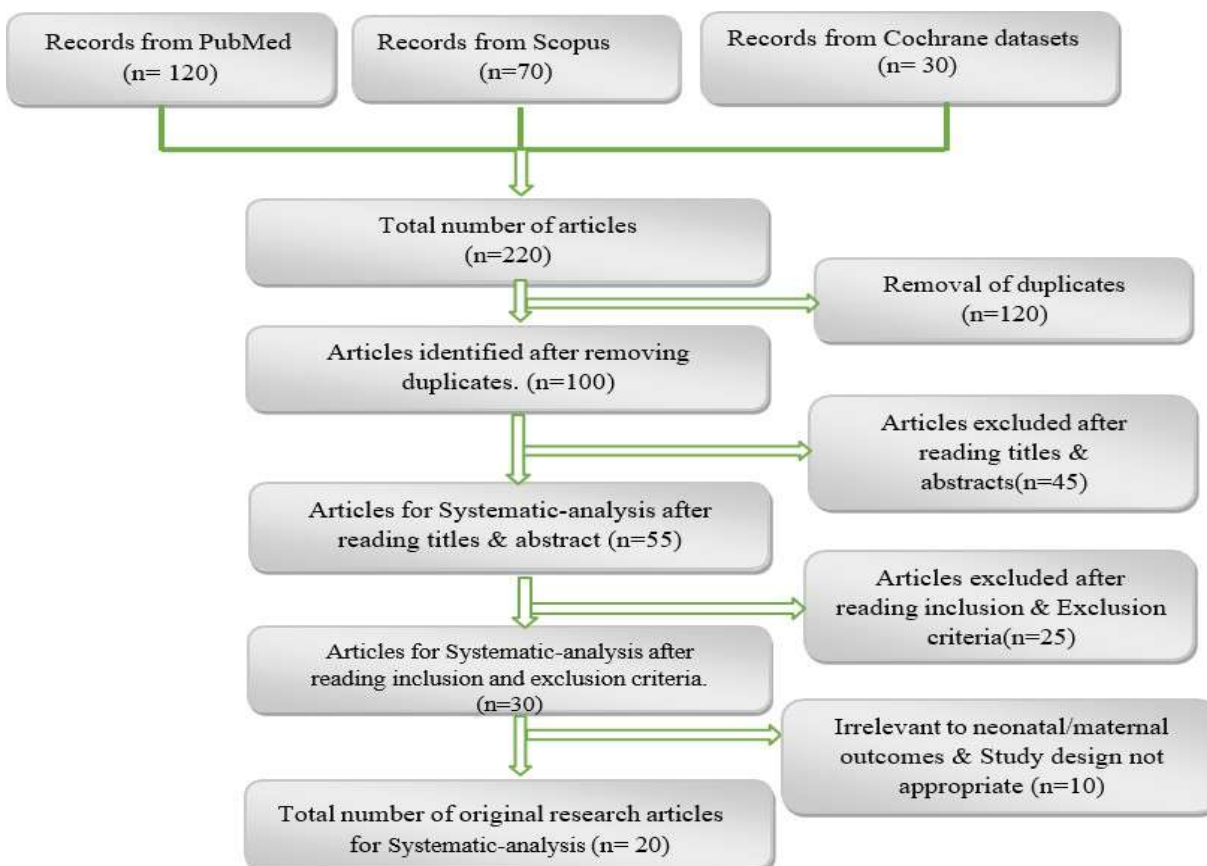


Figure 1: Prisma Flowchart Showing The Selection Of Included Studies

Results:-

Neonatal Outcomes:-

1. Hemoglobin and Iron Stores Multiple studies have consistently demonstrated that delayed cord clamping (DCC) leads to significantly higher neonatal hemoglobin and ferritin levels when compared to early cord clamping (ECC), highlighting its critical role in the prevention of anemia during infancy. A Cochrane review [1] encompassing over 3,000 neonates reported that infants who underwent DCC exhibited higher hemoglobin concentrations and greater iron stores at 4 to 6 months of age, thereby lowering the incidence of iron deficiency anemia. These benefits are attributed to the continued placental transfusion enabled by DCC, which can contribute up to a 30% increase in blood volume in term infants.
2. Neonatal Jaundice A frequently cited concern regarding delayed cord clamping (DCC) is the potential for an increased incidence of neonatal jaundice, stemming from the larger transfused blood volume and the associated rise in bilirubin levels. Nonetheless, systematic reviews indicate that although DCC may result in marginally higher bilirubin concentrations, the risk of clinically significant hyperbilirubinemia requiring phototherapy does not differ substantially between DCC and early cord clamping (ECC) groups. For instance, Andersson et al. [2] reported no significant difference in the frequency of phototherapy administration between infants in the DCC and ECC cohorts, despite the observed elevation in bilirubin among those who received DCC.
3. Respiratory and cardiovascular adaptation Cord clamping, particularly when delayed, has been associated with enhanced respiratory and cardiovascular adaptation immediately following birth, an effect especially pronounced in preterm infants. Evidence suggests that continued placental transfusion during delayed cord clamping (DCC) contributes to more stable systemic blood pressures and decreases the necessity for postnatal blood transfusions. In a randomized controlled trial, Rabe et al. [3] demonstrated that DCC significantly reduced the incidence of intraventricular hemorrhage and late-onset sepsis among preterm neonates, underscoring its protective benefits in this vulnerable population.

Maternal Outcomes:-

1. Postpartum Haemorrhage (PPH) Historically, early cord clamping (ECC) was widely practiced under the assumption that it would mitigate the risk of postpartum hemorrhage (PPH). However, contemporary evidence has called this rationale into question. A comprehensive systematic review conducted by McDonald et al.[1] found no significant difference in the incidence of PPH between delayed cord clamping (DCC) and ECC, indicating that DCC does not elevate the risk of maternal hemorrhage and can be safely implemented without compromising maternal outcomes.
2. Placental retention and uterotonic use ECC has been traditionally linked to quicker delivery of the placenta, but DCC does not appear to significantly delay placental expulsion. A Cochrane review [5] concluded that DCC does not increase the need for uterotonics or the incidence of retained placenta, dispelling concerns about its impact on the third stage of labor.

Discussion:-

Authors	Sample Size	Study Parameters	Observations	Conclusions
McDonald SJ et al. (2013) ¹	3911 women-infant pairs	Meta-analysis of 15 trials involving healthy term deliveries.	Independent reviewers assessed trial eligibility and extracted data.	Delayed cord clamping (DCC) enhances early hemoglobin levels and iron stores, supporting a more liberal DCC approach.
Ola Andersson et al. (2011) ²	400 full-term infants from low-risk pregnancies	Randomized to DCC (≥ 180 sec) vs. early clamping (≤ 10 sec).	Measured hemoglobin and iron status at 4 months; secondary outcomes included anemia and phototherapy needs.	DCC improved iron status, lowered neonatal anemia rates, with no observed adverse effects.
J.S. Mercer et al. (2017) ⁶	73 term singleton pregnancies	Compared 5-min DCC vs. immediate clamping (< 20 sec); assessed placental blood volume and hemoglobin.	Mean clamping time: 303s (DCC) vs. 23s (ICC); cord milking used in some DCC cases.	DCC provided hematologic benefit without increasing hyperbilirubinemia or polycythemia.
Ashish KC et al. (2017) ⁷	540 late preterm and term infants	Randomized to DCC (≥ 180 sec) or early clamping (≤ 60 sec).	Primary outcomes: anemia at 8 months; secondary: iron levels at 12 months.	DCC significantly reduced anemia at 8 and 12 months in high-risk populations.
Tarnow-Mordi W et al. (2017) ⁸	1566 live births < 30 weeks gestation	Randomized to immediate clamping (≤ 10 sec) vs. DCC (≥ 60 sec).	Median clamping time: 5s vs. 60s; mortality was 6.4% (DCC) vs. 9.0% (ICC).	DCC did not significantly reduce death or major morbidity compared to immediate clamping in very preterm infants.
S. Hosono et al. (2008) ¹²	40 infants (24–28 weeks gestation)	Studied umbilical cord milking vs. control in very preterm infants.	Milked group needed less respiratory support and fewer transfusions.	Cord milking is safe and reduces need for RBC transfusion and ventilation.
Ola Andersson et al. (2015) ¹³	382 full-term infants	Assessed neurodevelopmental outcomes at 4 years comparing DCC vs. ECC.	Improved fine-motor scores and movement tasks in DCC group.	DCC had long-term neurodevelopmental benefits, particularly for boys.

Khitam Mohammad et al. (2021) ¹⁶	128 full-term singleton pregnancies	Compared DCC (90s) vs. ECC (<30s) on maternal and neonatal outcomes.	Higher neonatal hemoglobin at 12 hours in DCC group; ECC group had higher oxygen therapy needs.	DCC improved neonatal hemoglobin without adverse maternal outcomes; supports practice change in Jordan.
Francesco Cavallin et al. (2019) ¹⁷	80 neonates from elective C-sections	Randomized to DCC (≥ 60 s) vs. ECC; assessed postnatal adaptation.	Higher hematocrit on day 2 in DCC group; no increase in phototherapy needs.	DCC in elective C-sections improves hematocrit without maternal risks. Further study needed.
Dorlasi LM & Lilian TM (2020) ¹⁸	19 healthcare professionals	Qualitative study exploring DCC practices in Tanzania.	Themes: experiences, perceptions, and influencing factors of cord clamping.	DCC is understood to benefit newborn oxygenation; wider practice adoption recommended.
Devin Joan & Larkin Patricia (2018) ¹⁹	153 midwife survey responses	Cross-sectional survey of midwifery practices in Ireland.	91.5% practiced DCC; definitions and practices varied.	Variation in DCC practice stems from clinical setting, research awareness, and resuscitation tools.
Abd El-Moneim A. Fawzy et al.	100 full-term primigravidas	Compared DCC (post-pulsation) vs. ECC (immediate) on newborn	Evaluated Apgar score, hemoglobin, bilirubin, blood sugar, oxygen	DCC was associated with better overall neonatal outcomes.

Table 1 shows the observations noted by the researchers

Benefits of Delayed Cord Clamping:-

The benefits of delayed cord clamping (DCC) are increasingly substantiated by a robust and expanding body of scientific literature. One of the most significant neonatal advantages of DCC is the marked increase in neonatal blood volume, which directly contributes to higher hemoglobin levels and improved iron stores. Numerous randomized controlled trials and systematic reviews have consistently demonstrated that infants who undergo DCC exhibit significantly elevated hemoglobin concentrations at birth, as well as enhanced iron reserves at 4 to 6 months of age, in comparison to those subjected to early cord clamping (ECC) [1,6]. These outcomes are especially vital in low- resource settings, where infant anemia is prevalent and healthcare resources are often constrained [2]. DCC facilitates the transfer of up to 30% of the neonate's total blood volume from the placenta, effectively serving as a physiological "autotransfusion" that elevates hematocrit levels [9].

This process of placental transfusion is associated with improved iron status and favorable neurodevelopmental outcomes during the critical first year of life [7]. Supporting this, a meta-analysis conducted by Kc et al. [7]) found that term infants who received DCC had a significantly lower risk of iron deficiency at both 8 and 12 months of age. These findings reinforce the role of DCC in the prevention of early childhood anemia. Moreover, the additional blood volume conferred by DCC is of particular importance in preterm infants, who are at heightened risk for anemia and often require blood transfusions in the neonatal period [8]. Beyond its well-documented hematological advantages, delayed cord clamping (DCC) has also been shown to facilitate a more effective cardiovascular transition at birth, particularly in preterm infants.

Infants who undergo DCC tend to exhibit more stable blood pressure levels and improved tissue perfusion during the immediate neonatal period [10]. These cardiovascular benefits are closely associated with a reduced risk of intraventricular hemorrhage (IVH), a serious and potentially life-threatening complication in preterm neonates. A systematic review by Tarnow-Mordi et al. [8] demonstrated that DCC significantly lowers the incidence of IVH by promoting a more gradual and physiologically stable transition from fetal to neonatal circulation. Complementary findings from Mercer et al. [11] further support these observations, reporting enhanced respiratory outcomes in preterm infants subjected to DCC an effect likely attributable to increased blood volume and improved oxygen-carrying capacity at birth.

Risks Associated with Delayed Cord Clamping:-

One of the primary concerns surrounding DCC is the potential for increased bilirubin levels and a higher incidence of neonatal jaundice. Since DCC results in the transfer of a larger blood volume to the neonate, it theoretically increases the risk of hyperbilirubinemia due to the breakdown of additional red blood cells [12]. While elevated bilirubin levels have been observed in neonates subjected to DCC, most studies have not reported a clinically significant increase in the need for phototherapy (8). For example, Andersson et al. [2] found that while bilirubin levels were higher in the DCC group, the incidence of hyperbilirubinemia requiring intervention did not significantly differ from the ECC group. Similarly, Bhatt et al. [10] concluded that the increased risk of jaundice associated with DCC is manageable with regular monitoring and appropriate treatment, and it does not outweigh the hematological benefits. This finding has been confirmed by several other studies, including those by Hosono et al. [16] and McDonald et al. [1], both of which showed no significant increase in the need for phototherapy among DCC infants. Therefore, while jaundice remains a theoretical risk, current evidence suggests that it can be managed effectively without compromising the benefits of DCC.

Maternal Outcomes and Concerns:-

In terms of maternal outcomes, one of the primary concerns with DCC is the risk of postpartum hemorrhage (PPH), which was a major reason ECC was historically preferred. However, multiple studies have debunked the notion that DCC increases the risk of PPH. A comprehensive review by McDonald et al. [1] found no statistically significant difference in the rates of PPH between DCC and ECC groups. This is supported by the findings of Andersson et al. [2], who reported that the timing of cord clamping had no impact on maternal blood loss or the incidence of retained placenta. Similarly, a large randomized controlled trial conducted by Rabe et al. [3] concluded that DCC does not adversely affect maternal outcomes, and the risk of uterine atony or the need for additional uterotonics is comparable between DCC and ECC.

Implications for Practice:-

The benefits of DCC have led to its recommendation by numerous health authorities, including the World Health Organization (WHO) and the American College of Obstetricians and Gynecologists (ACOG), which now advocate for DCC in both term and preterm deliveries [4,5]. The guidelines from these organizations emphasize that DCC should be the standard practice in uncomplicated deliveries, as it significantly improves neonatal outcomes without increasing maternal risks. In clinical settings, DCC has also been integrated into delayed newborn care practices, such as immediate skin-to-skin contact and delayed bathing, both of which are associated with improved breastfeeding rates and enhanced maternal bonding [15]. These additional benefits further support the widespread adoption of DCC as the standard of care in modern obstetric practice.

Conclusion:-

The evidence overwhelmingly supports the benefits of delayed cord clamping for neonatal outcomes, particularly in enhancing iron stores and stabilizing cardiovascular function. While ECC has historically been practiced to reduce PPH and facilitate rapid delivery of the placenta, modern evidence suggests that DCC does not negatively impact maternal outcomes. Future research should focus on the long-term neurodevelopmental impact of improved iron stores in DCC infants. Based on current evidence, DCC should be adopted as the standard practice in both term and preterm deliveries, with monitoring for neonatal jaundice as needed.

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