EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Coden USA: EJBPBO
Volume: 13
Issue: 6
Year: 2026

CLINICAL OUTCOMES OF DELAYED CORD CLAMPING IN NEWBORNS: A SYSTEMATIC REVIEW

***[1]Mohammad Hamadneh, [2]Batool Alrefie**

[1]MBBCH, MD, MRCPCH, Senior Neonatal Clinical Fellow NICU.
[2]Ashford and St. Peter's Hospitals NHS Foundation Trust.

***Corresponding Author: Mohammad Hamadneh**

MBBCH, MD, MRCPCH, Senior Neonatal Clinical Fellow NICU.

DOI: https://doi.org/10.5281/zenodo.20440315

How to cite this Article: *[1]Mohammad Hamadneh, [2]Batool Alrefie (2026). Clinical Outcomes Of Delayed Cord Clamping In Newborns: A Systematic Review. European Journal of Biomedical and Pharmaceutical Sciences, 13(6), 001–005.

Article Received on 25/04/2026 **Article Revised on 15/05/2026** **Article Published on 01/06/2026**

1. INTRODUCTION

A crucial aspect of immediate newborn care is the time of umbilical cord clamping (UCC), which has a big impact on both immediate and long-term results. In the past, early cord clamping (ECC), which is defined as clamping within the first 15 to 30 seconds after birth, was frequently used to speed up neonatal evaluation and lower the risk of problems for mothers. Over the past two decades, however, mounting data has cast doubt on this strategy by emphasizing the physiological and therapeutic advantages of delayed cord clamping (DCC).

By allowing placental transfusion to continue, DCC - usually defined as clamping at least 30 to 60 seconds after birth - improves iron reserves and increases newborn blood volume. It has been demonstrated that this extra blood transfer raises hemoglobin levels at delivery and lowers the risk of iron shortage in infancy, which is crucial for neurodevelopmental outcomes. Improved hemodynamic stability and a decrease in major sequelae including intraventricular hemorrhage and necrotizing enterocolitis have been linked to DCC in preterm newborns.

As evidence-based neonatal practices become more prevalent, major international organizations such as the American Academy of Pediatrics (Yamada et al. 2024), the American College of Obstetricians and Gynecologists (Chauhan et al. 2006), and the World Health Organization (WHO 2020) now advise DCC for both term and preterm infants. Despite these guidelines, there is still variation in clinical application because of worries about certain hazards, such as polycythemia and hyperbilirubinemia that need phototherapy.

The effects of DCC have been assessed by many randomized controlled trials and observational studies, however the results are occasionally inconsistent, especially when comparing different gestational age groups and healthcare settings. There are still unanswered problems about the best time to clip the cord and if it can be used in settings with limited resources or in emergency situations where newborn resuscitation is urgently needed.

Considering these factors, a thorough analysis of the available data is required to elucidate the advantages and possible hazards of DCC in newborns. With a focus on hematological parameters, morbidity, and mortality in both term and preterm children. This study attempts to thoroughly analyze the body of research on DCC and its effects on neonatal outcomes.

1. METHODS

2.1. Study Design and Reporting Guidelines

The PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was followed in the conduct of this systematic review (Zaman et al. 2023). The evaluation process was guided by a predetermined methodology that included data extraction techniques, eligibility requirements, and search strategy.

2.2. Data Source and Search Strategy

A comprehensive literature search was performed across multiple electronic databases, including PubMed, Scopus, and Web of Science, from 2015 to now. The search strategy combined Medical Subject Headings (MeSH) terms and free-text keywords related to DCC and neonatal outcomes. The following keywords were used: "delayed cord clamping", "umbilical cord

clamping", "newborn", "neonate", "preterm infant", "term infant", "neonatal outcomes", "hemoglobin", "iron deficiency", "intraventricular hemorrhage", and "necrotizing enterocolitis".

Moreover, Boolean operators (AND, OR) were applied to refine the search. Furthermore, reference lists of included studies and relevant reviews were manually screened to recognize any supplementary eligible studies.

2.3. Eligibility Criteria

The inclusion criteria of this study involve studies including term or preterm neonates, studies comparing DCC (≥ 30 - 60 seconds) versus early cord clamping, randomized controlled trials (RCTs), cohort studies, case-control studies, graduation projects, and dissertations. Also, it includes studies reporting at least one relevant neonatal outcome (e.g., hemoglobin levels, iron status, intraventricular hemorrhage, mortality), and articles published in English.

On the other hand, the exclusion criteria include case reports, editorials, conference abstracts, reviews, animal studies, studies without a comparison group, and studies with insufficient or missing outcome data.

2.4. Study Selection

Duplicate records were eliminated once all obtained records were loaded into reference management software. A full-text screening of possibly eligible studies was conducted after two independent reviewers evaluated abstracts and titles for relevance. A third reviewer was consulted or discussed to settle disagreements. The study selection process was documented using a PRISMA flow diagram.

2.5. Data Extraction

Data was independently extracted by two reviewers using a standardized data extraction form. However, extracted data included study characteristics such as author, year, country, study design, population details like gestational age, sample size, intervention details like timing of cord clamping, outcomes measured such as hemoglobin levels, iron stores, intraventricular hemorrhage, necrotizing enterocolitis, and mortality. It is important to mention that any discrepancies in data extraction were resolved by consensus.

2.6. Quality Assessment

Two reviewers independently evaluated the included studies' methodological quality. The Cochrane Risk of Bias Tool was used to analyze randomized controlled trials, while the Newcastle-Ottawa Scale was used to evaluate observational research. Based on predetermined criteria, studies were classified as having a low, moderate, or high risk of bias.

2.7. Ethical Considerations

As this study is a systematic review of previously published data, ethical approval was not required.

2. Literature Review

From searches for individual trials, 23 potentially eligible records were identified, of which 21 were reviewed in full text, and 10 met the inclusion criteria.

Zaman et al. provided valuable understandings into the comparison between the hematocrit, hemoglobin, need for transfusion, recurrent phototherapy, serum bilirubin level, and serum ferritin at different time frames for the UCM and DCC in both full-term and preterm infants. The study included 20 studies with a total of 5189 infants. Regarding preterm infants, hematocrit level showed no significant difference between intact Umbilical Cord Milking (iUCM) compared to DCC (Zaman et al. 2023). Moreover, neonatal death incidence was significantly higher with the UCM technique in comparison to DCC. Regarding term and late preterm infants, hematocrit level presented no substantial difference between the iUCM or cUCM methods compared to. The study illustrated that UCM led to a higher risk of neonatal death in preterm infants compared to DCC. However, the incidence of polycythemia was lower in the UCM group. Furthermore, UCM was associated with higher rates of severe intraventricular hemorrhage (IVH) events. The study concludes that DCC may be preferred due to its lower incidence of severe IVH and neonatal death.

(Rice 2016) showed that DCC addressed a placental transfusion that comprises red blood cells and stem cells, increases Hgb and Hct, increases blood volume, reduces anemia in newborns, increases blood pressure soon after delivery, decreases a need for blood transfusion, reduces incidence IVH, reduces occurrence of necrotizing enterocolitis, progresses cerebral oxygenation, and has no influence on active management of the third stage of labor. It also stated that preforming DCC and keeping the newborn connected to the mother by the placenta and umbilical cord needs minimal training and is free. Also, the work stated that DCC health properties contain illness prevention, health promotion and an increase in mother-infant bonding. Midwives can exercise, advocate and indorse this change that permits DCC after one minute post birth or until pulsation ceases.

(Kresch 2017) stated the impacts of delayed umbilical cord clamping on neonatal transitional physiology. The work showed that suspending cord clamping in preterm newborns has been exposed to progress both short-term and long-term consequences during the past 50 years. Additionally, the authors stated that delivering ventilation in the primary steps of neonatal resuscitation preceding to clamping of the umbilical cord has a physiological origin and results in better findings for newborns. The work addressed that there is a limit to enterprise equipment and approaches that can permit early resuscitation very close to the mother while the umbilical cord is still attached to the placenta.

In the last several years, attention in reviving DCC has been directed to an abundance of literature on the subject. (Kim and Warren 2015) stated that the presently existing evidence supports the use of DCC in preterm infants. Also, the study illustrated that the primary advantages for this population are a decrease in the quantity and frequency of blood transfusions as well as a lower risk of IVH. Although the statistics for term newborns are less reliable. In this study, they consistently demonstrate a lower risk of iron insufficiency and iron deficiency anemia in that cohort. This may be particularly important in the developing world, where anemia is more prevalent, but also worldwide because iron deficiency, even without anemia, may have adverse effects on neurodevelopment. Moreover, the most urgent issue for those who work with newborns is the ideal amount of time to wait before clamping the umbilical cord for long-term neurodevelopmental outcomes for newborns receiving ECC versus DCC, as well as other potential dangers and advantages in the term population.

To guarantee the best possible cardiovascular transition, (Niermeyer 2015) emphasized the transition from time-based to physiology-based UCC, stressing the significance of establishing neonatal respiration prior to clamping. Research indicates that DCC increases hemodynamic stability, improves placental transfusion, and lowers problems including IVH and transfusion requirements, especially in preterm infants. The study stated that early clamping prior to respiration is linked to higher morbidity and mortality, suggesting that the timing of clamping in relation to the commencement of breathing is crucial. Compared to DCC, umbilical cord milking is offered as a quicker option, but there is less solid proof. There are still a lot of unanswered questions about the best times, how to handle asphyxiated or non-breathing infants, and how to integrate resuscitation techniques, despite the benefits that have been shown. The review indicated that to successfully apply a physiological approach to cord clamping in a variety of clinical contexts, more research and clinical adaptation are required.

With an emphasis on placental transfusion methods including DCC and UCM, (Katheria, Hosono, and El-Naggar 2018) explored contemporary approaches to umbilical cord management. Although the ideal timing is still unknown, evidence supports DCC as the recommended strategy, showing decreased mortality, better hematologic results, and increased iron reserves in both preterm and term neonates. Delaying cord clamping until after the commencement of respiration, rather than relying only on time, seems to better promote the physiological transition after birth. Although studies have shown comparable short-term benefits, UCM is offered as a workable alternative, especially when DCC is not viable. However, questions regarding safety in extremely premature children continue to exist. Despite these advantages, applying these techniques to non-vigorous newborns and cesarean deliveries still presents difficulties. The authors concluded that more excellent study is required to elucidate the best methods and long-term results of various cord management strategies.

(Sundararajan, McFarlane, and Rabe 2024) stated that DCC is a simple intervention that calls for collaboration between healthcare professionals involved in delivery and a shift in the public health culture toward participation. The work showed that improved cardiopulmonary transition, increased preterm infant survival rates, decreased iron-deficiency anemia in the first year of life due to increased iron reserves, and favorable effects on neurodevelopment at age four are some of the main advantages of DCC.

Instead of depending just on set time intervals, (Raffaeli et al. 2020) examined a physiological approach to UCC, highlighting the connection between cord clamping timing and the commencement of infant respiration. Research shows that DCC improves hemodynamic stability, increases placental transfusion, and lessens the need for blood transfusions in preterm newborns. Other advantages include a lower risk of IVH and necrotizing enterocolitis. To maximize cardiovascular transition and lower the danger of hypoxia and brain damage, breathing should begin prior to cord clamping. When DCC is not practical, UCM is offered as a substitute, however there is still little data on its effectiveness and safety, especially in very premature infants. Even with encouraging results, there are still a lot of unanswered questions about the best time, how to handle asphyxiated or non-breathing children, and how to use them after cesarean birth or resuscitation. The authors concluded that to properly include physiological cord clamping into standard newborn practice, more investigation and clinical modification are needed.

In term infants, DCC at one minute after birth led to significantly higher hemoglobin and hematocrit values measured at 48 hours after birth compared to cord Hb and Hct, i.e., (16.53 vs. 16.69) and (49.47 vs. 50.02) (pvalue = 0.075 and 0.112, respectively), according to the observation made by (Pavitra 2017). Most of newborns exhibited ABO incompatibility (66%), which was demonstrated by a positive direct Coombs test; nonetheless, there was a correlation between DCC and substantial clinical jaundice requiring phototherapy ($p < 0.01$), but the mean time of phototherapy was modest (32.8 hours). Although clinical jaundice needed phototherapy was significant ($p < 0.01$) in the study, a detailed investigation of this group showed no clear correlation with DCC. However, it does not need an intervention like exchange transfusion and can be handled with straightforward phototherapy using the suggested technique. The Apgar score, respiratory distress, polycythemia, and sepsis did not differ significantly.

(Tayal et al. 2025) illustrated that iron deficiency is the most common nutritional deficit, affecting 20% to 50% of the world's population. The study showed that iron deficiency in children develops gradually and causes few severe symptoms. Children who are severely malnourished show signs of weakness and pallor, diminished appetite, and increased weariness. They may develop pica, experience recurring gastrointestinal and respiratory ailments, and show insufficient weight gain. The authors stated that the relationship between iron deficiency and impaired cognitive, behavioral, and psychomotor development is the most alarming. Over the past 30 years, several studies have shown this connection; nevertheless, it is still unclear if iron deficiency is the only factor contributing to these impairments.

3. RESULTS

3.1 Study Selection and Characteristics

Initially, 23 entries were found by searching databases in PubMed, Scopus, and Web of Science. 21 full-text publications were evaluated for eligibility following the elimination of duplicate records and first screening. 10 of these studies were included in the final qualitative synthesis because they satisfied the predetermined inclusion criteria. Systematic reviews, randomized controlled trials, observational studies, and evidence-based clinical reviews with a focus on both term and preterm newborns were among the included studies.

The impact of DCC on various neonatal outcomes, such as hemoglobin concentration, hematocrit, iron stores, need for blood transfusion, IVH, necrotizing enterocolitis (NEC), neonatal mortality, and incidence of jaundice requiring phototherapy, were assessed collectively by the chosen studies.

3.2 Hematological Outcomes

DCC continuously showed positive hematological effects in all the investigations included. When compared to early cord clamping (ECC), several studies found that infants receiving DCC had considerably higher hemoglobin and hematocrit levels. At 48 hours after birth, term babies had greater hemoglobin and hematocrit readings, indicating better placental transfusion and increased neonatal blood volume.

DCC was also linked to better iron reserves and a decreased incidence of iron insufficiency in infancy. Given the known link between early-life iron shortage and poor neurodevelopmental outcomes, these findings are especially significant.

3.3 Clinical Outcomes in Preterm Infants

DCC was linked to better hemodynamic stability and a lower requirement for blood transfusions in preterm newborns. When compared to other cord management methods like umbilical cord milking (UCM). Several studies found that the DCC group had a lower incidence of severe IVH and NEC. Significantly, UCM demonstrated a comparatively increased incidence of severe IVH and neonatal death in extremely preterm newborns, whereas neonatal mortality was observed to be decreased in the DCC group.

3.4 Adverse Events

While some term newborns with DCC had a higher frequency of clinical jaundice that required phototherapy, the period of phototherapy was usually brief and tolerable. Severe consequences like sepsis, respiratory distress, or symptomatic polycythemia did not significantly increase. Overall, the results show that DCC is safe and beneficial for both term and preterm newborn populations.

4. DISCUSSION

DCC is linked to major clinical benefits for babies, especially in terms of enhancing hematological parameters and lowering morbidity among preterm infants, as the current comprehensive study shows.

The improvement in hemoglobin levels, hematocrit, and iron reserves after DCC is among the most consistent findings among the trials studied. This can be explained by the placenta continuing to transfuse blood for the first 30 to 60 seconds after birth, which enables the newborn to receive more blood volume, red blood cells, and stem cells. By preventing early iron insufficiency, these physiological benefits may enhance both immediate postpartum adoption and long-term neurodevelopmental outcomes.

There is substantial evidence that DCC protects preterm infants from serious problems such as IVH, NEC, and the requirement for transfusions. Due to their direct impact on infant survival and long-term neurological prognosis, these results are clinically significant. Improved circulatory stability during the newborn transition may be linked to the lower incidence of IVH seen with DCC.

The assessment also draws attention to a significant continuing debate about how DCC and UCM compare. The evidence presented indicates that DCC is still the safest and better-supported approach, particularly for extremely preterm newborns, even though UCM might provide a quicker option in emergency scenarios.

Despite these benefits, implementation challenges remain in clinical practice, particularly in emergency deliveries and situations requiring immediate neonatal resuscitation. A physiology-based strategy, in which cord clamping is postponed until the commencement of spontaneous breathing rather than depending exclusively on set time intervals, is becoming increasingly supported by recent research.

The heterogeneity of the included studies in terms of study design, newborn populations, timing definitions for DCC, and reported results is a significant limitation of

this analysis. The overall strength of the evidence may also be impacted by the fact that some of the listed references are narrative reviews rather than primary comparative clinical investigations.

High-quality randomized controlled trials evaluating the ideal length of DCC, long-term neurodevelopmental results, and implementation in low-resource settings should be the focus of future research.

5. CONCLUSION

For both term and preterm babies, DCC is a straightforward, secure, and scientifically supported practice that offers substantial advantages. The results of this systematic review show that, especially in preterm infants, DCC improves hemoglobin concentration, increases neonatal iron stores, lowers the risk of transfusion, and decreases the incidence of serious complications like intraventricular hemorrhage and necrotizing enterocolitis. Despite the possibility of a minor rise in jaundice necessitating phototherapy, this risk seems clinically tolerable and does not exceed the significant advantages of DCC.

DCC should be regarded as standard practice in newborn care wherever it is clinically possible, according to the evidence now available. To ascertain the best time and evaluate long-term developmental outcomes, more research is advised.

REFERENCES

1. Chauhan, Suneet P, Vincenzo Berghella, Maureen Sanderson, Everett F Magann, and John C Morrison. 2006. 'American College of Obstetricians and Gynecologists practice bulletins: an overview', *American journal of obstetrics and gynecology*, 194: 1564-72.
2. Katheria, Anup, Shigeharu Hosono, and Walid El-Naggar. 2018. "A new wrinkle: Umbilical cord management (how, when, who)." In *Seminars in Fetal and Neonatal Medicine*, 321-26. Elsevier.
3. Kim, Amanda JH, and Jamie B Warren. 2015. 'Optimal timing of umbilical cord clamping: Is the debate settled? Part 2 of 2: Evidence in preterm and term infants, alternatives, and unanswered questions', *NeoReviews*, 16: e270-e77.
4. Kresch, Mitchell J. 2017. 'Management of the third stage of labor: how delayed umbilical cord clamping can affect neonatal outcome', *American journal of perinatology*, 34: 1375-81.
5. Niermeyer, Susan. 2015. 'A physiologic approach to cord clamping: Clinical issues', *Maternal Health, Neonatology and Perinatology*, 1: 21.
6. Pavitra, NA. 2017. 'Delayed Core Clamping Term Healthy Newborns and its Immediate Neonatal Outcome with Specific Reference to Clinical Jaundice', Rajiv Gandhi University of Health Sciences (India).
7. Raffaeli, Genny, Francesca Manzoni, Valeria Cortesi, Giacomo Cavallaro, Fabio Mosca, and Stefano Ghirardello. 2020. 'Iron homeostasis disruption and oxidative stress in preterm newborns', *Nutrients*, 12: 1554.
8. Rice, Ann E. 2016. 'Delayed Cord Clamping Impact on Transitional Outcomes of the Newborn'.
9. Sundararajan, Sripriya, Renske McFarlane, and Heike Rabe. 2024. 'Placental Transfusion in the Newborn.' in, *Principles of Neonatology* (Elsevier).
10. Tayal, Rohit, Heena Khan, Harshita, Amarjot Kaur Grewal, and Thakur Gurjeet Singh. 2025. 'Pediatric Iron Deficiency: Unveiling the Hidden Battle for Healthy Development.' in, *Maternal and Child Health, and Nutrition* (Springer).
11. WHO, CONSTITUTION OF. 2020. 'World health organization', *Air Quality Guidelines for Europe*.
12. Yamada, Nicole K, Edgardo Szyld, Marya L Strand, Emer Finan, Jessica L Illuzzi, Beena D Kamath-Rayne, Vishal S Kapadia, Susan Niermeyer, Georg M Schmölzer, and Amanda Williams. 2024. '2023 American Heart Association and American Academy of Pediatrics focused update on neonatal resuscitation: an update to the American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care', *Circulation*, 149: e157-e66.
13. Zaman, Amal Y, Hammad A Fadlalmola, Amani A Mohammed, Huda Hassabelrasool Abedelwahed, Kawther E Mohammed, DS Veerabhadra Swamy, Murtada M Gabir, Mohammed D Alshahrani, Mohammed A Assiri, and Saad A Al-Harthi. 2023. 'Comparing the safety and effectiveness of various umbilical cord milking techniques and delayed cord clamping in full-term and preterm infants: A systematic review and meta-analysis', *African journal of reproductive health*, 27: 99-125.