Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

# Comparison of Intact Cord Milking and Cut Cord Milking Among Neonates ≥28 Weeks Requiring Resuscitation at Birth: Protocol of a Randomized Controlled Trial

**Niteesh R N**

rnniteesh8@gmail.com

St.John's Medical College Hospital

**Manjula K S**

St.John's Medical College Hospital

**Saudamini Nesargi**

St.John's Medical College Hospital

**Suman Rao P N**

St.John's Medical College Hospital

---

**Study protocol**

**Keywords:** Intact cord milking, cut cord milking, neonatal resuscitation, placental transfusion.

**Posted Date:** November 11th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-9444934/v1

**License:** This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

**Additional Declarations:** No competing interests reported.

# COMPARISON OF INTACT CORD MILKING AND CUT CORD MILKING AMONG NEONATES ≥28 WEEKS REQUIRING RESUSCITATION AT BIRTH: PROTOCOL OF A RANDOMIZED CONTROLLED TRIAL

**Trial Registration: CTRI/2025/01/079614; prospectively registered on 28 January 2025.**

**AUTHORS:**

Niteesh R N (Principal Investigator)

Manjula K S

Saudamini Nesargi

Suman Rao P N

**AFFILIATIONS:**

[1] Department of Neonatology, St. John's Medical College Hospital, Bangalore, India

**CORRESPONDING AUTHOR:**

Dr.Niteesh R N

Department of Neonatology

St.John's Medical College Hospital

Bangalore, India

Email:rnniteesh8@gmail.com

Phone:+91 9900094050

## Abstract

### Background

Delayed cord clamping (DCC) and umbilical cord milking (UCM) may improve placental transfusion and neonatal hematological outcomes. In neonates requiring resuscitation at birth, intact cord milking (I-UCM) and cut cord milking (C-UCM) may provide alternative approaches to facilitate placental transfusion. Evidence comparing these approaches in neonates requiring resuscitation is limited.

### Methods

This is a single-centre, prospective, two-arm, parallel-group, superiority randomized controlled trial conducted at St John's Medical College and Hospital, Bengaluru, India. Neonates born at ≥28 weeks of gestation who require resuscitation at birth are eligible. Mothers are approached antenatally and written informed consent is obtained before delivery. Eligible participants are randomized in a 1:1 ratio before birth, with stratification by gestational age (<37 weeks and ≥37 weeks).

In the I-UCM group, the intact umbilical cord is milked three times toward the neonate before clamping and cutting. In the C-UCM group, the cord is clamped and cut before the cord is milked three times toward the neonate. Standard neonatal resuscitation and routine neonatal care are provided in both groups according to clinical indication and institutional protocols.

The primary outcome is haemoglobin concentration. Secondary outcomes include time to first breath, Apgar scores, heart rate, oxygen saturation, mean arterial pressure, cerebral oxygenation measures, need for inotropic support, bilirubin levels, red blood cell transfusion, and mortality. Follow-up continues until hospital discharge. Analyses will follow the intention-to-treat principle. A prespecified subgroup analysis will compare neonates born at <37 versus ≥37 weeks of gestation.

### Discussion

This trial will evaluate whether intact cord milking compared with cut cord milking improves haematological and clinical outcomes among neonates requiring resuscitation at birth. The findings may provide evidence to guide cord-management practices in this population.

### Keywords

Intact cord milking; cut cord milking; neonatal resuscitation; placental transfusion.

## 1. BACKGROUND

The transition from fetal to neonatal life is a critical period marked by significant cardiopulmonary changes. Placental transfusion—the transfer of residual placental blood to the newborn—is a key physiological process that improves hemodynamic stability, iron stores, and neurodevelopmental outcomes [1, 2]. The World Health Organization recommends delayed cord clamping (DCC) for 60-180 seconds as the standard of care for vigorous newborns [3].

For neonates who are non-vigorous at birth and require immediate resuscitation, DCC is not feasible as the "golden minute" of resuscitation takes precedence. In such scenarios, umbilical cord milking (UCM) has emerged as a viable alternative, providing a rapid placental transfusion within seconds [4]. UCM can be performed as intact cord milking (I-UCM), where the cord is milked towards the infant before being cut, or cut cord milking (C-UCM), where the cord is cut first and the segment is milked on the resuscitation trolley.

Evidence from systematic reviews and randomized trials, including one conducted at our centre, has established that UCM is superior to immediate cord clamping in preterm neonates, leading to higher haemoglobin levels, improved systemic blood flow, and reduced intraventricular haemorrhage [5, 6]. The 2023 ILCOR guidelines suggest that for infants >28 weeks who need resuscitation, I-UCM is a reasonable alternative to immediate clamping [7]. A pilot study by McAdams et al. suggested that I-UCM may transfer a greater blood volume than C-UCM [8]. However, no study has compared the clinical efficacy and safety of I-UCM versus C-UCM in the vulnerable population of neonates requiring resuscitation. This trial is designed to fill this critical evidence gap.

## 2. METHODS/DESIGN

### 2.1 Study Aim and Objectives

The aim of this study is to determine the best placental transfusion strategy in neonates ≥28 weeks gestation who require resuscitation at birth by comparing I-UCM and C-UCM. Primary Objective is to compare the effect of I-UCM versus C-UCM on serum haemoglobin levels at 6 hours of life. And secondary Objectives is to compare the effects of I-UCM versus C-UCM on Apgar scores at 1 and 5 minutes, time to first breath, heart rate and oxygen saturation at 5, 10, and 60 minutes, mean arterial pressure at 2 and 6 hours of life, need for inotropic support in the first 48-72 hours, cerebral oxygenation (measured by NIRS) over the first 6 hours, peak serum bilirubin level, need for packed red blood cell transfusion during the neonatal period and all-cause mortality during the neonatal period.

### 2.2 Trial Design

This is a prospective, two-arm, parallel-group, randomized, controlled, superiority trial conducted at a single tertiary care centre. Patients or members of the public were not involved in the design, conduct, or reporting of this trial. Given the acute nature of neonatal resuscitation and the need for antenatal consent and pre-birth randomization, patient and public involvement was not feasible.

2.3 Study Setting

The study will be conducted in the delivery rooms (Operation Theatre and Labor Room) and the Neonatal Intensive Care Unit (NICU) of St. John's Medical College Hospital, Bangalore, India.

2.4 Study population

Inclusion Criteria for the study are neonates born at ≥28 weeks of gestation delivered at SJMCH, who do not cry or breathe at birth and require resuscitation as per NRP guidelines. Exclusion Criteria includes neonates <28 weeks of gestation, multiple births (twins, triplets, etc.), antenatally detected major congenital anomalies, umbilical cord abnormalities (e.g., true knot) and hydrops fetalis. Participant details who are planned for enrolment are shown in table 1.

**Table 1. PRO EDI participant characteristics**

Expected demographic characteristics of participants included in the study protocol. Since this is a protocol article, the table describes anticipated participant characteristics rather than observed sample characteristics

| **PRO EDI characteristic** | |
|---|---|
| **Age** | Eligible participants are neonates born at ≥28 weeks' gestation who require resuscitation at birth. Gestational age is used for eligibility and stratified randomisation (<37 weeks vs ≥37 weeks). |
| **Sex** | The protocol does not restrict eligibility by infant sex. Sex assigned at birth will be recorded and patient enrolment will be according to the randomised group. |
| **Gender** | As participants are neonates and the intervention allocation is based on cord-milking strategy, gender is not an eligibility criterion. |
| **Race / ethnicity / ancestry** | The study is being conducted in southern part of India where the predominant anticipated race is South Asian. |
| **Socioeconomic status (SES)** | Socioeconomic status will not be assessed, as it is not directly relevant to the study objectives. Given the study location is a private tertiary care hospital, participants are expected to represent a broad range of socioeconomic backgrounds. |
| **Geographic location** | Single-centre recruitment at St. John's Medical College Hospital, Bengaluru, Karnataka, India. |

2.5 Sample Size

The sample size was calculated based on the haemoglobin levels reported by Orpak et al. [9]. Assuming a mean (SD) haemoglobin of 18.4 (1.4) g/dL in the I-UCM group and 17.7 (1.8) g/dL in the C-UCM group, with a power of 90% and a two-sided alpha of 0.05, a total of 224 neonates (112 per group) are required. To account for potential incomplete data, the sample size will be inflated to 240 (120 per group).

2.6 The Intervention

All delivering obstetricians and neonatal resuscitation team members will be trained on the standardized procedure using a video demonstration prior to the study commencement.

Group 1 (Intervention - I-UCM): After delivery, the obstetrician will milk the intact umbilical cord from a point approximately 25 cm from the introitus (marked by an artery forceps) towards the neonate three times at a speed of ~10 cm/sec. The cord will then be clamped and cut, and the infant will be transferred to the radiant warmer for standard resuscitation.

Group 2 (Control - C-UCM): After delivery, the obstetrician will immediately clamp and cut the umbilical cord at approximately 25 cm from the introitus. The infant will be transferred to the radiant warmer. The senior resident will then raise the cord and milk it from the cut end towards the infant three times at a speed of ~10 cm/sec. The cord will be re-clamped 2-3 cm from the base, and standard resuscitation will continue.

In both groups, the time to perform milking and the time to first breath will be recorded using a stopwatch. If the allocated cord-milking procedure cannot be safely completed, it will be discontinued and standard neonatal resuscitation will proceed without delay. Any modification, non-completion, or discontinuation of the allocated procedure will be documented with the reason and relevant clinical details. Standard neonatal resuscitation and routine NICU care will be provided equally in both groups according to clinical indication and institutional protocols. No additional co-intervention specifically related to the study allocation is permitted.

2.7 Outcomes

Primary Outcome is to estimate serum haemoglobin (g/dL), measured from a 0.5 mL peripheral venous blood sample at 6 hours of life.

Secondary outcomes planned for assessment includes resuscitation and transition: Apgar scores at 1 and 5 min; time to first breath (sec), hemodynamic and oxygenation: heart rate (bpm) and oxygen saturation (%) at 5min, 10min, and hourly for 6 hours; mean arterial pressure (mmHg) at 2 and 6 hours; cerebral tissue oxygen saturation

(crSO2%) measured by Near-Infrared Spectroscopy (NIRS) hourly for 6 hours;, clinical morbidities: need for inotropic support (Yes/No) in first 48-72 hrs; peak serum bilirubin level (mg/dL); need for packed red blood cell transfusion (Yes/No) during hospital stay and mortality: all-cause neonatal mortality (prior to discharge)

Safety and adverse events will be assessed by the treating neonatal team during the intervention, resuscitation, and subsequent hospital stay until discharge. Any adverse event potentially related to the intervention will be documented, assessed for severity and relatedness, and managed according to standard clinical practice.

2.8 Randomization

A computer-generated block randomization list with variable block randomization, stratified by gestation, has been prepared by statistician. The strata by gestation at birth are less than 37 weeks and more than or equal to 37 weeks. The random allocation is concealed in serially numbered, opaque, sealed envelopes prepared at SJMCH.

2.9 Blinding

Due to the nature of the intervention, the clinicians and investigators cannot be blinded. However, the laboratory personnel analysing the haemoglobin samples will be blinded to the group allocation.

2.10 Study implementation strategy

The clinical trial is conducted in compliance with the clinical trial protocol, good clinical practices, and the applicable regulatory requirements. The study is implemented in a standardized manner and trial conducted in audited and monitored by weekly meeting of primary investigator and guide. The progress will be documented, and necessary steps will be take taken to ensure protocol adherence.

2.11 The screening, randomization and enrolment

2.11.1 Screening

Antenatal mothers ≥28 weeks gestation admitted for delivery will be approached for written informed consent. Every effort will be made to take consent from both mother and father however, if mother is not approachable for any given reason then consent will be taken from father or guardian. Consent will be a two-stage process: antenatal information and consent for potential inclusion, with final enrolment contingent on the baby meeting the eligibility criterion of requiring resuscitation at birth.

2.11.2 Randomization and allocation

Randomization: Participants will be allocated in a 1:1 ratio to I-UCM or C-UCM using computer-generated random sequences.

Allocation Concealment: Opaque, sequentially numbered, sealed envelopes will be used to conceal the allocation until the moment of intervention.

2.11.3 Enrolment

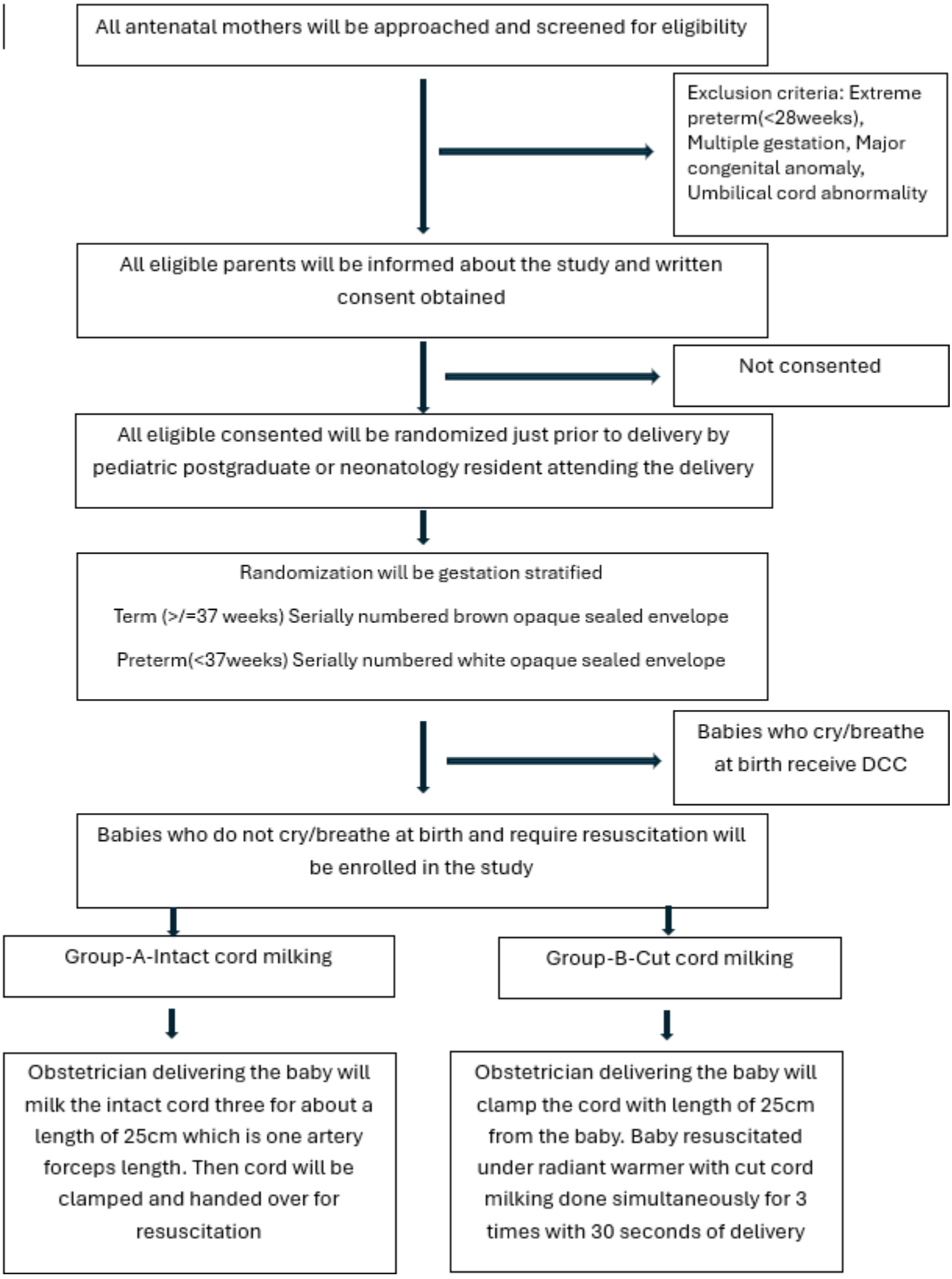
Neonatologist or paediatrician attending the delivery will randomise the baby prior to attending the delivery. Soon after the baby is delivered if baby cries then delayed cord clamping will be done as per WHO norms. However if the baby does not cry and requires resuscitation at birth, then will be enrolled to the respective group as per prior randomization. Suggested participant enrolment timeline and flow are showed in figure 1 and figure 2 respectively.

Figure 1: SPIRIT 2025 Participant timeline

| DOMAIN | PROCEDURE / ASSESSMENT | Antenatal (before birth) | Birth / final eligibility | 1 min | 5 min | 10 min | 1h | 2h | 3h | 4h | 5h | 6h | 48–72 h | Hospital discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ENROLMENT** | Eligibility screen | X | X | | | | | | | | | | | |
| | Written informed consent | X | | | | | | | | | | | | |
| | Final eligibility / trial enrolment if resuscitation required | | X | | | | | | | | | | | |
| | 1:1 randomization before birth | X | | | | | | | | | | | | |
| **INTERVENTION** | I-UCM | | X | | | | | | | | | | | |
| **COMPARATOR** | C-UCM | | X | | | | | | | | | | | |
| **ASSESSMENTS** | Baseline characteristics | | X | | | | | | | | | | | |
| | Apgar / time to first breath | | X | X | X | | | | | | | | | |
| | Heart rate / SpO2 | | | | X | X | X | X | X | X | X | X | | |
| | Mean arterial pressure | | | | | | | X | | | | X | | |
| | Haemoglobin | | | | | | | | | | | X | | |
| | NIRS / crSO2 / cFOE (hourly for first 6 h) | | | | | | X | X | X | X | X | X | | |
| | Need for inotropic support | | | | | | | | | | | | X | |
| | Peak bilirubin / PRBC transfusion / mortality | | | | | | | | | | | | X | X |
| | Fidelity / deviations / resuscitation details / adverse events | | X | | X | X | X | X | X | X | X | X | X | X |

Antenatal consent precedes birth and randomisation is before birth. Final trial enrolment occurs only if resuscitation is required. I-UCM/C-UCM are single delivery-room interventions.

Figure 2: Enrolment flow



2.12 Outcome measure team

2.12.1 Data Collection and Management

Data will be collected on a standardized case report form(CRF). Monitoring of heart rate, SpO2, blood pressure, and cerebral oximetry will be performed as per the schedule outlined in the outcomes section. All data will be stored securely, and electronic data will be password-protected. Access will be restricted to the investigation team. Follow-up will continue for all enrolled neonates until hospital discharge. Any protocol deviations, discontinuations, or withdrawals will be documented with the date, reason, and relevant clinical details.

2.13 Quality assurance

2.13.1 Training and standardisation

All the neonatologists, paediatric postgraduates and obstetricians attending delivery will be trained prior on several occasions and their training process would be documented. Training includes video demonstrations, teaching and simulation using mannequin and monthly refreshing the same.

Posters about the study will be prepared and displayed in NICU, labour rooms and operation theatres.

Post enrolment all the personnel attending delivery would be approached by the primary investigator and the procedure done would be retrospectively assessed using a quality assurance checklist to ensure fidelity with the intervention.

2.14 Trial registration

The trial is registered in Clinical Trials Registry India (CTRI) in January 2025 with CTRI number CTRI/2025/01/079614.

2.15 General principles for analysis

Data will be analysed on an intention-to-treat basis. The primary outcome, haemoglobin at 6 hours, will be compared between groups using a two-sample t-test, presented as a mean difference with a 95% confidence interval. Categorical secondary outcomes will be compared using the Chi-square or Fisher's exact test. A p-value of $<0.05$ will be considered statistically significant. Statistical analysis will be performed using SPSS or R software. Missing outcome data will be documented with the reason. Analyses will use available data, and the extent and pattern of missing data will be reported. No imputation is planned. A prespecified subgroup analysis will be performed according to gestational age

(<37 weeks vs ≥37 weeks) to assess the consistency of the treatment effect. No other subgroup analyses are planned.

2.15.1 Ancillary and post-trial care

All enrolled neonates will receive standard neonatal care according to clinical condition and institutional protocols, irrespective of group allocation. Any adverse event potentially related to the intervention will be assessed and managed appropriately and reported to the Institutional Ethics Committee when required. Compensation and management of trial-related injury, if applicable, will follow Institutional Ethics Committee and applicable regulatory requirements. No additional post-trial intervention is planned.

2.16 Data Monitoring

Weekly meetings of the investigators will be conducted to review the data and ensure fidelity with the intervention and study processes. The investigators will be responsible for interim data review and monitoring for any unforeseen adverse events. The datasets generated and/or analysed during the current study are not publicly available because of participant confidentiality and ethical restrictions but may be made available from the corresponding author on reasonable request, subject to institutional and ethical requirements.

2.16.1 Interim analysis and stopping rules

Data will be analysed after 50% and 75% of babies enrolled. Stopping rules will be as per Haybittle-Peto rules for efficacy.

2.17 Protocol Amendments

Any amendments to the protocol will be submitted to the IEC for approval prior to implementation.

2.18 Declaration

2.18.1 Ethics and Dissemination: The study protocol has been approved by the Institutional Ethics Committee of St.John's Medical College Hospital. The trial will be registered with the Clinical Trials Registry - India (CTRI) before participant enrolment begins. The results of this trial will be disseminated through publication in a peer-reviewed journal and presentation at scientific conferences.

2.18.2 Consent: Written informed consent will be obtained from a parent or legal guardian.

Availability of data and material

2.18.3 Confidentiality

All participant data will be de-identified using a unique study code. Confidentiality will be maintained throughout the study and in any publications.

2.18.4 Funding

This trial is self-funded, with no specific external grant from a public, commercial, or not-for-profit funding agency. The sponsor has no role in the study design, conduct, data collection, analysis, interpretation of results, or decision to submit the manuscript for publication. The Principal Investigator retains final decision-making authority regarding the conduct of the trial and publication of its results. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The sponsor of the trial is Niteesh R N, Department of Neonatology, St John's Medical College and Hospital, Bengaluru, India.

2.18.5 Competing interest

The investigators declare no competing interests. The Institutional Ethics Committee members involved in the ethical review of the study have no competing interests related to this trial.

2.18.6 Authors' contribution

- Niteesh R N: Conceptualization, Methodology, Investigation, Data Curation, Writing - Original Draft
- Suman Rao P N: Conceptualization, Methodology, Supervision, Writing - Review & Editing
- Manjula: Methodology, Resources, Writing - Review & Editing
- Saudamini Nesargi: Methodology, Supervision, Writing - Review & Editing
  All authors have read and approved the final manuscript.

## 3. Discussion

Placental transfusion has become an important and evolving topic in neonatology, leading to numerous recent randomized controlled trials (RCTs). Placental transfusion refers to the transfer of residual blood from the placenta to the newborn during the first minutes after birth. This can be achieved mainly through delayed cord clamping (DCC), intact umbilical cord milking (I-UCM), or cut cord milking (C-UCM). Historically, immediate cord clamping was common but growing physiological and clinical evidence has shown that this interrupts normal fetoplacental circulation and reduces neonatal blood volume.

Over the past decade, many RCTs have evaluated placental transfusion strategies. Studies consistently show that delayed cord clamping improves neonatal outcomes, particularly in

preterm infants, including improved transitional circulation, higher haemoglobin levels, reduced need for blood transfusion, and lower rates of intraventricular haemorrhage (IVH) and necrotizing enterocolitis. Because of this evidence, most guidelines recommend delaying cord clamping by at least 30–60 seconds in vigorous infants.

However, clinical situations sometimes make DCC difficult, especially when the infant requires immediate resuscitation. This has led to interest in cord milking, which attempts to rapidly transfer placental blood toward the infant. Some RCTs suggest that cord milking may increase haematocrit and improve systemic blood flow compared with DCC, particularly in caesarean deliveries. Yet evidence remains conflicting. A large trial in extremely preterm infants (23–27 weeks) was stopped early because umbilical cord milking was associated with a higher rate of severe IVH compared with delayed clamping, raising safety concerns. Conversely, more recent RCTs in moderately preterm infants (28–32 weeks) found no difference in severe IVH or death between cord milking and delayed clamping, suggesting it may be a reasonable alternative when DCC is not feasible.

The distinction between intact cord milking and cut cord milking is also important. Intact cord milking is performed before the cord is clamped and may allow continued placental circulation, whereas cut cord milking occurs after the cord is clamped and likely provides less transfusion. Unfortunately, there are relatively few direct RCT comparisons between these two approaches, leaving uncertainty regarding which method is safer or more effective.

In practice, the balance of evidence currently favours delayed cord clamping as the standard strategy, particularly for very preterm infants. Cord milking may still have a role when immediate neonatal stabilization is required, but caution is needed in extremely preterm infants due to possible risks of IVH. Upon completion, this trial will provide comprehensive data on efficacy of intact cord milking, cut cord milking and their comparison in developing countries.

## 4. Trial status

The recruitment of participants for the study is completed, and the protocol was submitted for publication before the patient recruitment was completed. Trial registration began in April 2025 and enrolment was completed in May 2026.

## 5. References


1. Guideline: Delayed Umbilical Cord Clamping for Improved Maternal and Infant Health and Nutrition Outcomes. Geneva: World Health Organization; 2014. PMID: 26269880.
2. McDonald SJ, Middleton P, Dowswell T, Morris PS. Effect of timing of umbilical cord clamping of term infants on maternal and neonatal

outcomes. Evid Based Child Health. 2014 Jun;9(2):303-97. doi: 10.1002/ebch.1971. PMID: 25404605.
3. Rabe H, Diaz-Rossello JL, Duley L, Dowswell T. Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcomes. Cochrane Database Syst Rev. 2012 Aug 15;(8):CD003248. doi: 10.1002/14651858.CD003248.pub3. Update in: Cochrane Database Syst Rev. 2019 Sep 17;9:CD003248. doi: 10.1002/14651858.CD003248.pub4. PMID: 22895933.
4. Robledo KP, Tarnow-Mordi WO, Rieger I, Suresh P, Martin A, Yeung C, Ghadge A, Liley HG, Osborn D, Morris J, Hague W, Kluckow M, Lui K, Soll R, Cruz M, Keech A, Kirby A, Simes J; APTS Childhood Follow-up Study collaborators. Effects of delayed versus immediate umbilical cord clamping in reducing death or major disability at 2 years corrected age among very preterm infants (APTS): a multicentre, randomised clinical trial. Lancet Child Adolesc Health. 2022 Mar;6(3):150-157. doi: 10.1016/S2352-4642(21)00373-4. Epub 2021 Dec 8. Erratum in: Lancet Child Adolesc Health. 2022 Mar;6(3):e12. doi: 10.1016/S2352-4642(22)00023-2. PMID: 34895510.
5. Thomas MR, Yoxall CW, Weeks AD, Duley L. Providing newborn resuscitation at the mother's bedside: assessing the safety, usability and acceptability of a mobile trolley. BMC Pediatr. 2014 May 29;14:135. doi: 10.1186/1471-2431-14-135. PMID: 24885712; PMCID: PMC4055396.
6. Al-Wassia H, Shah PS. Efficacy and safety of umbilical cord milking at birth: a systematic review and meta-analysis. JAMA Pediatr. 2015 Jan;169(1):18-25. doi: 10.1001/jamapediatrics.2014.1906. PMID: 25365246.
7. Patel S, Clark EA, Rodriguez CE, Metz TD, Abbaszadeh M, Yoder BA. Effect of umbilical cord milking on morbidity and survival in extremely low gestational age neonates. Am J Obstet Gynecol. 2014 Nov;211(5):519.e1-7. doi: 10.1016/j.ajog.2014.05.037. Epub 2014 May 29. PMID: 24881823.
8. Ram Mohan G, Shashidhar A, Chandrakala BS, Nesargi S, Suman Rao PN. Umbilical cord milking in preterm neonates requiring resuscitation: A randomized controlled trial. Resuscitation. 2018 Sep;130:88-91. doi: 10.1016/j.resuscitation.2018.07.003. Epub 2018 Jul 5. PMID: 29981817.
9. Kattwinkel J, Niermeyer S, Nadkarni V, Tibballs J, Phillips B, Zideman D, Van Reempts P, Osmond M. ILCOR advisory statement: resuscitation of the newly born infant. An advisory statement from the pediatric working group of the International Liaison Committee on Resuscitation. Circulation. 1999 Apr 13;99(14):1927-38. doi: 10.1161/01.cir.99.14.1927. PMID: 10199894.

10. Wyllie J, Perlman JM, Kattwinkel J, Wyckoff MH, Aziz K, Guinsburg R, Kim HS, Liley HG, Mildenhall L, Simon WM, Szyld E, Tamura M, Velaphi S; Neonatal Resuscitation Chapter Collaborators. Part 7: Neonatal resuscitation: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation. 2015 Oct;95:e169-201. doi: 10.1016/j.resuscitation.2015.07.045. Epub 2015 Oct 15. PMID: 26477424.
11. Wyckoff MH, Aziz K, Escobedo MB, Kapadia VS, Kattwinkel J, Perlman JM, Simon WM, Weiner GM, Zaichkin JG. Part 13: Neonatal Resuscitation: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2015 Nov 3;132(18 Suppl 2):S543-60. doi: 10.1161/CIR.0000000000000267. PMID: 26473001.
12. Committee Opinion No. 684 Summary: Delayed Umbilical Cord Clamping After Birth. Obstet Gynecol. 2017 Jan;129(1):1. doi: 10.1097/AOG.0000000000001855. PMID: 28002305.
13. Tolosa JN, Park DH, Eve DJ, Klasko SK, Borlongan CV, Sanberg PR. Mankind's first natural stem cell transplant. J Cell Mol Med. 2010 Mar;14(3):488-95. doi: 10.1111/j.1582-4934.2010.01029.x. Epub 2010 Feb 5. PMID: 20141549; PMCID: PMC3823451.
14. Katheria AC, Brown MK, Faksh A, Hassen KO, Rich W, Lazarus D, Steen J, Daneshmand SS, Finer NN. Delayed Cord Clamping in Newborns Born at Term at Risk for Resuscitation: A Feasibility Randomized Clinical Trial. J Pediatr. 2017 Aug;187:313-317.e1. doi: 10.1016/j.jpeds.2017.04.033. Epub 2017 May 16. PMID: 28526223.
15. Nevill E, Meyer MP. Effect of delayed cord clamping (DCC) on breathing and transition at birth in very preterm infants. Early Hum Dev. 2015 Jul;91(7):407-11. doi: 10.1016/j.earlhumdev.2015.04.013. Epub 2015 May 15. PMID: 25984654.
16. Al-Wassia H, Shah PS. Efficacy and safety of umbilical cord milking at birth: a systematic review and meta-analysis. JAMA Pediatr. 2015 Jan;169(1):18-25. doi: 10.1001/jamapediatrics.2014.1906. PMID: 25365246.
17. Katheria AC, Truong G, Cousins L, Oshiro B, Finer NN. Umbilical Cord Milking Versus Delayed Cord Clamping in Preterm Infants. Pediatrics. 2015 Jul;136(1):61-9. doi: 10.1542/peds.2015-0368. PMID: 26122803; PMCID: PMC4485011.
18. Erickson-Owens DA, Mercer JS, Oh W. Umbilical cord milking in term infants delivered by cesarean section: a randomized controlled trial. J Perinatol. 2012 Aug;32(8):580-4. doi: 10.1038/jp.2011.159. Epub 2011 Nov 17. PMID: 22094494.
19. Katheria A, Mercer J, Brown M, Rich W, Baker K, Harbert MJ, Pierce B, Hassen K, Finer N. Umbilical cord milking at birth for term newborns

with acidosis: neonatal outcomes. J Perinatol. 2018 Mar;38(3):240-244. doi: 10.1038/s41372-017-0011-9. Epub 2017 Dec 12. PMID: 29234144.
20. Upadhyay A, Gothwal S, Parihar R, Garg A, Gupta A, Chawla D, Gulati IK. Effect of umbilical cord milking in term and near term infants: randomized control trial. Am J Obstet Gynecol. 2013 Feb;208(2):120.e1-6. doi: 10.1016/j.ajog.2012.10.884. Epub 2012 Oct 31. PMID: 23123382.
21. Jaiswal P, Upadhyay A, Gothwal S, Singh D, Dubey K, Garg A, Vishnubhatala S. Comparison of two types of intervention to enhance placental redistribution in term infants: randomized control trial. Eur J Pediatr. 2015 Sep;174(9):1159-67. doi: 10.1007/s00431-015-2511-y. Epub 2015 Mar 24. PMID: 25800496.
22. Jaiswal P, Upadhyay A, Gothwal S, Chaudhary H, Tandon A. Comparison of Umbilical Cord Milking and Delayed Cord Clamping on Cerebral Blood Flow in Term Neonates. Indian J Pediatr. 2015 Oct;82(10):890-5. doi: 10.1007/s12098-015-1734-2. Epub 2015 May 27. PMID: 26008758.
23. McAdams RM, Fay E, Delaney S. Whole blood volumes associated with milking intact and cut umbilical cords in term newborns. J Perinatol. 2018 Mar;38(3):245-250. doi: 10.1038/s41372-017-0002-x. Epub 2017 Dec 12. PMID: 29234147.
24. Jain SN, Mehendale AM. A Review on Umbilical Cord Milking and Its Implications in Neonatal Health. Cureus. 2022 Oct 23;14(10):e30610. doi: 10.7759/cureus.30610. PMID: 36426307; PMCID: PMC9681015.
25. Katheria AC, Truong G, Cousins L, Oshiro B, Finer NN. Umbilical Cord Milking Versus Delayed Cord Clamping in Preterm Infants. Pediatrics. 2015 Jul;136(1):61-9. doi: 10.1542/peds.2015-0368. PMID: 26122803; PMCID: PMC4485011.
26. El-Naggar W, McMillan D, Hussain A, Armson A, Dodds L, Warren A, Whyte R, Vincer M, Simpson CD. Neurodevelopmental outcomes of very preterm infants who received cord milking at birth: a randomized controlled trial. Eur J Pediatr. 2022 Dec;181(12):4215-4220. doi: 10.1007/s00431-022-04638-x. Epub 2022 Oct 4. PMID: 36194256.
**27.** Orpak ÜS, Ergin H, Çıralı C, Özdemir ÖMA, Koşar Can Ö, Çelik Ü. Comparison of cut and intact cord milking regarding cerebral oxygenation, hemodynamic and hematological adaptation of term infants. J Matern Fetal Neonatal Med. 2021 Jul;34(14):2259-2266. doi: 10.1080/14767058.2019.1662781. Epub 2019 Sep 11. PMID: 31475597.