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Immediate versus delayed cord clamping and its effect on neonatal outcomes in vaginal deliveries: A randomized controlled trial

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Abstract

The timing of umbilical cord clamping in vaginal births at term may affect newborn outcomes. This randomized controlled trial aimed to compare immediate cord clamping (ICC) within 15 seconds with delayed cord clamping (DCC) 60-120 seconds after birth and evaluate their effects on the hematological and clinical parameters of newborns. A two hundred pregnant women, delivering vaginally, were randomly assigned equally to either ICC or DCC groups at Babylon Hospital, Iraq. Primary outcomes measured included hemoglobin and hematocrit at birth and 24 hours later, Apgar scores, need for resuscitation, jaundice rates, birth weight, temperature stability, and NICU admission rates. Statistical analyses included t-tests, chi-square tests, and multivariate logistic regression. The DCC group showed significantly higher hemoglobin and hematocrit levels (52.4% vs. 45.0%) ($p < 0.001$). Birth weight was also higher in the DCC group (3265 g vs. 3180 g, $p = 0.04$). No significant differences were observed in Apgar scores, resuscitation rates, jaundice requiring phototherapy, temperature instability, or NICU admissions. Delayed childbirth independently predicted higher neonatal hemoglobin (OR = 4.65, $p < 0.001$) Delayed cord clamping significantly improves the hematologic status of newborns in the early stages without increasing adverse clinical outcomes. Delayed cord clamping practices are recommended to improve newborn health.

Keywords: Umbilical cord clamping, Neonatal outcomes, Vaginal birth

Introduction

The timing of umbilical cord clamping at delivery has long been a topic of scientific debate, particularly concerning its impact on neonatal consequences. Traditionally, immediate cord clamping (ICC)—described as clamping within the first 15–30 seconds after delivery—was widely practiced, particularly in healthcare facility settings, to facilitate neonatal resuscitation or early separation from the placenta for numerous clinical or logistical reasons [1,2]. However, current evidence has increasingly supported not-on-time cord clamping (DCC), usually achieved 1 to 3 minutes after start or when cord pulsation ceases, due to its beneficial effects on neonatal hematologic status and overall health[3][4].

Several randomized trials and meta-analyses have established that DCC in time period newborns appreciably improve iron stores and hemoglobin concentrations all through the early neonatal length without increasing the risk of intense maternal postpartum hemorrhage[5,6]. Specifically, DCC permits a placental transfusion of 20–30% greater blood extent to the new child, contributing to higher pink blood mobile mass and improved degrees of hemoglobin and hematocrit [7]. These hematological upgrades are in particular critical for stopping early little one iron deficiency, which is associated with impaired neurodevelopment and cognitive results [8].

Despite the developing endorsement of DCC through worldwide health authorities—along with the World Health Organization (WHO), which recommends a delay of at least one minute for all births scientific exercise stays variable, specifically in low-useful resource settings or wherein institutional protocols desire instant interventions [9,29]. Moreover, worries approximately capacity risks such as neonatal jaundice, polycythemia, or respiration compromise continue to persuade scientific choices, although evidence regarding these dangers stays inconclusive [10,11].

Given this context, the present study aimed to rigorously compare the results of immediate versus delayed cord clamping on key neonatal outcomes in

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time period vaginal births thru a randomized managed trial layout. By offering high-quality proof from a managed setting, this research contributes to the ongoing effort to refine beginning practices and decorate early neonatal care.

Material and Methods

Study design

This has a look at turned into designed as a randomized controlled trial to evaluate the consequences of instant versus not-on-time umbilical cord clamping on neonatal consequences in time period vaginal births. The trial was carried out to offer first-rate evidence of the capability blessings or risks related to the timing of cord clamping. A parallel institution design was hired, with participants randomly assigned to one among two intervention arms: instant cord clamping (within 15 seconds of beginning) or delayed cord clamping (between 60 to 120 seconds after start).

Study setting and duration

The study was conducted at Babylon Hospital for Women and Children, positioned within the Babylon Governorate, Iraq. The health facility serves as one of the foremost centers for maternal and neonatal healthcare inside the place. The data series was executed over a duration of six months, from December 2024 to May 2025. This time body becomes selected to ensure the enrollment of a sufficient range of eligible participants and to permit adequate compliance with neonatal consequences.

Population and sample size

The observed population consisted of pregnant women who had been admitted to the hard work and delivery unit for spontaneous vaginal delivery at a period (gestational age ≥ 37 completed weeks). A sample size of 200 members (one hundred in each group) was calculated with the use of electricity analysis to come across giant variations in number one neonatal outcomes such as hemoglobin ranges and Apgar scores, with an alpha degree of 0.05 and a strength of 80%. Allowances for potential dropouts and incomplete statistics have been also considered inside the very last pattern length.

Participants were included the have a look at whether they met precise eligibility conditions that ensured the safety and reliability of the studies. Women have been eligible for inclusion if they had been between 18 and 40 years of age, had a singleton pregnancy at term (described as 37 finished weeks of gestation or more), and were scheduled for spontaneous vaginal shipping. Only those with a cephalic fetal presentation and who were introduced without using instrumental assistance, together with forceps or vacuum extraction, have been considered. Additionally, inclusion required a lack of hard work or delivery headaches and a willingness to provide knowledgeable consent.

Conversely, women had been excluded from participation if any medical or obstetric situation became the gift that might potentially interfere with the outcomes of the take-a-look at or pose dangers to the mother or newborn. This included pregnancies complicated using recognized fetal anomalies, Rh incompatibility, or severe maternal anemia (hemoglobin stage much less than 8 g/dL). Maternal situations along with preeclampsia, diabetes mellitus, placenta previa, or abruptio placentae additionally warranted exclusion. Furthermore, any neonate requiring immediate resuscitation at the beginning or whose transport led to a cesarean segment was now not enrolled inside the observation. These criteria have been mounted to maintain homogeneity inside the pattern and to minimize confounding factors that could affect neonatal consequences.

Randomization and blinding

Eligible members were randomly assigned to either the immediate cord-clamping group or the delayed-cord clamping organization through the usage of a computer-generated randomization listing. The allocation was hidden in opaque, sealed envelopes, which had been opened handiest after the shipping of the little one. Due to the character of the intervention, blinding of the attending midwives and obstetricians turned into now not viable. However, the employees chargeable for measuring neonatal effects and studying the facts were blinded to the group assignments.

Intervention protocol

In the immediate cord clamping (ICC) organization,

the umbilical cord became clamped and reduced within 15 seconds after birth. In the delayed cord clamping (DCC) organization, the umbilical cord turned clamped and cut between 60 to one hundred twenty seconds after beginning, bearing in mind persistent placental transfusion. In each business, newborns had been located on the mom's abdomen or chest to promote skin-to-skin touch in the course of the waiting length or clamping method. Standard obstetric and neonatal care strategies were accompanied by health center rules.

Data collection tools and procedure

Data have been collected through the usage of a dependent tick list and recording sheet developed mainly for this study. Maternal demographic and obstetric information has been accumulated from scientific facts and interviews with participants before shipping. Neonatal statistics have been gathered right away after birth and at some stage in the first 24 hours of life.

Primary neonatal effects included

Hemoglobin and hematocrit degrees measured 24 hours after birth the use of venous blood samples

1-minute and 5-minute Apgar ratings
Respiratory attempt and want for resuscitation
Incidence of neonatal jaundice requiring phototherapy
Birth weight and temperature balance
Admission to the neonatal intensive care unit (NICU)

Trained pediatric nurses and laboratory technicians have been responsible for blood pattern series and evaluation. The laboratory at Babylon Hospital for Women and Children followed trendy protocols for processing hematologic parameters.

Ethical considerations

Prior to the commencement of the study, ethical approval was obtained from the Scientific Research and Ethics Committee of Babylon Health Directorate. Written knowledgeable consent was received from all participating women after explaining the reason, blessings, and ability risks of the observation. Participation turned into voluntary, and individuals had the right to withdraw at any time without any effect on the care they or their babies received.

Quality assurance and validity

The study's contraptions have been reviewed by a panel of specialists in obstetrics, neonatology, and biostatistics to ensure content material validity. A pilot test related to 10 participants (now not covered within the fundamental examination) was carried out to check feasibility and refine the data series system. Regular supervision and move-checking of statistics entries were applied to limit errors and bias. Data collection strategies had been standardized through education sessions for all worried personnel.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) model 26. Descriptive information, such as approach, preferred deviations, frequencies, and chances, were used to summarize the demographic and clinical characteristics of the take a look at the populace. To check the variations between the immediate and delayed- cord clamping businesses, inferential data was carried out. The independent sample t-test looks at changes used to compare continuous variables such as neonatal hemoglobin and hematocrit ranges, at the same time as the chi-square test becomes applied to study associations between express variables, consisting of Apgar scores, occurrence of jaundice, and NICU admission costs. In instances wherein assumptions for parametric tests have been violated, non-parametric options including the Mann–Whitney U check were employed. Moreover, multivariate logistic regression analysis was performed to alter for ability confounding variables and to decide the independent effect of cord clamping time on neonatal effects. A p-value of much less than 0.05 becomes considered statistically great for all analyses.

Results

Table 1. Baseline maternal and neonatal characteristics (n=200)

Variable	ICC Group (n=100)	DCC Group (n=100)	Mean Difference (95%CI)	p-value
Maternal Age (years)	28.5±4.1	28.8±4.4	−0.3 (−1.4 to 0.8)	0.65
Gestational Age (weeks)	39.1±0.9	39.0±1.0	0.1 (−0.2 to 0.4)	0.48
Birth Weight (g)	3180±340	3265±310	−85 (−166 to −4)	0.04*
Male Newborns (%)	51 (51.0%)	49 (49.0%)	–	0.76

**Statistically significant at p<0.05*

Table (1) compares maternal and neonatal baseline traits among the Immediate Cord Clamping (ICC) and Delayed Cord Clamping (DCC) agencies, each with one hundred individuals. Maternal age and gestational age were similar between businesses, with non-full-size suggest differences (p = 0.65 and 0.48, respectively), indicating that individuals had been well-matched in those elements. However, the implied birth weight changed considerably better inside the DCC group by 85 grams (p = 0.04), suggesting a likely association between delayed clamping and expanded beginning weight. The share of male newborns changed into nearly the same in each agency (51% ICC vs. 49% DCC), without a statistical significance (p = 0.76).

Table 2. Primary neonatal hematological outcomes in 24 h

Outcome	ICC Group (n=100)	DCC Group (n=100)	Mean Difference (95%CI)	p-value
Hemoglobin (g/dL)	14.5 ± 1.2	17.2 ± 1.3	−2.7 (−3.1 to −2.3)	<0.001*
Hematocrit (%)	45.0 ± 3.8	52.4 ± 4.1	−7.4 (−8.5 to −6.3)	<0.001*

**Statistically significant at p<0.05*

Table (2) reports key hematological effects at 24 hours post-birth. The DCC group had drastically higher implied hemoglobin (17.2 g/dL vs. 14.5 g/dL) and hematocrit (52.4% vs. 45.0%) levels compared to the ICC organization. The mean variations have been −2.7 g/dL for hemoglobin and −7.4% for hematocrit, both statistically good-sized (p <0.001). These findings strongly propose that delayed-cord clamping complements early neonatal hematological status.

Table 3. Neonatal apgar scores and resuscitation needs

Variable	ICC Group (n=100)	DCC Group (n=100)	Risk Difference (95%CI)	p-value
Apgar Score ≥7 at 1 min (%)	91 (91.0%)	94 (94.0%)	−3.0% (−10.5% to 4.5%)	0.41
Apgar Score ≥9 at 5 min (%)	96 (96.0%)	99 (99.0%)	−3.0% (−7.9% to 1.9%)	0.18
Required Resuscitation (%)	6 (6.0%)	2 (2.0%)	+4.0% (−1.3% to 9.3%)	0.14

Apgar scores and resuscitation wishes were similar among companies. While the DCC organization had slightly higher proportions of neonates with Apgar rankings ≥7 at 1 minute (94% vs. 91%) and ≥9 at 5 mins (99% vs. 96%), the differences had been no longer statistically good sized (p = 0.41 and 0.18, respectively). Resuscitation became slightly extra frequent within the ICC organization (6% vs. 2%), but again, the distinction was now not substantial (p=0.14), indicating that cord clamping timing did not meaningfully impact instant neonatal version.

Table 4. Incidence of Neonatal Jaundice and Thermal Stability

Outcome	ICC Group (n=100)	DCC Group (n=100)	Risk Difference (95%CI)	p-value
Jaundice requiring phototherapy (%)	8 (8.0%)	12 (12.0%)	−4.0% (−12.1% to 4.1%)	0.34
Temperature instability (%)	11 (11.0%)	7 (7.0%)	+4.0% (−4.3% to 12.3%)	0.32

Table (4) indicates non-sizeable variations between companies inside the costs of jaundice requiring phototherapy and temperature instability. The DCC institution had a slightly higher rate of phototherapy (12% vs. 8%) and a decreased price of thermal instability (7% vs. 11%), however, neither final results reached statistical significance (p = 0.34 and 0.32, respectively), suggesting that delayed clamping does now not notably increase risks of jaundice or thermal law problems.

Table 5. Neonatal Intensive Care Unit (NICU) admission and respiratory morbidity

Outcome	ICC Group (n=100)	DCC Group (n=100)	Risk Difference (95%CI)	p-value
NICU Admission (%)	9 (9.0%)	4 (4.0%)	+5.0% (−1.2% to 11.2%)	0.15
Respiratory Distress (%)	6 (6.0%)	2 (2.0%)	+4.0% (−1.1% to 9.1%)	0.14

The rates of NICU admission (9% ICC vs. 4% DCC) and respiration distress (6% ICC vs. 2% DCC) had been better inside the ICC institution, although the variations had been not statistically tremendous (p=0.15 and 0.14, respectively). While now not conclusive, these trends recommend ability breathing and hospitalization blessings related to delayed-cord clamping.

Table 6. Multivariate logistic regression in predictors of neonatal hemoglobin>16 g/dL

Predictor Variable	Adjusted OR (95% CI)	p-value
Delayed Cord Clamping	4.65 (2.45–8.82)	<0.001*
Birth Weight (per 100 g)	1.11 (1.02–1.22)	0.018*
Male Infant	0.91 (0.47–1.76)	0.78

**Statistically significant at p<0.05*

This logistic regression evaluation recognized delayed-cord clamping as a sturdy independent predictor of neonatal hemoglobin >60 g/dL, with an adjusted odds ratio (OR) of 4.65 (p<0.001). Additionally, each 100-gram boom in delivery weight was related to an 11% growth in odds of increased hemoglobin (OR = 1.11, p = 0.018). Male sex changed into not a sizable predictor (p = 0.78). These consequences underscore the significance of both delayed-cord clamping and higher beginning weight in optimizing neonatal hematologic results.

Discussion

The findings of this randomized managed trial offer compelling proof assisting the advantages of delayed cord clamping (DCC) on neonatal outcomes, specifically in hematologic parameters, whilst additionally addressing ability issues regarding protection consequences inclusive of jaundice and respiratory distress.

The baseline characteristics of the study individuals proved adequate comparability between the immediate cord clamping (ICC) and DCC businesses in terms of maternal age, gestational age, and newborn sex, suggesting a minimum chance of confounding (Table 1). However, a first-rate and statistically widespread finding becomes the higher suggested start weight determined within the DCC organization (p = 0.04), aligning with evidence from previous studies that report increased placental transfusion extent with delayed-cord clamping, doubtlessly contributing to greater birth weight via

more advantageous blood quantity and iron stores[12][13].

The maximum significant outcome turned into the clean advantage of DCC in improving neonatal hemoglobin and hematocrit tiers at 24 hours of delivery (Table 2). These findings are consistent with the literature indicating that delayed clamping lets in additional placental blood to transfer to the newborn, resulting in increased crimson blood cell mass and improved iron status[14][15]. The adjusted odds ratio from multivariate logistic regression further showed DCC as a sturdy impartial predictor of neonatal hemoglobin >16 g/dL (OR = 4.65, $p < 0.001$), emphasizing the robustness of this association. Similarly, delivery weight turned into a predictor, echoing the physiological reason that larger toddlers may additionally receive more placental transfusion[16][28].

While issues approximately immediately neonatal edition have historically tempered enthusiasm for DCC, this study located no statistically full-size differences in Apgar ratings or resuscitation needs (Table 3).

These consequences improve the developing consensus that DCC no longer compromises instant neonatal nicely-being and is safe in period vaginal births [17][18]. A barely better—but non-vast—requirement for resuscitation in the ICC group shows that immediate clamping might not confer any adaptive advantage.

Safety results, which include jaundice and thermal instability (Table 4), revealed no enormous differences between groups. Although the DCC institution had a better fee for phototherapy (12% vs. 8%), this distinction changed into not statistically good sized, aligning with findings from different trials that report modest and clinically conceivable growth in jaundice danger with DCC [19][20][27]. Furthermore, the lack of sizeable difference in temperature instability supports the thermal protection of DCC in the time period newborns when recurring thermal care practices are located.

Although the differences in NICU admissions and breathing misery have been not statistically good sized (Table 5), the developments desired by the DCC organization, suggest a potential clinical gain. These consequences are echoed with the aid of studies displaying a decreased prevalence of breathing headaches and want for NICU admission while cord clamping is delayed, likely due to advanced circulatory transition facilitated by way of expanded blood quantity and higher pulmonary perfusion [21-24].

The findings of this study add to a developing frame of proof recommending not on-time cord clamping in term vaginal births. DCC notably improves neonatal hematologic repute without increasing the chance of negative outcomes which include jaundice, thermal instability, or breathing misery. These advantages help cutting-edge WHO and ACOG pointers advocate for DCC as a standard practice unless immediate resuscitation is needed [25][26][30].

This examination had several limitations. First, it changed into being carried out in a single center, which might also restrict the generalizability of the findings to other populations or healthcare settings. Second, the comply with-up duration became confined to the immediate neonatal length, so long-time period outcomes of delayed-cord clamping (DCC) couldn't be assessed. Third, whilst randomization was completed, capability confounding elements consisting of maternal hemoglobin degrees and intrapartum variables have been no longer controlled. Lastly, the study depended on clinical tests, which may additionally introduce subjective bias, specifically in comparing results like temperature instability and jaundice.

Conclusion

The study highlights that delayed cord clamping significantly improves hematologic outcomes for newborns, including higher hemoglobin and hematocrit levels, without increasing side effects such as jaundice or respiratory complications. Given these benefits, delayed cord clamping is recommended as standard practice in full-term vaginal deliveries to improve newborn health. Future research should focus on long-term developmental outcomes and explore the implementation of newborn care protocols across different healthcare settings to maximize their global impact on newborn care.

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Conflicts of interest

There are no conflicts of interest.

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