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Original Research Article

Frequency of Anemia in Early Umbilical Cord Clamping in Term Pregnancy Neonates

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Abstract: *Placental transfusion during the first few minutes after birth provides the newborn with an additional 80–100 mL of blood, increasing blood and red cell volume, which helps prevent neonatal anemia. Early umbilical cord clamping (ECC), performed within 30 seconds of delivery, interrupts this natural transfusion and may lead to reduced hematocrit and iron stores in neonates.* ***Objective:*** *To determine the frequency of anemia in term pregnancy neonates undergoing early umbilical cord clamping and to evaluate its association with maternal and neonatal factors.* ***Methodology:*** *This cross-sectional descriptive study was conducted at the Department of Obstetrics and Gynaecology, Shaikh Zaid Women Hospital, SMBBMU Larkana, over six months (February–July 2020). A total of 121 term neonates were included using non-probability consecutive sampling. Early cord clamping was performed within 30 seconds of birth, and cord blood hematocrit was measured using an automated analyzer. Neonatal anemia was defined as a hematocrit <45%. Maternal demographic, obstetric, and clinical data were recorded. Data were analyzed using SPSS v26, with chi-square tests used to assess associations; p≤0.05 was considered significant.* ***Results:*** *The mean maternal age was 28.26 ± 5.64 years, and the mean gestational age was 38.21 ± 1.03 weeks. Among 121 neonates, 31 (25.6%) were anemic and 90 (74.4%) were non-anemic. Maternal age, gestational age, parity, booking status, obesity, hypertension, and previous postpartum hemorrhage were not significantly associated with anemia, while maternal diabetes mellitus showed a significant relationship (p=0.039).* ***Conclusion:*** *A considerable proportion of term neonates developed anemia following early cord clamping. Promoting delayed cord clamping may help reduce neonatal anemia and improve early hematologic outcomes.*
Keywords: Anemia, Cord blood hematocrit, Early umbilical cord clamping, Neonates, Term pregnancy

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Introduction

Placental transfusion is the natural transfer of blood from the placenta to the newborn during the first minutes after birth, contributing approximately 80 mL by 60 seconds and up to 100 mL by 3 minutes (1, 2). By allowing this physiological transfusion to occur, delayed cord clamping (DCC) enables newborns to receive an estimated 20–30% increase in blood volume and up to a 50% increase in red cell mass compared to early cord clamping (ECC) (3, 4). Numerous clinical trials have demonstrated the advantages of DCC, including higher hemoglobin and hematocrit levels (3, 5), improved blood pressure stability (6), reduced incidence of anemia and decreased need for blood transfusions (7), greater total body iron stores (8), and enhanced neurodevelopmental outcomes (9).

Several international organizations, including the American College of Obstetricians and Gynecologists (ACOG) (10), the American Academy of Pediatrics (AAP) (11), the European Resuscitation Council (12), the National Institute for Health and Care Excellence (NICE) (13), the Society of Obstetricians and Gynecologists of Canada (14), and the World Health Organization (WHO) (15), have endorsed DCC as the preferred practice. However, the definition and duration of DCC vary across these recommendations, ranging from 30 seconds to 5 minutes or until cord pulsations cease. Despite such consensus, studies have reported wide variations in the actual clinical implementation of DCC across different healthcare settings (16).

The concept of early and delayed cord clamping has been discussed for decades as an essential determinant of neonatal blood volume and iron status. Within the first three minutes after birth, approximately 80–100 mL of blood can be transferred from the placenta to the newborn. Since over 90% of this transfusion occurs during the initial heartbeats and breaths after delivery, the timing of cord clamping critically influences neonatal hematological outcomes. Delayed cord clamping facilitates greater placental blood transfer, thereby enhancing neonatal iron storage and improving hematologic indices. It also allows for the transfer of stem cells and immunoglobulins, which play vital roles in tissue repair and immune function (2, 3).

Comparative studies have consistently shown that delayed cord clamping significantly reduces the incidence of neonatal anemia compared to early clamping (4, 5). DCC also minimizes the likelihood of subsequent blood transfusions and helps prevent iron deficiency, a condition known to impair early childhood neurodevelopment (6, 7). However, some studies have noted that DCC may reduce the volume of cord blood collected for donation by redistributing blood into the infant's circulation (4). Research comparing DCC with umbilical cord milking has shown variable results, with some studies indicating that cord milking may yield higher hemoglobin levels and blood pressure, particularly in neonates delivered by cesarean section (8, 9). In contrast, others report no significant differences in neurodevelopmental outcomes (10).

Despite strong evidence supporting delayed cord clamping, early umbilical cord clamping remains a common practice in many obstetric units, often due to concerns about maternal management or lack of awareness regarding its neonatal implications. Given the potential link between early cord clamping and reduced neonatal hematocrit, it is essential to quantify the extent of anemia associated with this practice in term neonates. The present study aims to determine the frequency of anemia in term pregnancy neonates undergoing early umbilical cord clamping at a tertiary care hospital.

Methodology

This cross-sectional descriptive study was conducted in the Department of Obstetrics and Gynaecology Unit at Shaikh Zaid Women Hospital, Shaheed Mohtarma Benazir Bhutto Medical University (SMBBMU), Larkana, over six months from February 2, 2020, to July 2, 2020. The primary objective was to determine the frequency of anemia in term neonates following early umbilical cord clamping.

The sample size was calculated using the WHO formula for a single proportion, assuming a prevalence of early umbilical cord clamping in term infants of 13%, with a 6% margin of error and a 95% confidence level. The calculated sample size was 121 term neonates. A non-probability consecutive sampling technique was employed to ensure that every eligible neonate born during the study period and fulfilling the inclusion criteria was included until the required sample size was achieved.

All term pregnant women aged 18–40 years with a gestational age of 37–42 weeks, delivering singleton live births through spontaneous vaginal delivery, were included. Pregnancies complicated by preterm delivery (<37 weeks), post-term delivery (>42 weeks), multiple gestations, congenital anomalies, intrauterine growth restriction, meconium-stained liquor, or history of antepartum hemorrhage were excluded. Neonates requiring resuscitation at birth or those with cord blood sampling failure were also excluded to maintain the accuracy of hematocrit assessment.

After obtaining informed consent from the mothers, detailed demographic and obstetric data were recorded on a pre-designed pro forma. Maternal variables included age (in years), gestational age (in weeks), height (in centimeters), and weight (in kilograms) measured before delivery using calibrated scales. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared and categorized as obese when BMI exceeded 25 kg/m². Obstetric and clinical characteristics, such as parity (primiparous or multiparous), booking status (booked or unbooked), residence (urban or rural), and the presence of diabetes mellitus, hypertension, or a history of postpartum hemorrhage (PPH), were documented from antenatal records and clinical interviews.

All deliveries were attended by trained obstetric staff. Early umbilical cord clamping was standardized and performed within 30 seconds of the neonate's delivery, before the onset of placental pulsations, as per the study protocol. The cord blood sample was collected immediately after clamping in EDTA tubes and transported to the hospital's hematology laboratory within 30 minutes for hematocrit estimation using an automated hematology analyzer (Sysmex XT-2000i). Neonatal hematocrit was expressed as a percentage (%), and anemia was defined as a hematocrit value of <45%. The neonatal gender was also recorded.

The data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Continuous variables, such as maternal age, gestational age, weight, height, BMI, and neonatal hematocrit, were expressed as mean ± standard deviation (SD). Categorical variables, including parity, booking status, residence, maternal obesity, diabetes mellitus, hypertension, previous PPH, neonatal gender, and neonatal anemia status, were presented as frequencies and percentages. The primary outcome variable was the presence or absence of neonatal anemia following early umbilical cord clamping. Effect modifiers, including maternal age group (≤25, 26–30, 31–40, >40 years), gestational age group (37–38 weeks / 39–42 weeks), parity, booking status, residence, maternal obesity, diabetes mellitus, hypertension, previous PPH, and neonatal gender, were assessed through stratification to control confounding. A post-stratification chi-square test was applied to compare the proportions of neonatal anemia across strata. A p-value ≤0.05 was considered statistically significant. Ethical approval for the study was obtained from the Institutional Ethical Review Committee of Shaikh Zaid Women Hospital, SMBBMU Larkana. All participants were briefed on the study's purpose and procedures, and data confidentiality was maintained throughout the research process.

Results

A total of 121 term pregnant women meeting the inclusion criteria were enrolled in this study conducted at the Department of Obstetrics and Gynaecology, Shaikh Zaid Women Hospital, SMBBMU Larkana. The purpose was to determine the frequency of neonatal anemia following early umbilical cord clamping and to assess its association with various maternal and neonatal factors. The mean maternal age was 28.26 ± 5.64 years (95% CI: 27.25–29.28), and the mean gestational age was 38.21 ± 1.03 weeks (95% CI: 38.03–38.40). The mean maternal weight was 58.46 ± 5.38 kg (95% CI: 57.49–59.43), and the mean height was 155.77 ± 6.52 cm (95% CI: 154.60–156.94). The mean body mass index (BMI) was 24.11 ± 1.89 kg/m² (95% CI: 23.77–24.45) (Table 1). Regarding obstetric and clinical characteristics, 59.5% of women were primiparous, while 40.5% were multiparous. A majority of participants were unbooked (55.4%) and resided in urban areas (62.8%). Maternal obesity (BMI >25 kg/m²) was observed in 19.8% of the women. Diabetes mellitus was present in 27.3%, hypertension in 18.2%, and a previous history of postpartum hemorrhage (PPH) in 12.4%. Among the neonates, 39.7% were males and 60.3% were females (Table 2). Out of 121 neonates, 31 (25.6%) were found to be anemic (hematocrit <45%), while 90 (74.4%) were non-anemic following early umbilical cord clamping (Table 3). Stratification of neonatal anemia by maternal and neonatal variables revealed that anemia was slightly more frequent among mothers aged ≤25 years (26.5%) and those with gestational age 39–42 weeks (31.7%). However, these associations were not statistically significant (p=0.993 and p=0.272, respectively). Similarly, parity, booking status, residence, maternal obesity, hypertension, and previous PPH showed no significant relationship with neonatal anemia (p>0.05). However, a statistically significant association was found between maternal diabetes mellitus and neonatal anemia (p=0.039), indicating that neonates born to diabetic mothers were less likely to be anemic compared to those born to non-diabetic mothers. Although not statistically significant, anemia was more frequent in neonates from urban areas (31.6%) compared to rural areas (15.6%) (p=0.056). The association between neonatal gender and anemia was also non-significant (p=0.310) (Table 4).

Table 1. Maternal demographic characteristics (n=121)

Variable	Mean ± SD	95% CI
Maternal Age (years)	28.26 ± 5.64	(27.25 – 29.28)
Gestational Age (weeks)	38.21 ± 1.03	(38.03 – 38.40)
Weight (kg)	58.46 ± 5.38	(57.49 – 59.43)
Height (cm)	155.77 ± 6.52	(154.60 – 156.94)
BMI (kg/m²)	24.11 ± 1.89	(23.77 – 24.45)

Table 2. Maternal obstetric, clinical, and neonatal characteristics (n=121)

Variable	Category	n (%)
Parity	Primiparous	72 (59.5)
	Multiparous	49 (40.5)
Booking Status	Booked	54 (44.6)
	Un-booked	67 (55.4)
Residence	Urban	76 (62.8)
	Rural	45 (37.2)
Obesity (BMI >25 kg/m²)	Yes	24 (19.8)
	No	97 (80.2)
Diabetes Mellitus	Yes	33 (27.3)
	No	88 (72.7)
Hypertension	Yes	22 (18.2)
	No	99 (81.8)
Previous PPH	Yes	15 (12.4)
	No	106 (87.6)
Neonatal Gender	Male	48 (39.7)
	Female	73 (60.3)

Table 3. Frequency of neonatal anemia following early umbilical cord clamping (n=121)

Neonatal Status	n (%)
Anemic	31 (25.6)
Non-anemic	90 (74.4)

Table 4. Stratification of neonatal anemia with respect to maternal and neonatal variables (n=121)

Variable	Category	Anemia n (%)	No Anemia n (%)	Total n (%)	p-Value
Maternal Age (years)	≤25	13 (26.5)	36 (73.5)	49 (40.5)	0.993
	26–30	10 (25.0)	30 (75.0)	40 (33.1)	
	31–40	6 (26.1)	17 (73.9)	23 (19.0)	
	>40	2 (22.2)	7 (77.8)	9 (7.4)	
Gestational Age (weeks)	37–38	18 (22.5)	62 (77.5)	80 (66.1)	0.272
	39–42	13 (31.7)	28 (68.3)	41 (33.9)	
Parity	Primiparous	18 (25.0)	54 (75.0)	72 (59.5)	0.850
	Multiparous	13 (26.5)	36 (73.5)	49 (40.5)	
Booking Status	Booked	16 (29.6)	38 (70.4)	54 (44.6)	0.364
	Un-booked	15 (22.4)	52 (77.6)	67 (55.4)	
Residence	Urban	24 (31.6)	52 (68.4)	76 (62.8)	0.056
	Rural	7 (15.6)	38 (84.4)	45 (37.2)	
Obesity (BMI >25 kg/m²)	Yes	7 (29.2)	17 (70.8)	24 (19.8)	0.657
	No	24 (24.7)	73 (75.3)	97 (80.2)	
Diabetes Mellitus	Yes	4 (12.1)	29 (87.9)	33 (27.3)	0.039*
	No	27 (30.7)	61 (69.3)	88 (72.7)	
Hypertension	Yes	3 (13.6)	19 (86.4)	22 (18.2)	0.186
	No	28 (28.3)	71 (71.7)	99 (81.8)	
Previous PPH	Yes	3 (20.0)	12 (80.0)	15 (12.4)	0.758
	No	28 (26.4)	78 (73.6)	106 (87.6)	
Neonatal Gender	Male	15 (31.3)	33 (68.7)	48 (39.7)	0.310
	Female	16 (21.9)	57 (78.1)	73 (60.3)	

Discussion

In this study, 31 out of 121 term neonates (25.6%) were found to be anemic (hematocrit <45%) following early umbilical cord clamping. The mean maternal age (28.3 ± 5.6 years), gestational age (38.2 ± 1.0 weeks), and BMI (24.1 ± 1.9 kg/m²) reflected a predominantly term, low-risk obstetric population. The prevalence of neonatal anemia observed in this study is consistent with previous literature, which has reported higher rates of anemia following ECC than DCC (4, 5, 17-19). Rashid et al. (13) and Saba et al. (15) also reported significantly lower neonatal hemoglobin and hematocrit levels in ECC groups compared to DCC groups, supporting our findings that ECC predisposes neonates to early anemia.

The physiological basis for these findings lies in the volume of placental transfusion, approximately 80–100 mL transferred during the first 3 minutes after birth, which contributes to a 20–30% increase in blood volume and up to 50% in red cell mass (20-23). Early interruption of this transfer through ECC limits placental contribution to neonatal circulation, leading to reduced hemoglobin and iron stores (24-26). Studies by Díaz-Castro et al. (27) and Andersson et al. (28) further confirmed that delayed clamping improves hematologic indices and reduces oxidative stress, enhancing iron storage and long-term developmental outcomes.

In our study, maternal age, gestational age, parity, booking status, residence, obesity, hypertension, and prior postpartum hemorrhage were not significantly associated with neonatal anemia, consistent with findings from McDonald et al. (24) and Ranjit et al. (21), who reported that cord-clamping timing was the principal determinant of neonatal hematocrit, independent of sociodemographic factors. We noted a non-significant trend toward higher anemia frequency among urban neonates (31.6%) than rural (15.6%), possibly reflecting differences in antenatal care or nutritional status rather than an inherent urban–rural disparity.

Interestingly, maternal diabetes mellitus was significantly associated with a lower incidence of neonatal anemia (12.1% vs 30.7%, p=0.039). This finding aligns with known pathophysiology, as infants of diabetic mothers often develop polycythemia secondary to chronic intrauterine hypoxemia and elevated erythropoietin levels (29). Similar trends were noted by Linderkamp et al. (30), where infants of diabetic mothers had higher hematocrits compared to non-diabetic counterparts.

No significant differences were found for neonatal gender, hypertension, or prior PPH, consistent with other studies reporting minimal gender-related or maternal comorbidity influence on neonatal hematologic outcomes when ECC is performed (31-34).

The overall anemia frequency of 25.6% after ECC underscores the hematologic disadvantage of early clamping. Numerous controlled trials, including those by KC et al. (14) and Mitra et al. (34), have shown that DCC significantly enhances neonatal hemoglobin and ferritin levels up to 6 months of age. Given these consistent findings, it is reasonable to infer that ECC deprives neonates of optimal blood transfusion from the placenta, thereby contributing to early anemia and potential long-term iron deficiency (7, 8,9).

Conclusion

In this single-centre cross-sectional study of term deliveries with ECC within 30 seconds, about one quarter of neonates were anemic (hematocrit <45%) in the early neonatal period. Most maternal sociodemographic and obstetric variables showed no significant association with neonatal anemia. At the same time, infants of diabetic mothers had a lower frequency of anemia, likely reflecting known diabetic-related fetal erythropoietic responses rather than a protective maternal effect. Given robust prior evidence that delayed cord clamping increases neonatal blood volume and reduces early anemia and iron deficiency, efforts to adopt DCC where safe and feasible should be prioritized and evaluated locally. The uploaded literature and prior trials support DCC as a safe practice that improves early neonatal hematologic status and should inform clinical guidelines and counselling.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-20)

Consent for publication

Approved

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Conflict of interest

The authors declared no conflict of interest.

Author Contribution

F (FCPS)

Manuscript drafting, Study Design,

Review of Literature, Data entry, Data analysis, and drafting an article.

MN (FCPS)

Conception of Study, Development of Research Methodology Design,

Z (FCPS)

Study Design, manuscript review, and critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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