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Research Article

EVALUATION OF UMBILICAL CORD THICKNESS AND ITS ASSOCIATION WITH ANTENATAL MATERNAL RISK FACTORS

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ABSTRACT

Objectives: The umbilical cord provides the pathway for unhindered blood transport from the placenta to the fetus and vice versa. Antenatal risks may lead to a change in the thickness of the umbilical cord. The aim of the study was to determine the association between umbilical cord thickness and antenatal maternal risk factors.

Methods: This was a cross-sectional prospective study conducted between January 2023 and December 2023 at the Department of Pediatrics, Pacific Medical College and Hospital, Udaipur, India. A total of 400 newborns were subjected to this study. Out of these 200 newborns enrolled as the control group for this study. Informed consent was obtained from the caregivers. Institutional Ethical Committee approval was sought before the start of the study.

Results: Mean umbilical cord diameter (UCD) among neonates with antenatal risk factors (UCD in mm) was 11.53±2.59, and mean UCD among newborns without antenatal risk factors was 12.23±2.43, respectively. The difference in UCD in mm among cases and controls was significant ($p<0.05$). Bad obstetric history and pregnancy-induced hypertension were associated with a significant change in umbilical cord thickness. Among cases, 23% neonates required Neonatal Intensive Care Unit (NICU) admission, and 77% did not require NICU admission, whereas among controls, only 0.5% neonates required NICU admission and 99.5% did not require NICU admission. There was a significant association between NICU admission among cases and the control group ($p<0.05$).

Conclusion: The presence of antenatal risk factors leads to a significant change in umbilical cord thickness. A thin umbilical cord has been found to be associated with the need for NICU admission.

Keywords: Antenatal risk factors, Umbilical cord thickness, Pregnancy-induced hypertension.

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INTRODUCTION

The umbilical cord serves as a critical conduit for nutrient and gas exchange between the fetus and placenta, ensuring continuous bidirectional blood flow essential for fetal development. The connection between the fetus and mother through the umbilical cord was recognized as early as the time of Aristotle (384–322 BC) [1].

The well-being of the fetus is affected by several factors, which are seen clearly in terms of maturity, birth weight, and intrauterine growth restriction. These factors include maternal genetics, antenatal risk factors, placenta, and umbilical cord length and diameter. Fetal growth is primarily influenced by maternal nutrition, which is delivered through the placenta and umbilical cord, highlighting their vital role in intrauterine development.

Limited studies have explored the relationship between umbilical cord dimensions, maternal antenatal risk factors, and subsequent neonatal outcomes. Narayan *et al*. did evaluation of umbilical cord thickness and its association with antenatal maternal risk factors [2]. They concluded that a reduction in umbilical cord thickness and diameter can compromise fetal growth.

Lee *et al*. studied correlations between the status of the umbilical cord and neonatal health status. They concluded that assessing the umbilical cord diameter (UCD) and status in newborns is an important tool for evaluating neonatal health status after birth, and this point also underscores the importance of professionals' careful observations in the newborn nursery [3].

Studies have emphasized the importance of observing umbilical cord status through ultrasonography as part of pre- natal care and during pregnancy [4], and have pointed out the practicality of using disinfectants or nursing methods for umbilical cord separation [5]. However, the importance of observing the thickness and status of the umbilical cord is still underrecognized in the clinical setting, to the point that the umbilical cord may not even be measured with a tape measure. This oversight may stem from a common misconception that the umbilical cord becomes clinically irrelevant once it is severed at birth [6].

There is a lack of data regarding antenatal risk factor, neonatal outcome, and their association with UCD. So, we planned this study to evaluate the association of UCD with antenatal risk factors and neonatal outcomes.

METHODS

Study design
Hospital-based prospective observational study.

Study place
Department of Pediatrics, Pacific Medical College and Hospital, Udaipur.

Study population
Neonates are born in the labor room, at Pacific Medical College and Hospital, Udaipur.

Study period
January 2023 to December 2023.

Inclusion criteria

Neonates associated with antenatal risk factors were considered cases, and neonates who were not associated with antenatal risk factors were considered controls, during the period of January 2023 to December 2023.

Antennal risk factors which were included in study are antenatal ultrasound abnormalities, maternal pre-pregnancy disease, bad obstetric history, recurrent abortion (more than two abortion), recurrent preterm delivery (more than two premature delivery), blood transfusion during pregnancy, history of pregnancy induced hypertension (PIH), antepartum hemorrhage, gestational diabetes mellitus, hypothyroidism, oligohydramnios and polyhydramnios, meconium-stained liquor, premature rupture of membranes (PROM), toxoplasmosis, other, rubella, cytomegalovirus, herpes infection and anemia in mother.

Exclusion criteria

1. Weight <1250 g
2. Gestational age <34 weeks.

Sampling procedure

The study group comprised controls and cases. UCD was taken after birth, and among them, those who were associated with antenatal risk factors were considered cases. Neonates who were not associated with antenatal risk factors were considered controls. Detailed history regarding antenatal risk factors was taken and recorded in a pre-defined proforma.

Data collection

Informed consent was taken from parents while enrolling the newborn in the study. A detailed general examination of the newborn, along with the diameter of the umbilical cord using Vernier calipers, was taken and recorded in a pre-defined proforma. A comparison of the diameter of the umbilical cord with antenatal risk factors of the mother, newborn condition after birth, vitals, morbidity, and mortality data of case and control groups was recorded in a proforma and was analyzed by appropriate statistical methods.

UCD

After delivery, the UCD 2.5 cm above the base of the cord on the neonate side was measured by Vernier calipers. The average diameter was recorded if there was a discrepancy in the two or three diameters of the cord. Diameter was measured by a Vernier caliper on the top side of the cut portion of the umbilical cord.

Caliper

A calliper is a device used to measure the distance between two opposite sides of an object.

Ethical approval

Institute Ethics Committee Approval was taken.

Statistical analysis

The collected data were transformed into variables, coded, and entered into Microsoft Excel. Data were analyzed and statistically evaluated using the Statistical Package for the Social Sciences-PC-25 version.

RESULTS

A total of 400 neonates were enrolled during the study period. Out of these, 200 neonates that fulfilled the inclusion criteria were enrolled as cases. Two hundred neonates were enrolled as controls as per the criteria.

Among cases, the distribution of subjects was equal according to gender, i.e., 50% male neonates and 50% female neonates, and among the control group, 52% were female neonates and 48% were male neonates. The difference between cases and controls based on gender was not significant (p>0.05).

Among cases, 86% were multigravida and only 14% were primigravida, whereas among controls, 73% were multigravida and 27% were primigravida. There was a significant association between the type of gravida distribution among cases and the control group (p<0.05).

Among cases and controls, mean UCD (UCD in mm) was11.53±2.59 and 12.23±2.43, respectively. Thus, the difference in UCD in mm among cases and controls was significant (p<0.05) as shown in Table 1.

Distribution of cases based on antenatal risk factors is tabulated in Table 2.

Among cases, 23% neonates required Neonatal Intensive Care Unit (NICU) admission, and 77% did not require NICU admission, whereas among controls, only 0.5% neonates required NICU admission and 99.5% did not require NICU admission. There was a significant association between NICU admission among cases and the control group (p<0.05). Other results are shown below in Table 3.

Table 1: Mean UCD among cases and controls

Group	Number (n)	Umbilical cord diameter mean±SD (mm)	p-value
Case	200	11.53±2.59	0.005
Control	200	12.24±2.43	

UCD: Umbilical cord diameter, SD: Standard deviation. n=200

Table 2: Distribution of cases based on antenatal risk factors

Antenatal risk factor	Yes (%)	No (%)
Oligohydromnios	73 (36.5)	127 (63.5)
Meconium-stained liquor	37 (18.5)	163 (81.5)
Bad obstetric history	30 (15)	170 (85)
History of PIH	25 (12.5)	175 (87.5)
Leaking PROM	15 (7.5)	185 (92.5)
Polyhydromnios	7 (3.5)	193 (96.5)
Gestational diabetes	2 (1)	198 (99)

PIH: Pregnancy-induced hypertension, PROM: Premature rupture of membranes. n=200

Table 3: Maternal antenatal risk factors and umbilical cord diameter

Parameters	No. of neonates (n)	Mean umbilical cord diameter (mm)±SD	p-value
Bad obstetric history			
Yes	30	13.17±2.183	0.039
No	170	12.18±2.438	
PIH			
Yes	25	11.42±2.835	0.003
No	175	13.04±2.501	
Gestational diabetes			
Yes	2	9.85±3.05	0.354
No	198	11.55±2.57	
Meconium-stained liquor			
Yes	37	11.41±2.619	0.583
No	163	11.67±2.594	
Oligohydromnios			
Yes	73	11.53±2.604	0.797
No	127	11.63±2.618	
Polyhydrominios			
Yes	7	12.29±2.289	0.576
No	193	11.63±2.618	
PROM			
Yes	15	10.87±2.949	0.246
No	185	11.68±2.562	

SD: Standard deviation, PIH: Pregnancy-induced hypertension, PROM: Premature rupture of membranes

DISCUSSION

In our study, a total of 400 neonates were included, which were classified into two groups: cases (with antenatal risk factors) and controls (without antenatal risk factors). Diameter of umbilical cord, placenta, antenatal risk factors, and antenatal care directly affect the neonatal outcome. The function of the umbilical cord depends on the mother, placenta, and fetus, and it is an important factor in predicting the baby's health after birth. Raio *et al.* [7] studied that umbilical cord vessels are protected by Wharton's jelly, and their reduction may decompose the vessel of the umbilical cord due to its bending and compression because of extracellular matrix reduction and dehydration.

Our prospective observational hospital-based study has been done to find the association of the thickness of the umbilical cord and its relation to neonatal outcome. It was analyzed that antenatal risk factors directly affect the thickness of the umbilical cord, and neonatal outcome is directly related to the diameter of the umbilical cord. In our study, the proportion of male and female neonates was equal, and similarly was also the case in controls. Moreover, the study conducted by Elghazaly *et al*. [8] observed predominance of male neonates, while findings of Scott and Wilkinson [9] match with our study. In male and female neonates among cases, the mean UCD was 11.59±2.61 and 11.65±2.595, and this difference was statistically insignificant. This finding was similar to the findings of Scott and Wilkinson, while in contrast with the findings of Barbieri *et al.* [10], Sepulveda *et al.* [11], and Elghazaly *et al*. [8], who observed UCD to be significantly larger in male neonates as compared to female neonates.

In our study, mean UCD (UCD in mm) among cases and controls was 11.53±2.59 and 12.23±2.43, respectively. Thus, the difference in UCD in mm among cases and controls was statistically significant. $p<0.05$, and this finding was similar to the findings of Sepulveda *et al*. [11], Barbieri *et al*. [10], Tahmasebi and Alighanbari [12], and Togni *et al*. [13].

In our study, the case of multigravida was more common in both groups. Mean UCD (UCD in mm) among cases with primigravida was larger than that of cases with multigravida. The difference was statistically significant, and this finding was consistent with the findings of Sepulveda *et al*. [11], Barbieri *et al.* [10], and Togni *et al*. [13].

Antenatal risk factors were studied in both groups. It was found that among cases, 36.5% had oligohydramnios, 18.5% had meconium stained liquor, 15% had bad obstetric history, 12.5% had history of PIH, 7.5% had PROM leaking, 7% required resuscitation, 3.5% had polyhydramnios and 1% had gestational diabetes and this finding was relevant with the findings of Tahmasebi and Alighanbari [12] and Togni *et al.* [13].

In our study, the mean UCD (UCD in mm) among cases with a bad obstetric history was 12.18±2.438, and with no bad obstetric history, it was 13.17±2.183. This difference in UCD in mm among cases with bad obstetric history was significant as compared with cases without bad obstetric history ($p<0.05$). This finding resembles with the findings of Sepulveda *et al*. [11], Barbieri *et al*. [10], Tahmasebi and Alighanbari [12], Udoh *et al*. [14], and Balkawade and Shinde [15]. The mean UCD (UCD in mm) of cases with and without a history of PIH was 11.42±2.501 and 13.04±2.835, respectively, and this difference in UCD in mm among cases with and without a history of PIH was significant ($p<0.05$). This finding was close to the findings of Balkawade and Shinde [15], who also observed large UCD in cases with no history of PIH as compared with a history of PIH. A study by Narayan *et al.* showed that umbilical cord thickness has a significant association with oligohydramnios and meconium-stained liquor, which were not found to be significant in our study [2]. Other antenatal risk factors, such as gestational diabetes, meconium-stained liquor, and PROM leaking, had no effect on the thickness of UCD and neonatal outcome in our study and Udoh *et al.* [14], Balkawade and Shinde [15], Tahmasebi and Alighanbari [12], and Sepulveda *et al*. [11] also found similar findings.

In our study, NICU admission was significantly higher in cases with small UCD as compared with large UCD (10.59±2.446 and 11.93±2.564, respectively), which is the same as the findings of Sepulveda *et al*. [11] and Balkawade and Shinde [15].

In our study, 57% cases were discharged, and 32.5% controls were discharged. 42% cases were shifted, whereas 67.5% controls were shifted. 1% mortality was seen in cases, whereas no mortality was found in controls. Thus, a significant positive association was seen between the case and control groups regarding the outcome ($p<0.001$).

CONCLUSION

The exploration of antenatal risk factors and their correlation with UCD and neonatal outcomes underscores the critical importance of prenatal care and risk assessment. Through comprehensive antenatal screening and early identification of potential risk factors such as maternal medical conditions, gestational complications, and lifestyle factors, healthcare providers can intervene effectively to mitigate adverse outcomes for both the mother and the newborn.

In conclusion, the presence of antenatal risk factors leads to a smaller umbilical cord. A thin umbilical cord has been found to be associated with low birth weight and the need for NICU admission. The presence of antenatal risk factors has been associated with adverse neonatal outcomes. Moreover, the findings emphasize the necessity of tailored interventions and personalized care plans to address specific risk factors identified during pregnancy. This individualized approach not only enhances maternal and fetal well-being but also contributes to improved neonatal outcomes, reducing the incidence of UCD-related complications and promoting optimal health for the newborn.

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AUTHOR'S CONTRIBUTIONS

Dr. Sunny Malvia: Contributed to formulating the question, designing the study, carrying it out, and analyzing the data. Dr. Puneet Jain: Contributed to formulating the question, designing the study, carrying it out, and proofreading. Dr. Swaroop Singh: Collecting the data.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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Nil.

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