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Exploring the impacts of a nuchal cord on perinatal outcomes in vaginal delivery

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ABSTRACT

Objectives: To investigate the frequency of cord entanglement and neonatal outcomes in vaginal deliveries.
Methods: A total of 24,623 patients who had vaginal delivery at at Kayseri City Hospital between July 2018 and January 2023 were included in the study. The incidence of nuchal cord was determined in the study group. The characteristics and perinatal outcomes of groups with and without nuchal cord were compared. Chi-square test was used for statistical evaluation. A p value less than 0.05 was considered significant in the evaluation.
Results: The rate of cord entanglement in the neck at birth was 15.7%. There was no statistically significant difference between the infant weights, genders, maternal ages, hospitalization rates in the neonatal intensive care unit, and apgar scores at the 1st and 5th minutes of the babies included in the study. We detected amniotic fluid with meconium in 506 (13.1%) patients with a nuchal cord and 270 (1.3%) without a nuchal cord, and the difference was found to be significant.
Conclusions: There is no significant relationship between vaginal deliveries with the nuchal cord and poor perinatal outcomes, except for meconium amniotic fluid. For this reason, pregnant women diagnosed with nuchal cord in the third trimester can deliver vaginally, but they should be carefully monitored in terms of meconium and related complications. However, neonates with nuchal cord do not have significantly longer neonatal hospital stays, and thus the adverse effects of nuchal cord may be transient.
Keywords: Nuchal cord, vaginal delivery, meconium, perinatal outcomes

The umbilical cord, an extension of the fetal cardiovascular system, is known to supply nutrients and oxygen to and removes wastes from the fetus. It consists of the outer layer of the amnion, Wharton's gel, two uterine arteries, and a vein. [1] Most umbilical cords are 40-70 cm long, and those < 30 cm and > 100 cm are known to be rare. It should be noted that extremely long cords increase the likelihood of cord entanglement. [2]. Not surprisingly, cord loops are frequently encountered when the umbilical cord gets wrapped around various fetal parts during fetal movements [2]. In this sense, a nuchal cord is a condition occurring when the umbilical cord wraps around the fetal neck. Nuchal cords can be encountered in any period of pregnancy, and 25-50% of them can resolve spontaneously before delivery [3, 4]. The incidence of nuchal cords at birth was previously reported to be 14.7%-33.7% [5-9]. On the other hand, the previous research identified various risk factors for a nuchal cord, such as monozygotic twinning, male fetus, long

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umbilical cord, previous birth with a nuchal cord, and posterior placentation. Nonetheless, the definitive etiology and pathogenesis have not been fully elucidated yet. Moreover, the clinical significance of nuchal cords remains controversial. A nuchal cord may cause cord compression during delivery, resulting in metabolic acidosis and decreased cardiac output and increased arterial resistance caused by fetal bradycardia. In the literature, some studies associated nuchal cords with variable fetal heart rate during delivery, increased prevalence of deceleration, low 1-minute Apgar score, and high incidence of meconium-stained amniotic fluid [10, 11]. Nevertheless, the literature also hosts a plethora of studies that could not conclude any relationship between nuchal cords and increased cesarean section rate, low 5-minute Apgar score, perinatal mortality, and neonatal intensive care unit admission [5, 6, 8, 12, 13]. Ultimately, the present study compared the perinatal outcomes of normal delivery patients with and without a nuchal cord.

METHODS

Research Design and Sample

After obtaining ethical approval from the Ethics Committee Kayseri City Hospital, we retrospectively analyzed the perinatal outcomes of 24,623 normal delivery patients in the Department of Gynecology and Obstetrics at the said hospital between July 2018 and January 2022. In the patient data, we discovered that gestational week was calculated according to the first day of the last menstrual period or the findings of ultrasound performed in the first trimester [14]. Accordingly, we considered the data of those with a calculated gestational week of 37 weeks and above. Yet, we excluded the patients with an intrauterine chromosomal anomaly or metabolic disease, neural tube defects, anencephaly (and other central nervous system anomalies), additional cardiovascular anomalies, no routine perinatology follow-ups, and intrauterine ex fetuses. Then, the patients were divided into two by the presence of a nuchal cord: 3,868 with a nuchal cord and 20,755 without a nuchal cord at normal delivery. We retrospectively reviewed the patients' files and compared their demographic characteristics and perinatal outcomes.

Statistical Analysis

In statistical analyses, we first resorted to the Kolmogorov-Smirnov test to check whether the data showed a normal distribution. Accordingly, while showing the normally distributed data as means (M) and standard deviations (SD), we present non-normally distributed as medians (min-max). Discrete variables are given as percentages. In group comparisons, we utilized independent samples t-test for normally-distributed variables. Moreover, we compared categorical variables using the Chi-square test. We performed all statistical analyses on the SPSS 17.0 program and accepted a p - value < 0.05 statistically significant.

RESULTS

Demographic characteristics of the patients in our study are shown in Table 1. The findings revealed the mean age of the patients to be 27.9 ± 4.1 years in the nuchal cord (+) group and 28.01 ± 4.2 years in the

Table 1. Patients' demographic characteristics

	NC (+) (n = 3,868)	NC (-) (n = 20,755)	*p* value
Maternal age (years)	27.9 ± 4.1	28.01 ± 4.2	0.216
Parity	1.2 ± 0.9	1.3 ± 1.1	0.324
BMI (kg/m^2)	28.9 ± 2.5	28.4 ± 2.3	0.241
Hemoglobin (g/dL)	11.6 ± 1.5	11.2 ± 1.3	0.189
Gestational week	40.1 ± 0.7	39.2 ± 0.6	**< 0.001**
Birth weight (g)	3,397 ± 440.6	3,407 ± 442.6	0.467

Data are given as mean ± standard deviation. NC = nuchal cord

nuchal cord (-) group, but there was no significant difference between the groups by age ($p = 0.216$). Nevertheless, we discovered a significant difference between the groups by the week of delivery. While the mean week of delivery was 40.1 ± 0.7 among the patients with a nuchal cord, it was 39.2 ± 0.6 among those without a nuchal cord ($p < 0.001$). On the other hand, while the mean parity of the patients with an NC was found to be 1.2 ± 0.9, it was 1.3 ± 1.1 among those without a nuchal cord. Yet the groups did not significantly differ by parity ($p = 0.324$).

In our study, we could not conclude a significant difference between the groups' mean body mass index (BMI) values, calculated to be 28.9 ± 2.5 kg/m^2 and 28.4 ± 2.3 kg/m^2, respectively ($p = 0.241$). It was also the case for hemoglobin values, discovered to be 11.6 ± 1.5 among the patient with a nuchal cord and 11.2 ± 1.3 among those without a nuchal cord ($p = 0.189$). Finally, despite no significant difference between the groups ($p = 0.467$), the mean birth weights of newborns with and without a nuchal cord were found to be 3,397 ± 440.6 g and 3,407 ± 442.6 g, respectively.

In this study, we retrospectively analyzed the data of 24,623 normal delivery patients. Among them, 3,868 (15.7%) had a nuchal cord at birth. We detected amniotic fluid with meconium in 506 (13.1%) patients with a nuchal cord and 270 (1.3%) without a nuchal cord, and the difference was found to be significant ($p < 0.001$). The 1- and 5-minute Apgar scores of newborns were similar in both groups. Although the number of male babies was higher in both groups, the difference was not statistically significant ($p = 0.337$). Moreover, the groups did not significantly differ by the number of newborns admitted to the neonatal intensive care unit (NICU) ($p = 0.561$). Accordingly, while 550 (14.2%) newborns were admitted to the NICU in the nuchal cord (+) group, this number was found to be 2,200 (10.6%) in the nuchal cord (-) group ($p = 0.561$). The groups' perinatal outcomes are presented in Table 2.

DISCUSSION

Our findings revealed the rate of a nuchal cord in the neck to be 15.7% in normal deliveries, overlapping with the previous results that showed the rate of cord entanglement in the neck between 14.7-33.7% [5-9].

Due to its sticky and viscous properties, meconium may cause mechanical obstruction in the airways, changes in the tracheobronchial mucociliary transport, and difficulties in gas exchange in the early period of pregnancy [15]. Later, it may lead to inflammation, chemical pneumonia, vasculitis, ischemia, mucosal necrosis, and a decrease in or inactivation of endogenous surfactant synthesis. In addition, meconine directly inhibits endogenous surfactant production and functions [16, 17]. Partial occlusion of small airways causes air accumulation in the alveoli and alveolar rupture, while complete occlusions lead to atelectasis [18]. Meconium and the bile salts in it also exert direct toxic effects on the lung tissue and blood vessels [15]. Therefore, the impacts of meconium lead to necrosis and ulceration in fetal membranes, placenta, and umbilical cord and vasoconstriction in placenta and fetal blood vessels [19]. An inflammatory response occurs in the lungs a few hours after aspiration, and there may be an increase in the release of cy-

Table 2. Patients' perinatal outcomes

	NC (+) (n = 3,868)	NC (-) (n = 20,755)	*p* value
Meconium, n (%)	506 (13.1)	270 (1.3)	< 0.001
1-min. Apgar	8 (4-9)	8 (7-9)	
5-min. Apgar	9 (5-10)	9 (8-10)	
Sex, n (%)			
Male	2050 (53)	10,585 (51)	0.337
Female	1818 (47)	10,170 (49)	
NICU admission, n (%)	550 (14.2)	2,200 (10.6)	0.561

Data are given as median (minimum-maximum) or n (%). NC = nuchal cord, NICU = neonatal intensive care unit

tokines involved in the inflammatory process. The released substances account for damage to the lung parenchyma, severe vasoconstriction of blood vessels, and pulmonary hypertension [19, 20]. When it comes to pregnancy, the probability of the fetus being born with meconium increases as the gestational age progresses ([21]. The previous research reported that about 10.5% of newborns with meconium bear meconium aspiration syndrome (MAS) and that the morbidity and mortality rate in newborns with severe MAS is 12% [20]. In this study, we concluded an increased rate of birth with meconium amniotic fluid among those with a nuchal cord ($p < 0.001$).

The previous research showed that the presence of a nuchal cord does not pose a risk of decreased 1-and 5-minute Apgar scores [5,9,22-27]. Similarly, we did not find a significant difference between the groups by Apgar scores. The groups did also not significantly differ by newborn birth weight. In their studies, Schaffer *et al*. [1] and Miser *et al*. [28] observed low birth weight in the nuchal cord (+) group but no significant difference between the groups by newborn birth weight. Yet, our findings showed a significant difference between the mean week of delivery among patients with a nuchal cord and that of those without a nuchal cord. Accordingly, the patients with an NC gave birth at later weeks than their counterparts ($p < 0.001$). Similarly, Uludağ *et al*. [29] found that the rate of delivery at the 41st week or later among cases with a nuchal cord was significantly higher than among those cases without a nuchal cord. Our findings showed no significant difference between the groups by age and parity, overlapping with the findings of Miser *et al*. [28] that discovered that maternal age and parity had no effect on the incidence of nuchal cords. Finally, there was no significant difference between the groups by the sex of newborns, although there seemed to be more male newborns in the group with an NC. Yet, Miser *et al*. [28] reported the incidence of a nuchal cord to be significantly more in male newborns.

Cord compression causes chronic, intermittent, or acute interruption of blood flow to the fetus, directs the blood flow to the extremities to the central circulation (heart, adrenal, and brain), and alters the fetus' body to take self-protective measures [11]. This situation, in turn, triggers the development of fetal hypoxia by allowing the release of catecholamine, cortisol, vasopressin, angiotensin, and other biochemicals by baroreceptors and chemoreceptors. While the relevant literature hosts research documenting that compression of the umbilical cord may cause poor newborn outcomes [10, 30-32], some other studies showed no significant connection between a nuchal cord and poor perinatal outcomes [9, 33, 34].

CONCLUSION

In conclusion, our findings revealed the presence of a nuchal cord not to be associated with adverse perinatal outcomes, except for meconium-containing amniotic fluid. Therefore, pregnant women diagnosed with an NC in the third trimester can deliver vaginally but may need to be carefully followed up in terms of meconium and related complications. Nuchal cord entanglement was associated with a higher risk of meconium; however, there was no additional risk for an adverse neonatal outcome. Most obstetricians experience anxiety in the presence of the nuchal cord, but our study did not detect any negative outcomes in newborns.

Authors' Contribution

Study Conception: MA, ŞDÇ; Study Design: MA, MBD; Supervision: MA, CRC; Funding: ŞDÇ, MBD; Materials: CDC, MBD; Data Collection and/or Processing: MA, CRC; Statistical Analysis and/or Data Interpretation: MA, CRC; Literature Review: MA, ŞDÇ, CRC; Manuscript Preparation: MBD, CRC, MA and Critical Review: MA, ŞDÇ, CRC, MBD.

Conflict of interest

The author disclosed no conflict of interest during the preparation or publication of this manuscript.

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