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MATERNAL-FETAL MEDICINE

Adverse pregnancy outcomes and multiple nuchal cord loops

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Abstract

Purpose To evaluate the effects of nuchal cord and the number of loops during labor and delivery on delivery outcomes among women with singleton pregnancy who delivered vaginally.

Methods This retrospective cohort study included 42,798 women with singleton, vertex, and vaginal deliveries at 24–43 weeks of gestation. We analyzed delivery outcomes based on the number of nuchal cord loops.

Results A total of 42,798 deliveries met the inclusion criteria, of which, 3809 (8.9%) had nuchal cord with 1 loop at delivery, 1035 (2.42%) had 2 loops, and 258 (0.6%) had 3 loops. Nuchal cord with 3 loops compared to no nuchal cord has been associated with higher incidence of intrauterine fetal death (1.9%), Apgar scores less than 7 at 1 and 5 min (7.4%, 2.3%), and higher rate of operative vaginal deliveries (17.5%). Nuchal cord with 2 or 3 loops was associated with higher incidence of intrauterine growth restriction (10.2%, 11.6%). In a multiple logistic regression model, nuchal cord with 3 loops was an independent risk factor for operative vaginal delivery and Apgar score less than 7 in 1 min.

Conclusions In the case of vaginal delivery in the presence of nuchal cord, as the number of nuchal cord loops increased, so did the number of adverse delivery outcomes. While 3 loops were associated with higher incidence of intrauterine fetal death, intrauterine growth restriction, increased operative vaginal deliveries, and low Apgar scores, 1 loop was not associated with adverse perinatal outcomes.

Keywords Adverse pregnancy outcomes · Apgar scores · IUGR · Multiple loops · Nuchal cord

Introduction

Nuchal cord during labor is a common, incidental finding that occurs in 20% of deliveries. It is a risk factor for variable decelerations and for non-reassuring fetal heart rate during labor, but not a parameter of interest during pregnancy or prior to delivery, as part of fetal evaluation or labor management [1–3]. The clinical significance of nuchal cord and the number of loops is debated.

Several studies showed that nuchal cord is associated with increased risk of intrauterine growth restriction (IUGR), cesarean delivery, low Apgar scores, and perinatal mortality [4–9]. In addition, there is evidence that nuchal cord is associated with higher rate of abnormalities in the umbilical cord blood gases, but with little or no impact on the newborn [10–12]. However, other studies found that nuchal cord was not associated with adverse perinatal outcomes [1–3, 13]. Data on how to manage nuchal cord detected on prenatal ultrasound and whether the number of loops of the cord around the neck should influence the management are inconsistent [14–16].

Nuchal cord can be identified before delivery by ultrasound and Doppler imaging with high sensitivity and specificity [17]. The sensitivity is higher when more than one loop is present [18, 19].

A possible mechanism for fetal compromise in the presence of nuchal cord during labor is related to umbilical cord compression [12]. It is possible that the risk for fetal compromise is higher with more loops.

A random finding of multiple umbilical cord loops around the neck by ultrasound near term raises anxiety and concerns about the risks associated with vaginal delivery in this context. There is no solid evidence about how to manage a case of nuchal cord according to number of loops.

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Although the perinatal outcomes of pregnancies with nuchal cord has been studied, its significance is still equivocal and further studies are needed, especially in the case of multiple loops. In addition, the previous studies included heterogeneous groups with cesarean and vaginal deliveries.

The objective of the current study was to evaluate whether vaginal deliveries with a postpartum diagnosis of nuchal cord are associated with higher incidence of operative vaginal deliveries. Secondary outcomes were lower Apgar scores, rate of IUGR, and perinatal fetal death.

Materials and methods

We reviewed and analyzed the electronic medical records of 54,110 deliveries, from 2005 through 2014, in a single university-affiliated medical center. Inclusion criteria were singleton pregnancy with vertex presentation and vaginal delivery from 24 through 42 weeks of gestation.

Neonates with a nuchal cord served as the study group. Those without nuchal cord comprised the control group. The study group was further divided based on the number of nuchal cord loops.

Maternal age, parity, gestational week at delivery, birth weight, mode of delivery, Apgar scores < 7 at 1 and 5 min, and perinatal mortality were analyzed.

Data analysis

Nominal variables are described as numbers and percentages and continuous parameters as means and standard deviations. Differences between nonmetric data were analyzed with Chi-square or Fisher's exact test, each as appropriate, and between two metric variables with *t* test or Mann–Whitney non-parametric test, as appropriate. For more than two groups, one-way analysis of variance was used with Bonferroni post hoc comparisons. Logistic regression was used to understand the influence of the confounders and clinical parameter between nuchal cord and no nuchal cord. $p < 0.05$ was considered statistically significant. Data were analyzed with SPSS-23 software (IBM Corp., Armonk, NY, USA).

Ethical approval

The study was approved by the Institutional Review Board (approval, number 0240-16-MMC. According to the IRB decision, as this was a retrospective study, patient informed consent was not required.

Results

A total of 54,110 deliveries were reviewed. After excluding cesarean deliveries, non-vertex presentations and multiple gestations, 42,798 vaginal deliveries were eligible for inclusion in the study. The overall incidence of nuchal cord was 11.92% ($n = 5102$); 3809 (8.9%) had 1 loop, 1035 (2.42%) 2 loops, and 258 (0.6%) 3 loops (Fig. 1).

Table 1 presents selected characteristics of the study groups. Overall nuchal cord was associated younger maternal age, higher parity, older gestational age, and greater birth weight. In a multiple logistic regression model, each of these factors was found to be an independent risk factor. Although the differences were not clinically significant.

Nuchal cord was also associated with male sex. There were 19,045 (50.5%) males delivered in the control group and 2768 (54.3%) in the nuchal cord group ($p < 0.001$).

Nuchal cord with 3 loops was associated with higher incidence of adverse outcomes when compared to deliveries without nuchal cord: intrauterine fetal death (1.9% vs. 0.5%,

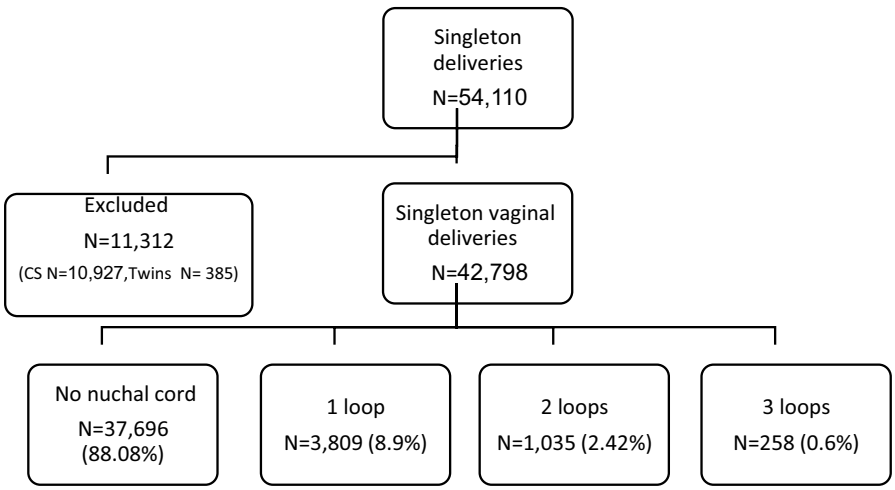

Fig. 1 Study profile. *CS* cesarean section

CS, cesarean section

Table 1 Demographic and obstetrical characteristics according to nuchal cord (NC) and number of loops

Characteristic	No NC ($n=37,696$)	Any NC ($n=5102$)	1 loop ($n=3809$)	2 loops ($n=1035$)	3 loops ($n=258$)
Maternal age, years (mean ± SD, min–max)	35.2 ± 5.8 (18–57)	34.7 ± 5.6* (18–59)	34.6 ± 5.6* (18–59)	35.0 ± 5.6 (20–49)	34.7 ± 5.9 (20–51)
Gravidity (average)	2.65	2.69*	2.64	2.85*	2.8
Parity (average)	2.26	2.28*	2.24	2.42*	2.35
Gestational age, weeks (mean ± SD)	39.1 ± 1.7	39.2 ± 1.5*	39.2 ± 1.4	39.3 ± 1.5*	39.2 ± 1.5
Birth weight, grams (mean ± SD, min–max)	3217 ± 494.8 (500–6340)	3235 ± 442 (604–4760)	3244 ± 443 (800–4760)	3229 ± 437 (604–4700)	3137 ± 430* (1385–4260)
Male, *n* (%)	19,045 (50.5%)	2768* (54.3%)	2074* (54.4%)	562* (54.3%)	132 (51.2%)

Each group was compared to the group with no nuchal cord

*$p<0.05$

$p=0.002$), low Apgar scores at 1 (7.4% vs. 1.9%, $p<0.001$), and 5 min (2.3% vs. 0.7%, $p=0.001$), and more operative vaginal deliveries (17.5% vs. 11.6%, $p=0.004$). These findings were not associated with 1- or 2-loop nuchal cords. The incidence of IUGR, defined as fetal weight < 10th percentile according to local reference curves [20], was significantly higher in the groups with 2 loops (10.2% vs. 8.2%, $p=0.016$) and 3 loops compared to the group without nuchal cord (11.6% vs. 8.2%, $p=0.042$). Nuchal cord with 1 loop was associated with lower incidence of intrauterine fetal death (0.2% vs. 0.5%, $p=0.001$).

To assess whether nuchal cord with 3 loops is an independent risk factor for adverse neonatal outcomes and to account for confounders (maternal age, parity, gestational age and birth weight), we constructed a multivariate regression. Nuchal cord with 3 loops was found to be an independent risk factor only for operative vaginal delivery and lower 1-min Apgar scores (Table 2).

Discussion

The current study evaluated the effect of nuchal cord at delivery on pregnancy and delivery outcomes and found that a single loop did not result in adverse outcomes. However, three loops of nuchal cord at delivery were associated with higher incidence of IUGR, intrauterine fetal demise, operative vaginal delivery, and low Apgar scores. Nuchal cord with 3 loops was independently associated with higher incidence of operative vaginal delivery and with lower 1-min Apgar score.

Although several previous studies analyzed pregnancies complicated by nuchal cord, they included mixed populations of patients with cesarean and vaginal deliveries [2, 14–16].

To focus on the birth process which includes contractions and fetal descent and its results in the presence of nuchal cord, the current study included only vaginal deliveries. Evaluating only vaginal deliveries enabled interpretation of clinically useful information regarding intrapartum management.

Our observation that one loop of nuchal cord was not correlated with pregnancy or delivery complications

Table 2 Pregnancy outcomes according to the presence of nuchal cord (NC) and the number of loops

Outcome	No NC ($n=37,696$)	Any NC ($n=5102$)	1 loop ($n=3809$)	2 loops ($n=1035$)	3 loops ($n=258$)
IUGR	3035 (8.2%)	461 (9%)*	325 (8.5%)	106 (10.2%)*	30 (11.6%)*
Operative vaginal delivery	4390 (11.6%)	625 (12.2%)	450 (11.8%)	130 (12.6%)	45 (17.5%)*, **
1 min Apgar < 7	704 (1.9%)	113 (2.2%)	69 (1.8%)	25 (2.4%)	19 (7.4%)*, **
5 min Apgar < 7	244 (0.7%)	25 (0.5%)	9 (0.2%)*	10 (1.0%)	6 (2.3%)*
Perinatal fetal death	195 (0.5%)	21 (0.4%)	8 (0.2%)*	8 (0.8%)	5 (1.9%)*

Each group was compared to the group with no nuchal cord

*$p<0.05$; **independent risk factor

agrees with the previous studies [2, 3, 13, 15]. We found a lower percentage of single nuchal cord loops; however, only vaginal deliveries were included.

The previous studies evaluated the outcomes of nuchal cord with 2 or more loops. In accordance with our results, Larson et al. evaluated 8565 term deliveries and studied the outcomes of 2 or more loops compared to a single and no nuchal cord [14]. They found a significant increase in operative vaginal deliveries, meconium-stained fluid, and abnormal fetal heart rate patterns during advanced labor in 326 term pregnancies with 2 or more nuchal cord loops. The incidence of 5 min Apgar score < 7 and stillbirth was not increased.

In contrast, Schaffer et al. [16] evaluated 11,748 deliveries. They compared pregnancy and delivery outcomes of nuchal cord with 2 or more loops, with no nuchal cord in term and postterm pregnancies. They found that the mode of delivery was unchanged, and the incidence of Apgar scores < 7 at 5 min and neonatal intensive unit admissions was not increased.

Our observation of increased rates of IUGR when the nuchal cord has 3 or more loops compared to no nuchal cord (11.6% vs. 8.2%) agrees with Schaffer et al. [14] who found significantly lower neonatal weights associated with nuchal cord. This was especially pronounced in postterm deliveries with multiple loops. However, the lower birth weights in that study did not meet the criteria of IUGR. Schaffer et al. [16] also described our observation of more male fetuses with nuchal cord compared to female fetuses. This finding has not been explained adequately.

The discrepant findings among the studies are most likely due to different inclusion criteria, sample sizes, and research methodologies. Larson et al. [14] and similarly, Schaffer et al. [16] defined multiple nuchal cords as 2 or more loops and included cesarean deliveries. The current study compared the outcomes of nuchal cords, with 1, 2, and 3 or more loops separately, and with no nuchal cord to evaluate the clinical impact of multiple cord loops. In our study, the poorer pregnancy outcomes including IUGR, operative vaginal delivery, low Apgar scores, and higher perinatal fetal death rate were increased among cases with three loops. The group with two loops was associated with IUGR, but not with other adverse outcomes.

Kong et al. [15] evaluated 4404 singleton term pregnancies and compared 3 loops to 1 or 2 loops, and nuchal cord to no nuchal cord. In accordance with our results, they found higher incidence of adverse outcomes in the group with 3 loops, but not with 2 loops. The incidences of meconium-stained amniotic fluid, admission to neonatal intensive care unit and emergency cesarean delivery were higher, but the incidence of IUGR and lower Apgar scores were not affected. However, the study included only 146 deliveries with 2 nuchal cord loops and 20 deliveries with nuchal cord with 3 loops.

One potential mechanism for fetal distress with nuchal cord is restriction of carotid artery blood flow from tight entanglement around the neck; however, severe venous congestion might be sufficient to cause asphyxia. Another potential mechanism is compression of the umbilical cord vessels themselves when the cord becomes tightly compressed against itself or the fetal neck. The previous studies failed to distinguish a loose or tight cord on ultrasound [17, 19], although multiple loops might cause the cord to be tighter.

The strengths of the current study lie in its size, which includes the largest database of nuchal cords with multiple loops during labor, to date. We also divided the multiple nuchal cord group into groups of 2 or 3 loops.

This study is limited by its retrospective nature. Other potential weaknesses include the lack of data about all cases with meconium-stained amniotic fluid and fetal heart rate patterns that can increase suspicions of fetal distress. However, the findings of higher incidence of intrauterine fetal demise, IUGR, low 1- and 5-min Apgar scores and operative vaginal deliveries, imply that nuchal cord with 3 loops is associated with fetal distress.

This study indicates the value of prenatal diagnosis of nuchal cord with 2 or more loops, especially when there is a diagnosis of IUGR and when there are signs suspicious of fetal distress during labor. In addition, when multiple nuchal cord loops are detected on prenatal ultrasound scan, the patient may be counseled about the higher incidence of adverse neonatal outcomes. This finding should be considered during pregnancy and delivery, along with parameters such as labor progression and fetal heart rate monitoring. Further research is needed to determine why more male than female fetuses have nuchal cord.

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Compliance with ethical standards

Conflict of interest The authors report no conflicts of interest.

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