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Original Article

J Clin Gynecol Obstet. 2019;8(2):48-53

The Presence of Nuchal Cord Does Not Hinder the Normal Progression of Labor

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Abstract

Background: Nuchal cord is a common occurrence at birth, and its relation to some perinatal outcomes has been reported. The objective of this study was to investigate whether the presence of nuchal cord affects the normal progression of labor.

Methods: We retrospectively examined women who delivered their babies at our clinic. The inclusion criteria were ≥ 37 weeks of gestation, cephalic presentation and a singleton pregnancy. The rates of induction/augmentation of labor, cesarean section/vacuum extraction and prolonged labor and the durations of the first and second stages of labor were compared between women with and without a nuchal cord, separately among nulliparous and multiparous women.

Results: We enrolled 2,277 nulliparous and 2,548 multiparous women. A single nuchal cord was found in 559 (24.5%) nulliparous and 616 (24.2%) multiparous women. Multiple nuchal cords were found in 99 (4.3%) nulliparous and 104 (4.1%) multiparous women. Among nulliparous women, the use of vacuum extraction was higher in women with multiple nuchal cords; no such difference was observed among multiparous women. The rate of induction/augmentation of labor was similar between women with and without a nuchal cord in both nulliparous and multiparous women. Among nulliparous women, the median duration of the first stage of labor was 558, 635 and 550 min (P = 0.211), and that of the second stage of labor was 55, 59 and 60 min (P = 0.183), with no nuchal cord, a single nuchal cord and multiple nuchal cords, respectively. Among multiparous women, the corresponding values were 260, 270 and 256 min (P = 0.313) for the first and 13, 13 and 12 min (P = 0.616) for the second stage. The rate of prolonged labor was similar between nulliparous and multiparous women, regardless of the nuchal cord state.

Conclusion: A nuchal cord is not associated with labor induction, nor does it hinder the normal progression of labor.

Keywords: Labor duration; Labor induction; Prolonged labor; Nuchal cord

Manuscript submitted May 7, 2019, accepted June 25, 2019

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doi: https://doi.org/10.14740/jcgo549

Introduction

A nuchal cord, or cord around the fetal neck, is a frequent finding at birth, and accounts for 20-30% of births [1-5]. Due to its high prevalence, a nuchal cord is considered to be a physiologic event [6]. A nuchal cord, as well as its relationship to obstetrical and neonatal outcomes, has been extensively studied. It has been previously reported that a nuchal cord is associated with shoulder dystocia [2], non-reassuring fetal heart rate tracing [7], low umbilical cord arterial blood pH [4, 8], acidosis [9], low Apgar score [4, 8-13], neonatal admission [13], meconium stain [10, 12-14], decreased fetal size relative to that of the placenta [15], operative vaginal delivery [11, 16], fetal distress [10, 12, 16] and cesarean section [11, 12, 16, 17]. However, several reports showed no relationship between the presence of a nuchal cord and adverse perinatal outcomes [3, 18-28]. Indeed, from a forensic point of view, Walla et al [9] concluded that a nuchal cord is not associated with an adverse perinatal outcome. The association of a nuchal cord with induction of labor [2, 10], and with a longer duration of labor [2, 14, 16], has also been reported. However, Karnanidhi et al [29] did not show such an association. Therefore, we investigated whether a nuchal cord hinders the normal progression of labor; namely, whether the normal descent of the fetus during labor is interrupted, leading to a prolonged labor.

Materials and Methods

We retrospectively examined women who delivered their babies in our clinic, from January 2004 to December 2017. Enrollment criteria were as follows: 37 weeks gestation or more, cephalic presentation and a singleton pregnancy. Cases with fetal demise before the onset of labor, non-cephalic presentation, a previous cesarean section, an elective cesarean section and cord entanglement other than around the fetal neck, were excluded. Our clinic is a private OB/GYN clinic, located in Shizuoka City in central Japan (population, about 700,000). The clinic mainly accepts women who are classed as low risk for pregnancy and delivery, namely, pregnant women with severe medical disease such as maternal heart disease, thyroid disease, and mental disease, or with severe pregnancy-induced hypertension; morbidly obese women were referred to tertiary hospitals. Vacuum extraction was used when appropriate; however, forceps delivery was not carried out in our clinic. Attending physicians, midwives, nurses and pregnant women and

Table 1. Presence or Absence of Nuchal Cord in Nulliparous and Multiparous Women

	Nulliparas (N = 2,277)	Multiparas (N = 2,548)	P-value
No nuchal cord	1,619 (71.1%)	1,828 (71.7%)	0.599
Single nuchal cord	559 (24.5%)	616 (24.2%)	
Multiple nuchal cord	99 (4.3%)	104 (4.1%)	

P-value: Mann-Whitney U test.

their families, did not know the presence or absence of nuchal cord before delivery. Women with nuchal cord were classified in two groups: a single nuchal cord (one turn around the neck) and multiple nuchal cords (two or more turns). This study was approved by the Local Ethical Committee (No. 18002).

Statistical analysis

Continuous data are reported as the mean ± standard deviation (SD) if normally distributed, and as the median and interquartile range (IQR), or 10 and 90 percentile, if not normally distributed. Categorical data are represented as n (%). Between-group comparisons among groups for continuous variables were made by one-way analysis of variance (ANOVA) if normally distributed, or Kruskal-Wallis test if not normally distributed, and by Fisher's exact test for categorical variables. Comparisons of the means between groups were made using an unpaired *t*-test for normally distributed data and the Mann-Whitney U test for nonparametric data. Fisher's exact test was used for ratio comparisons. Multiplicity of comparisons among groups was analyzed by using Bonferroni correction. All statistical analyses were performed with SPSS version 22.0 for Windows (IBM Japan, Tokyo, Japan). A P-value of less than 0.05 was considered statistically significant.

Results

Two nulliparous women without nuchal cord and one multiparous woman with a single nuchal cord were excluded due to intrauterine fetal demise before the onset of labor. Cord entanglement other than around the fetal neck was noticed in 64 nulliparous women and 72 multiparous women, and they were also excluded from this study. A total of 2,277 nulliparous and 2,548 multiparous women were enrolled.

A single nuchal cord was found in 559 (24.5%) nulliparous and 616 (24.2%) multiparous women; multiple nuchal cords were noted in 99 (4.3%) nulliparous and 104 (4.1%) multiparous women (Table 1). The rate of the presence of nuchal cord was similar in nulliparous and multiparous women. Clinical characteristics are shown in Table 2.

The presence of multiple nuchal cords increased the likelihood of vacuum extraction in nulliparous women (Table 3); however, the presence of nuchal cord did not affect the mode of delivery in multiparous women (Table 3). The rates of using epidural analgesia and labor induction/augmentation were similar in nulliparous and multiparous women, with and without nuchal cord (Table 3).

In nulliparous women, the duration of the first stage of labor was 558 min (215, 1,478), 635 min (222, 1,404) and 555 min (250, 1,490) (P = 0.211), and that of the second stage of labor was 55 min (19, 193), 59 min (22, 194) and 60 min (18, 182) (median (10th percentile, 90th percentile])) (P = 0.183) with no nuchal cord, a single nuchal cord and multiple nuchal cords, respectively (Table 4). In multiparous women, the duration of the first stage of labor was 260 min (104, 593), 270 min (109, 592) and 256 min (90, 548) (P = 0.313), and that of the second stage of labor was 13 min (4, 39), 13 min (4, 37) and 12 min (5, 39) (P = 0.616) (median (10th percentile, 90th percentile), with no nuchal cord, a single nuchal cord and multiple nuchal cords, respectively (Table 4).

The rates of prolonged first and second stages of labor were similar irrespective of the presence of nuchal cord in both nulliparous and multiparous women (Table 5).

Discussion

This study showed that the rate of augmentation/induction of labor was irrespective of the presence of nuchal cord (Table 3) and that nuchal cord did not affect the duration of the first and second stage of labor in both nulliparous and multiparous women (Tables 4 and 5). The study also revealed that nuchal cord was associated with a lower neonatal weight, a lower Apgar score at 1 min, a lower umbilical arterial pH and operative vaginal delivery, in nulliparous women (Tables 2 and 3). Additionally, nuchal cord was associated with a lower neonatal weight, a lower Apgar score at 1 and 5 min, a lower umbilical arterial pH and base excess, in multiparous women (Tables 2 and 3), as shown in previous reports [4, 8-13].

A nuchal cord may be single or multiple, loose or tight, or the cord may entangle other parts of the fetus [6, 30]. Usually, nuchal cords are labeled as being either tight or loose depending on whether or not the loop can be manually reduced over the fetal head [3]. If the nuchal cord could not be reduced easily over the head, it was clamped and cut before delivery, and regarded as a tight nuchal cord [2]. Henry et al [3] raised a question as to whether dichotomous classification as a loose or tight nuchal cord is suitable, given that the tightness of the nuchal cord is more likely to exist over a spectrum. Kobayashi et al [4] reported that umbilical cord entanglement around the trunk was associated with a higher risk of lower Apgar scores and a low umbilical artery pH. Therefore, in this study, the classification of a loose or tight nuchal cord was not employed, and cases with cord entanglement other than around the neck were excluded. Kong et al [24] reported that a nuchal cord of one turn and two turns accounted for 23.6% and 2.9%, respec-

Table 2. Characteristics of Pregnant Women With or Without Nuchal Cord

Nulliparas	No NC (N = 1,619)	Single NC (N = 559)	Multiple NC (N = 99)	P-value		
				For all	No NC vs. single NC	No NC vs. multiple NC
Maternal age	29.9 ± 4.5	30.0 ± 4.2	30.7 ± 4.6	0.165	> 0.999	0.186
Maternal height (cm)	158.4 ± 5.2	158.1 ± 5.2	159.0 ± 5.1	0.174	0.476	0.888
Maternal weight (kg)	50.7 ± 6.5	50.7 ± 7.1	51.6 ± 7.9	0.476	> 0.999	0.652
BMI (kg/m^2)	20.2 ± 2.3	20.3 ± 2.5	20.4 ± 2.7	0.597	> 0.999	> 0.999
Weight gain (kg)	10.7 ± 3.5	10.8 ± 3.5	10.2 ± 3.4	0.277	> 0.999	0.553
Gestational age (days)	277.6 ± 6.8	277.9 ± 6.8	277.3 ± 7.6	0.609	> 0.999	> 0.999
Cord length (cm)	53.6 ± 10.5	61.1 ± 10.2	71.1 ± 12.7	0.000	0.000	0.000
Neonatal weight (g)	3,014 ± 349	3,007 ± 335	2,872 ± 378	0.000	> 0.999	0.000
AS at 1 min	9 (9, 10)	9 (9, 10)	9 (9, 10)	0.009*	0.017$^{\#}$	0.279$^{\#}$
AS at 5 min	10 (10, 10)	10 (10, 10)	10 (10, 10)	0.112*	0.868$^{\#}$	0.154$^{\#}$
UA pH	7.31 ± 0.07	7.30 ± 0.07	7.31 ± 0.06	0.012	0.009	> 0.999
UA base excess	-3.2 ± 3.0	-3.6 ± 3.4	-3.9 ± 2.6	0.059	0.251	0.174
Epidural use (N)	98 (6.3%)	36 (6.6%)	10 (10.1%)	0.296**	> 0.999$^{\#\#}$	0.419$^{\#\#}$

Multiparas	No NC (N = 1,828)	Single NC (N = 616)	Multiple NC (N = 104)	P-value		
				For all	No NC vs. single NC	No NC vs. multiple NC
Maternal age	32.4 ± 4.1	32.0 ± 4.0	32.4 ± 4.5	0.178	0.194	> 0.999
Maternal height (cm)	158.2 ± 5.1	158.1 ± 5.3	158.0 ± 5.5	0.799	> 0.999	> 0.999
Maternal weight (kg)	51.4 ± 7.1	51.7 ± 7.2	51.5 ± 7.4	0.753	> 0.999	> 0.999
BMI (kg/m^2)	20.5 ± 2.6	20.7 ± 2.6	20.6 ± 2.6	0.535	0.795	> 0.999
Weight gain	10.3 ± 3.4	10.4 ± 3.1	10.4 ± 3.2	0.538	0.824	> 0.999
Gestational age (days)	275.2 ± 6.3	274.6 ± 6.3	275.7 ± 7.4	0.071	0.103	> 0.999
Cord length (cm)	54.9 ± 10.3	61.7 ± 9.8	71.0 ± 10.7	0.000	0.000	0.000
Neonatal weight (g)	3,083 ± 345	3,066 ± 338	2,999 ± 301	0.038	0.837	0.046
AS at 1 min	10 (9, 10)	9 (9, 10)	9 (9, 10)	0.000*	0.000$^{\#}$	0.017$^{\#}$
AS at 5 min	10 (10, 10)	10 (10, 10)	10 (10, 10)	0.001*	0.003$^{\#}$	0.038$^{\#}$
UA pH	7.34 ± 0.06	7.34 ± 0.08	7.32 ± 0.09	0.021	0.759	0.014
UA base excess	-1.0 ± 2.6	-1.3 ± 2.9	-2.0 ± 3.6	0.004	0.124	0.010
Epidural use (N)	50 (2.7%)	17 (2.8%)	2 (1.9%)	> 0.999**	> 0.999$^{\#\#}$	> 0.999$^{\#\#}$

Data are presented as mean ± standard deviation; median (interquartile range: 25th percentile, 75th percentile). NC: nuchal cord; BMI: body mass index; UA: umbilical artery; AS: Apgar score. P-value: one-way analysis of variance. *Kruskal-Wallis test. **Fisher's exact test (for all). Unpaired *t*-test with Bonferroni correction. $^{\#}$Mann-Whitney U test with Bonferroni correction. $^{\#\#}$Fisher's exact test with Bonferroni correction (no NC vs. single or multiple NC).

tively, which was similar to the present study (Table 1).

Ogueh et al [2] reported that in a Canadian population study, the overall mean duration of labor and the first stage of labor was similar among women with and without nuchal cord; however, the second stage of labor was longer (53.8 vs. 51.7 min) in the presence of nuchal cord and if the nuchal cord was tight, the second stage of labor was even longer (56.1 min). Narang et al [14] showed that prolonged second stage of labor was more common among women with nuchal cords than those without. However, Karunanidhi et al [29] showed that the duration of the active phase of labor was no different with or without nuchal cord among nulliparous and multiparous women, as presented in this study (Tables 4 and 5). The explanation of prolonged second stage of labor is failure of decent of the vertex in cases with nuchal cords [2]. Another explanation is that pregnancies associated with nuchal cords (with their association of small babies and abnormal fetal heart rate pattern) may be more intensively managed in labor with more vaginal examinations and so the onset of the second stage of labor is detected earlier and hence the longer stage of labor [2]. We speculate that even tight nuchal cord may not be always too short for the normal descent of the fetus [31].

Ogueh et al [2] reported that the requirement for augmentation with oxytocin was greater in the presence of nuchal cord

Table 3. Mode of Delivery and Induction/Augmentation of Labor With or Without Nuchal Cord

Nulliparas	No NC (N = 1,619)	Single NC (N = 559)	Multiple NC (N = 99)	P-value		
				For all	No NC vs. single NC	No NC vs. multiple NC
Cesarean section	57 (3.5%)	14 (2.5%)	0 (0%)			
Vacuum extraction	169 (10.4%)	53 (9.5%)	19 (19.2%)	0.016	> 0.999	0.016
Normal delivery	1,393 (86.0%)	492 (88.0%)	80 (80.8%)			
Induction/augmentation	538 (33.2%)	186 (33.3%)	36 (36.4%)	0.806	> 0.999	> 0.999

Multiparas	No NC (N = 1,828)	Single NC (N = 616)	Multiple NC (N = 104)	P-value		
				For all	No NC vs. single NC	No NC vs. multiple NC
Cesarean section	1 (0.1%)	0 (0%)	0 (0%)			
Vacuum extraction	28 (1.5%)	17 (2.8%)	4 (3.8%)	0.096	0.297	0.416
Normal delivery	1,799 (98.4%)	599 (97.2%)	100 (96.2%)			
Induction/augmentation	306 (16.7%)	107 (17.4%)	20 (19.2%)	0.733	> 0.999	> 0.999

NC: nuchal cord. P-value: Fisher's exact test (for all), Fisher's exact test with Bonferroni correction (no NC vs. single or multiple NC).

Table 4. Duration of the First and Second Stage of Labor With or Without Nuchal Cord

Nulliparas	No NC (N = 1,561)	Single NC (N = 545)	Multiple NC (N = 99)	P-value		
				For all	No NC vs. single NC	No NC vs. multiple NC
First stage of labor	**558 (215, 1,478)**	**635 (222, 1,404)**	**550 (250, 1,490)**	**0.211**	**0.250**	**> 0.999**
Second stage of labor	**55 (19, 193)**	**59 (22, 194)**	**60 (18, 182)**	**0.183**	**0.198**	**> 0.999**

Multiparas	No NC (N = 1,826)	Single NC (N = 616)	Multiple NC (N = 104)	P-value		
				For all	No NC vs. single NC	No NC vs. multiple NC
First stage of labor	260 (104, 593)	270 (109, 592)	256 (90, 548)	0.313	0.631	> 0.999
Second stage of labor	13 (4, 39)	13 (4, 37)	12 (5, 39)	0.616	> 0.999	> 0.999

NC: nuchal cord. Data: median (10th percentile, 90th percentile) (min). P-value: Kruskal- Wallis test (for all), Mann Whitney U test with Bonferroni correction (no NC vs. single or multiple NC).

Table 5. Rate of Prolonged Labor With or Without Nuchal Cord

Nulliparas	No NC (N = 1,562)	Single NC (N = 545)	Multiple NC (N = 99)	P-value		
				For all	No NC vs. single NC	No NC vs. multiple NC
Prolonged first SoL[a] (+)	251 (16.1%)	84 (15.4%)	14 (14.1%)	0.874	> 0.999	> 0.999
(-)	1,311	461	85			
Prolonged second SoL[b] (+)	163 (10.4%)	56 (10.3%)	9 (9.1%)	0.966	> 0.999	> 0.999
(-)	1,399	489	90			

Multiparas	No NC (N = 1,827)	Single NC (N = 616)	Multiple NC (N = 104)	P-value		
				For all	No NC vs. single NC	No NC vs. multiple NC
Prolonged first SoL[c] (+)	55 (3.0%)	18 (2.9%)	2 (1.9%)	0.926	> 0.999	> 0.999
(-)	1,772	598	102			
Prolonged second SoL[d] (+)	17 (0.9%)	4 (0.6%)	3 (2.9%)	0.096	> 0.999	0.267
(-)	1,810	612	101			

NC: nuchal cord; SoL: stage of labor. [a]Duration > 20 h. [b]Duration > 3 h, with epidural use > 4 h. [c]Duration > 14 h. [d]Duration > 2 h, with epidural use > 3 h. P-value: Fisher's exact test (for all), Fisher's exact test with Bonferroni correction (no NC vs. single or multiple NC).

(adjusted odds ratio (OR): 1.06) and that induction of labor was also higher among women with nuchal cord (adjusted OR: 1.09). Rhoades et al [10] reported that the induction rate doubled in women with nuchal cord compared to those without. However, Karunanidhi et al [29] showed that the requirement of induction and augmentation was similar with or without nuchal cord; the present study is in agreement with this report.

This study also showed that cesarean section delivery was not more frequent among women with nuchal cord than those without (Table 3), consistent with previous reports [2, 5, 22, 24, 26, 32]. Reed [33] claimed that when a cesarean section is carried out for reasons of "fetal distress" or "lack of progress" during labor, the presence of nuchal cord is often stated as the reason, as the cord prevents the fetal descent. The author continued to claim that the cord was unlikely to have had anything to do with the stress or lack of progress. Ogueh et al [2] reported that women with even tight nuchal cords had lower rates of cesarean sections (relative risk, 0.145, compared with no nuchal cord, $P < 0.0001$). As the Apgar score and umbilical artery pH were lower among women with nuchal cord (Table 2), the nuchal cord does appear to induce a certain level of stress on the fetus. However, this study supports Reed's opinion that the cord does not have anything to do with the lack of the progression of labor.

The present study has some limitations. Firstly, this study was conducted in a single private clinic where only low risk labor/deliveries were accepted; the results may be different in women with moderate or high-risk pregnancies. Secondly, in this study forceps delivery was not performed; forceps delivery is regarded as being more prompt and successful than vacuum extraction [34, 35]. With the use of forceps, the duration of the second stage of labor would be shorter, and the rate of cesarean section would be lower.

There were also advantages of this study. For instance, no, single and multiple nuchal cords were analyzed separately. It is reasonable to suggest that if a single nuchal cord affected the normal onset and duration of labor, then multiple nuchal cords would have an even greater effect; this study did not show such a "dose effect' (Tables 3-5). In addition, nulliparous women and multiparous women were analyzed separately given that the duration of labor is quite different between the two groups.

The author hopes that this study will contribute to better understanding of the nuchal cord by the physician, coworkers, as well as pregnant women and their family, and that antenatally diagnosed nuchal cord will not provide undue cause for concern.

Conclusion

The presence of nuchal cord is not associated with the induction/augmentation of labor, nor is it associated with prolonged labor, in both nulliparous and multiparous women.

Acknowledgments

The author is grateful to Yousuke Sasaki (Department of Medical Statistics, Satista Co., Ltd, Uji, Japan, www.satista.jp) for his assistance with the statistical analysis and to Editage (www.editage.com) for English language editing.

Financial Disclosures

None.

Conflict of Interest

None.

Informed Consent

Not applicable.

Author Contributions

KI performed all the research including research design, data collection, analyzed the data and wrote the paper.

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