Outcome of Infants Born with Nuchal Cords

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Background. The effect of a nuchal cord on the outcome of delivery is controversial. The purposes of this study were to investigate the frequency of nuchal cords and determine the effect that nuchal cords have on the neonate.

Methods. In a retrospective, case-control study, 706 consecutive infant deliveries in a community hospital were evaluated. Sixteen deliveries that were complicated by the umbilical cord entangled around an extremity or by a prolapsed cord were excluded from further analysis. The study group consisted of the 167 deliveries (23.7%) complicated by a nuchal cord. The remaining 523 deliveries were used as the control group.

Results. There were no significant differences found in maternal age, race, parity, prepregnancy weight, or amount of weight gain between the mothers of the infants in the two groups. Fetal bradycardia and variable decelerations in fetal heart rate occurred almost twice as often in the nuchal cord group (18.6% as compared with 9.6%, $P < .01$). Despite this finding, there was no significant difference in the number of operative deliveries or in Apgar scores at 1 and 5 minutes between the two groups. There were no perinatal deaths associated with nuchal cords. Infants born with nuchal cords weighed less than those in the control group (3345 g compared with 3468 g, $P < .01$). There were also significantly fewer large-for-gestational-age and macrosomic infants born in the nuchal cord group. Complications such as jaundice, hypoglycemia, sepsis, and respiratory problems were not increased in the postnatal period because of a nuchal cord.

Conclusions. This study suggests that nuchal cords are common and are rarely associated with significant morbidity or mortality in neonates.

Key words. Umbilical cord; labor complications; fetal distress.

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As Baden so eloquently wrote in 1955, "intrauterine life, sustained only by two small arteries and a tortuous vein coursing through a long flexible cord, hangs by a very delicate thread."[1] To those who practice obstetrics, it seems that this delicate thread too often is wrapped around the newborn's neck. Much like a hangman's noose, the nuchal cord is often blamed for problems that are encountered during delivery and is often cited as a major cause of fetal distress and perinatal mortality. However, the actual significance that a nuchal cord has on the outcome of an infant is controversial.

Does the nuchal cord really affect the outcome of delivery? The purposes of this retrospective study were to investigate the actual frequency of nuchal cords encountered in a community hospital setting and to determine the effect, if any, of a nuchal cord on an infant as it passes through the birth canal and immediately after delivery. The questions to be answered included the following: (1) How frequently do nuchal cords occur? (2) Are operative deliveries more common in those pregnancies involving nuchal cords? (3) Does the presence of a nuchal cord cause fetal distress? If so, is neonatal morbidity or mortality increased?

Methods

From June 1986 to December 1986, a review of the labor records showed that 765 infants were born at Reynolds Army Community Hospital at Fort Sill, Oklahoma. Twenty family physicians and three obstetricians provided the level II obstetric care.

The study data were collected from three differeent sources. Demographic data on the mother were collected from a review of the prenatal record, and included age, race, parity, prepregnancy weight, weight gain during pregnancy, and previous personal and obstetric history.

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Table 1. Incidence of Cord Complications in 706 Deliveries

Cord Complication	No. (%)
None	523 (74.1)
Nuchal cord (one coil)	153 (21.7)
Nuchal cord (two coils)	12 (1.7)
Nuchal cord (three coils)	2 (0.3)
Hand or body entanglement	13 (1.8)
Prolapsed cord	3 (0.4)

The maternal delivery record provided the data for gestational age, method of delivery, presence of meconium in the amniotic fluid, fetal heart rate monitoring that was done routinely, presence of nuchal cord, and any other complications that may have occurred at the time of delivery. The newborn's record was used to collect data for sex, birthweight, Apgar scores, congenital anomalies, and perinatal course.

Of the 765 deliveries, 706 (92.3%) were reviewed. The remaining 59 deliveries were excluded from the study because either the maternal or the infant record could not be located. The reason why these records were missing could not be determined by the records personnel. The study group consisted of those 167 births involving nuchal cords. The 16 deliveries complicated by a prolapsed cord or by a cord entangled around an extremity were excluded from further analysis. The remaining 523 deliveries in which nuchal cords did not occur served as the control group.

A nuchal cord was considered to be "loose" when it could easily be uncoiled before delivery of the newborn. When it needed to be clamped and cut before delivery, the nuchal cord was called "tight." Fetal distress was defined as the presence of bradycardia or variable or late decelerations in heart rate detected by an electronic fetal heart monitor. Infant hypoglycemia was defined as a serum glucose level of less than 2.2 mmol/L (40 mg/dL). The presence of jaundice was determined by both the age of the infant and the level of bilirubin, and infant anemia was defined as a central hematocrit of less than 0.40 (40%).

Statistical analyses were performed using chi-square with Yates' correction factor or Fisher's exact test on nominal data, and Student's *t* test for independent samples on interval data.

Results

During the study period, 23.7% of all deliveries had some form of nuchal cord (Table 1). The incidence of one coil of the umbilical cord around the neck was 21.7%, while two coils and three coils of the cord occurred in 1.7% and 0.3% of the deliveries, respectively.

Table 2. Comparison of Deliveries Between Infants with Nuchal Cords and Infants in a Control Group

Factors	Nuchal Cord Group, % (n=167)	Control Group, % (n=523)	*P* Value
Gestational age (wk)			
<38	6.6	10.7	NS
38–42	91.0	88.1	NS
>42	2.4	1.1	NS
Type of delivery			
Vaginal	83.8	73.4	<.01
Primary cesarean section	10.2	11.5	NS
Repeat cesarean section	1.2	9.4	<.01
Forceps	3.6	4.2	NS
Vacuum extraction	1.2	1.5	NS
Complications			
Breech presentation	0.6	3.4	NS
Placental abruption	0.6	1.1	NS
Meconium stain	19.2	19.5	NS
Fetal distress*	18.6	9.6	<.01

**As manifested by fetal bradycardia, variable, or late decelerations. NS denotes not statistically significant.*

Of the 167 nuchal cords, 43 (25.7%) were loose, 38 (22.8%) were tight, and no mention was made of the severity of the nuchal cord in the charts of the remaining 86 cases. The most complex case involved a baby boy born with a triple nuchal cord and true knot; he did well with Apgar scores of 7 and 9.

There were no significant differences in the maternal age, race, parity, prepregnancy weight, or weight gain between the two groups. The mean age of the mothers in both groups was slightly over 24 years. The majority were white (61%) and nulliparous (43%). The mean prepregnancy weight was 135 pounds, and the mean weight gain during pregnancy was 33 pounds. There were no significant differences in hypertensive (5.4%) or diabetic (4.2%) complications between the two groups.

Table 2 is a summary of the timing, method, and complications of labor and delivery. The mean gestational age at birth was just over 39 weeks in both groups. Vaginal deliveries occurred significantly more often in the nuchal cord group ($P < .01$). This significance, however, is lost when the repeat cesarean sections are excluded. There was no statistical difference in frequency of primary cesarean sections, use of forceps, or vacuum extractions between the two groups. The rate of primary cesarean section for fetal distress was 7.2% in the nuchal cord group compared with 5.9% in the control group ($P > .10$).

The control group had more breech presentations and placental abruptions than the nuchal cord group; however, the difference was not statistically significant. Meconium staining of the amniotic fluid was equally present in both groups. Fetal bradycardia and variable

Table 3. Comparison of Outcomes Between Infants with Nuchal Cords and Infants in a Control Group

Factors	Nuchal Cord Group, % (n=167)	Control Group, % (n=523)	*P* Value
Apgar score at 1 minute			
0–3	3.6	1.3	NS
4–6	4.8	3.5	NS
7–10	91.6	95.2	NS
Apgar score at 5 minutes			
0–3	0	0.6	NS
4–6	1.2	0.4	NS
7–10	98.8	99.0	NS
Male sex	47.9	51.1	NS
Birthweight (g)			
<2500	3.6	3.6	NS
2500–4000	88.6	82.4	NS
>4000	7.8	14.0	NS
Complications			
LGA	13.2	21.2	<.05
IUGR or SGA	3.0	1.9	NS
Respiratory problems	3.0	4.8	NS
Sepsis	1.2	1.7	NS
Hypoglycemia	2.4	5.0	NS
Jaundice	7.2	7.8	NS
Anemia	1.8	0.4	NS

NS denotes not statistically significant; LGA, large for gestational age; IUGR, intrauterine growth retardation; SGA, small for gestational age.

decelerations occurred almost twice as often in the nuchal cord group ($P < .01$).

The Apgar scores, sex, and birthweight of the infants, and any neonatal complications that occurred, are given in Table 3. There was no significant difference found between the mean of both the 1- and 5-minute Apgar scores (8 and 9, respectively) between the two groups, but infants born with nuchal cords tended to have lower scores at 1 minute. The percentage of infants born with an initial Apgar score of less than 7 in the nuchal cord group was almost twice that of infants in the control group (8.4% and 4.8%, respectively). This trend was not evident in the 5-minute Apgar test. There was only one stillbirth (incidence 0.1%), which occurred in the control group.

The greater occurrence of nuchal cords in female infants was not statistically significant. Infants born with nuchal cords weighed 123 g less than those in the control group (3345 g vs 3468 g, $P < .01$). Also, there were significantly more large-for-gestational-age and macrosomic infants in the control group ($P < .05$), but no significant difference in the number of births involving small-for-gestational age and intrauterine-growth-retardation infants.

There was no significant difference in respiratory problems, sepsis, hypoglycemia, or jaundice between the two groups. Anemia did occur more frequently in the nuchal cord group, but the small numbers prevent adequate statistical comparison. Of the five cases in which an infant was anemic or hypovolemic, two were in the control group. The other three cases all involved a tight nuchal cord. One infant from each group required a blood transfusion.

Discussion

The frequency of nuchal cords found in this study is 23.7%, which is similar to findings in prior studies. From the 35,489 reported cases involving nuchal cords, the incidence varies from 12.6% to 33.3%, with an overall average of 20.4%.[2-15] Thus, nuchal cords commonly occur.

This study was unable to demonstrate any association between nuchal cords and maternal age, race, parity, prepregnancy weight, or weight gain. There was no indication that the presence of a nuchal cord influences the length of the pregnancy, a finding that agrees with other reports.[7,10] Infant sex was not significantly associated with nuchal cords, although one study did suggest that more boys are born with nuchal cords.[7]

Although not measured in this study, others have shown that the length of the umbilical cord predisposes an infant to a nuchal cord. The average umbilical cord length is 50 to 58 cm, with the longest reported cord measuring 175 cm.[9,11,16] Longer cords tend to become looped around the neck.[8-11] Nuchal coiling can occur in shorter cords, in which cases the cord tends to be more tightly wrapped around the infant's neck.[9,10]

The presence of a nuchal cord in this study was not associated with an increased frequency of primary cesarean, vacuum, or forceps deliveries. Thus, operative deliveries were not more common in those pregnancies involving nuchal cords, although this is controversial in the literature.[3,7,9]

A study by Horwitz et al[9] found that the rate of nuchal cords was higher in breech (30.4%) than vertex (24.8%) presentations. This finding has been contradicted by Spellacy et al[10] as well as by the findings of the present study. Of the 19 breech presentations, only one involved a nuchal cord. The much lower occurrence could be because cords in breech presentations tend to be shorter,[16] and thus are less likely to be looped around the neck.

Several studies in the past have implicated nuchal cords as a cause of fetal death.[1,17-20] Harrar and Buchman[17] reported 14 unanticipated deaths occurring in the second stage of labor due to nuchal cords. In contrast, several authors agree with the present study that nuchal

cords do not increase fetal mortality.[7,10-12] Shui and Eastman[8] found a higher fetal death rate in those deliveries *not* involving nuchal cords, and concluded that coiling of the umbilical cord around the infant's neck was a rare cause of perinatal death. Horwitz et al[9] found the neonatal death rate to be 1%, regardless of the presence of a nuchal cord.

The presence of a nuchal cord is often cited as a major cause of fetal distress, as evidenced by meconium-stained amniotic fluid and/or fetal bradycardia or tachycardia.[4,7,10,20-23] In a study by Fisher,[12] fetal distress was twice as common in births complicated by nuchal cords. In those births with nuchal cords, 12.0% had meconium and 4.3% had fetal bradycardia (less than 100 beats per minute), compared with 6.9% and 0.4%, respectively, in those without nuchal cords.

In the present study, over 19% of deliveries in each group were complicated by some form of meconium staining, which agrees with the findings of Spellacy et al[10] that the incidence of meconium is not increased by nuchal cords. Fetal bradycardia and variable decelerations were found almost twice as often in the group with nuchal cords (18.6% as compared with 9.6%, $P < .01$) in the present study. This finding is consistent with that found by Bruce et al,[19] who studied 8038 births and found cord compression to be the major factor associated with variable decelerations. Similar increases in both moderate and severe variable decelerations in labors complicated by nuchal cords have been reported by other authors.[10,24-28]

Recent studies of fetal monkeys and lambs have shown that fetal heart rate changes are mediated by both chemoreceptors and baroreceptors.[29,30] Variable deceleration occurs only after the umbilical blood flow is acutely reduced by 50%; lesser degrees of cord compression do not significantly affect the fetal heart rate.

Several studies have shown that this cord compression results in reduced blood flow to the fetus and subsequent changes in the umbilical artery blood gases.[3,25,31-33] If compression is high enough to occlude the artery, the fetus is unable to exchange carbon dioxide adequately, resulting in hypercapnia and subsequent acidosis. Acidosis is significantly more common in newborns with nuchal cords.[33] This acidosis is of a "mixed" (68%) or a pure respiratory (23%) type and is corrected quickly by prompt ventilation of the newborn.

Paradoxically, despite the higher incidence of bradycardia and acidosis, the Apgar score is not dramatically affected. The present study was unable to demonstrate a significant difference in the mean 1-minute Apgar score beween the two groups, although the nuchal cord group did tend to have a larger percentage of infants born with a score of less than 7. This difference was absent at 5 minutes after birth when the second Apgar score was given, suggesting that any possible effect is only transient. Similar findings by others suggest that nuchal cords are *not* a major cause of fetal asphyxia.[3,9,10]

It is interesting to note that the Apgar scores in the nuchal cord group of this study were comparable to those of the control group, despite the much higher occurrence of fetal distress noted during labor. It may be that the Apgar score is a better indicator of the newborn's health at the time of birth than the fluctuations in heart rate noted during labor.

Another interesting finding in this study is that infants born with nuchal cords weighed less than those in the control group. The difference of 123 g was statistically significant ($P < .01$), although the clinical significance of this finding is unclear. The nuchal cord group had significantly fewer macrosomic and large-for-gestational-age infants as compared with the control group ($P < .05$). These findings have not been reported in the past, and further studies would need to be done to determine the actual significance of nuchal cords on intrauterine growth.

In terms of congenital anomalies, respiratory problems, jaundice, sepsis, and hypoglycemia, those infants born with nuchal cords were not found to be at higher risk. There was, however, an increased rate of anemia found in the "tight" nuchal cord group (1.8% as compared with 0.4%). This anemia was explained by feto-placental blood transfusion, where blood flow is obstructed in the less muscular umbilical vein, but fetal blood continues to perfuse the placenta, resulting in anemia. The infant can be deprived of as much as 20% of his blood volume by a tight nuchal cord.[34-36] Shepherd et al[2] found a greater frequency of anemia in neonates born with nuchal cords.

A limitation of the present study was that 59 records could not be completely reviewed. These missing records, although representing only a small percentage of the study population, could have documented complicated cases that would have affected the overall results. Another major limitation was the small sample size, which precluded comparison of certain complications that occur infrequently. Considering the study size and the rarity of fetal deaths, it is very difficult to conclude that nuchal cords do not increase neonatal mortality. A much larger study would need to be done to determine definitively whether nuchal cords are a cause of neonatal mortality.

In conclusion, this study suggests that nuchal cords occur commonly, but are rarely associated with significant neonatal morbidity or mortality.

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