The Effect of Nuchal Cord on Amniotic Fluid Index and Estimated Fetal Weight Detected by Ultrasound

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ABSTRACT:

BACKGROUND:
Umbilical cord around fetal neck (nuchal cord) is quite common finding, it is often assumed that it might cause cord compression and thus low fetal weight, oligohydramnios and intrapartum complication.

OBJECTIVE:
To determine effect of the nuchal cord on amniotic fluid index (AFI) and fetal weight.

MATERIALS AND METHODS:
Two hundred full term pregnant women were enrolled in this study. By using color Doppler ultrasound to detect the presence of nuchal cord, trans abdominal altrasound to detect AFI and fetal weight were estimated according hadlock equation, half of them were with nuchal cord (study group) and the remaining were without nuchal cord (control group).

RESULTS:
Descriptive statistics of studied groups revealed no statistically significant difference in mean maternal age, gestational age and obstetrical history between study group and control group. Loose nuchal cord was the dominant type reported in 90% of the patients and 71.6% having only single loop, while multiple loops were seen in 28.4% of study group.
A significant association was found between reduced AFI level and presence of cord around fetal neck and the mean estimated fetal weight was significantly lower in nuchal cord group 3068.9 ± 489.6 g compared to non-nuchal cord group 3208.5±331.5g, p < 0.05.

CONCLUSION:
Cord around fetal neck is associated with higher incidence of low fetal weight, low AFI which in turn increase risk for adverse perinatal outcome such as fetal distress that needs an urgent cesarean section.

KEYWORDS: fetus, nuchal cord, AFI, fetal weight, ultrasound.

INTRODUCTION:

Presence of single or multiple loop of cord around fetal neck is physiological, and is seen in 25% of deliveries. Fetal movement through the pelvis can spin the cord around his neck which is more common with increasing gestation and having longer cord [1,2]. Most nuchal cords (>80%) are wrapped right to left around the fetal neck. Most torsion (>70%) is counter clockwise away from the fetus. Nuchal cords can be classified by The **Giacomello classification system** in two types [3, 4]:

Type A _a nuchal loop 360 degrees around the neck of the fetus where the placental end crosses over the umbilical end, entangling the neck in an unlocked pattern that can undo itself.

Type B _a nuchal loop 360 degrees around the fetal neck where the placental end crosses under the umbilical end, and this entangling the neck in a locked pattern that cannot undo itself. This pattern can form a true knot when it passes down over the fetal body.

Divot sign describes the formation of circular indentations of the nuchal skin (created by the encircled nuchal cord) which are visible upon sagittal ultrasonographic scanning of the neck. The 'divot sign' should not be confused with cystic posterior neck masses, folds of fetal skin or amniotic fluid pockets [5]. Nuchal cord is an incidental finding in routine second and third trimester ultrasound scans [6]. During labour, the only indication of the umbilical cord being around fetal neck may be variable fetal heart decelerations on the monitor. These are generally timed with contractions as at that time the cord is stretched more tightly [7].

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Nuchal cord was first described in 1982 by Jouppila and Kirkinen, The use of color Doppler flow has increased the accuracy of the diagnosis, and various studies have mentioned that sensitivity varying from 60%- 95%, A nuchal cord is diagnosed when the umbilical cord is visualized encircling at least three quarters of the fetal neck [8, 9,10].

Setting: The study was conducted at Al-Elwiya Maternity Teaching Hospital during the period from February 2016 to April 2017.

Study design: A case-control, cohort study.

PATIENTS AND METHODS:

The study conducted at Al-Elwiya Maternity Teaching Hospital at Baghdad, Department of Obstetrics and Gynecology for the period from 1st of April 2016 to 1st of April 2017. The study protocol was approved by the Scientific Council Obstetrics and Gynecology of Iraqi Board for Medical Specializations.

Two hundred pregnant women at term were enrolled in this study while attending the hospital for further assessment or they started early labor. After taking verbal consent, they were subjected to full history and examination included: order number, parity, and gestational age (which is determined by using last menstrual period and early pregnancy ultrasound).

Inclusion Criteria:
Singleton viable fetus.
With intact fetal membrane.

Exclusion Criteria:
Multiple pregnancies.
Any fetal abnormality.
Preterm premature rupture of membrane (PPROM).
Maternal medical disorder (DM, pregnancy induced HT and lupus).
Antepartum hemorrhage.

Certain items were measured for fetus by using ultrasound performed by doctor specialist in Radiology who explains in details for all required parameters with author using device with convex transducer frequency of 3.5 MHz (Braun, U.K).

The presence of nuchal cord encirclement single or multiple whether loss or tight measured by Doppler ultrasound.

Amniotic fluid index(AFI): Measured by sum total of the deepest vertical pocket in each of the four-quadrant, into which the uterus is divided by using umbilicus and linea nigra as reference points for the upper and lower halves and for the left and right halves, respectively.

Fetal weight is automatically estimated by scanner using a combination of the BPD, AC, HC and FL, based on sonography (hadlock).

Fetal weight is estimated by hardlock formula loaded in the machine using AC, BPD, FL and HC.

Hadlock 2 formula [21,22]:

$$log10(weight) = 1.335 - (0.0034 \times AC \times FL) + (0.0316 \times BPD) + (0.0457 \times AC) + (0.1623 \times FL)$$

After collecting data, the patients were arranged according to umbilical cord condition, in to nuchal cord encirclement group and those without nuchal cord encirclement.

The encirclement group was further divided according to gestational age parity, their estimated fetal weight, number of encirclements, and type of nuchal cord.

Statistical Analysis:

Data was first entered in excel file then copied to a file of Statistical Package for Social Sciences version 22 (SPSSv22) for data analysis.

Continuous variables presented as means with their standard deviations and discrete variables presented as numbers and percentages.

T test and Mann-Whitney test used to test the significance. Chi-square test and Fishers exact test were used to test the significance of association between variabilities. Level of significance was set at 0.05.

RESULTS:

This study enrolled 100 pregnant women with cord around their fetal neck (nuchal cord) and 100 pregnant with no nuchal cord according to ultrasound examination.

Age of sampled women varied from 17 to 40 years in nuchal cord group and from 16 to 41 in non-nuchal cord group. Nuchal cord group of women were younger than non-nuchal cord group women according to the following two observations:

Mean age was 25.3±5.0 y for nuchal cord group was higher than that of non-nuchal cord group (28.6±6.7 years). This variation found to be significant (P < 0.05).

Vast majority (97%) of nuchal cord group was of an age group of 15-35 y and only three women aged more than 35 y, while non-nuchal cord group women was distributed as 79% for the age group of 15-35 y and 21% older than 35y. This variation found to be significant (P < 0.05, Figure 1).
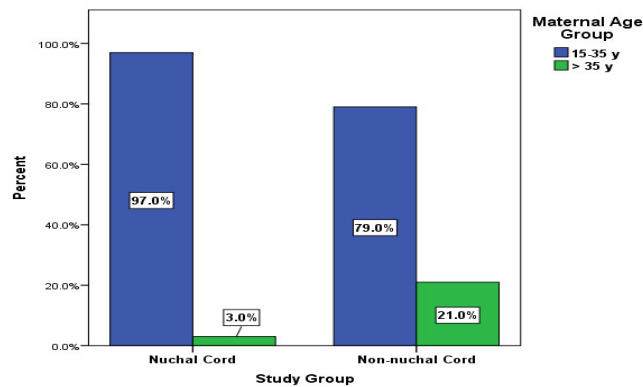
Figure 1: Distribution of sampled women according to study group and to maternal age.

Gestational age of sampled women varied from 37 to 40 wk for both study groups. Mean gestational age was 38.1±1.1 wk for nuchal cord group and 38.3±0.8 for non-nuchal cord group. This variation found to be not significant (P > 0.05).

Parity history: Primipara women constituted 25 (25.3%) of nuchal cord group and 35 (35%) of non-nuchal cord group while multipara women constituted 74 (74.7%) of nuchal group and 65 (65%) of non-nuchal group. Parity history of sampled women showed no significant association with nuchal cord status (P > 0.05).

AFI varied from 1 to 26 cm in nuchal cord group and from 8 to 20 cm in non-nuchal group. Mean AFI in nuchal group (8.1±4.9 cm) is significantly lower than mean AFI in non-nuchal group (11.0±2.0 cm) (P < 0.05).

This study found significant association between lower AFI levels and nuchal cord group (P < 0.05, Figure 2) and as follow:

Nuchal cord group women: (43.4%) were having reduced AFI.

Non-nuchal cord group women: 12 (21%) were having reduced AFI and none of them have increased AFI.
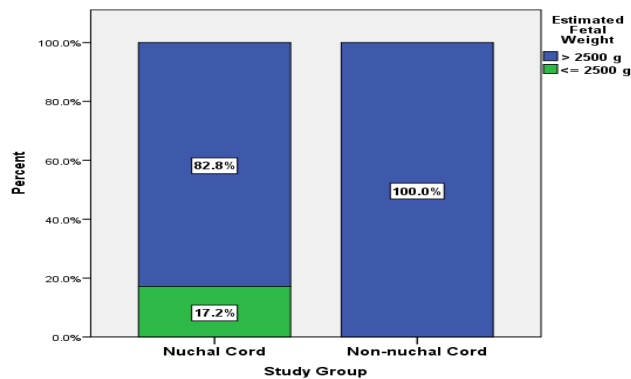
Estimated fetal weight in nuchal cord group varied from 1600 to 4020 g and in non-nuchal group from 2700 to 4000 g. Mean estimated fetal weight was significantly lower in nuchal cord group (3068.9-489.6 g) compared to non-nuchal cord group (3208.5-331.5 g) (P<0.05).
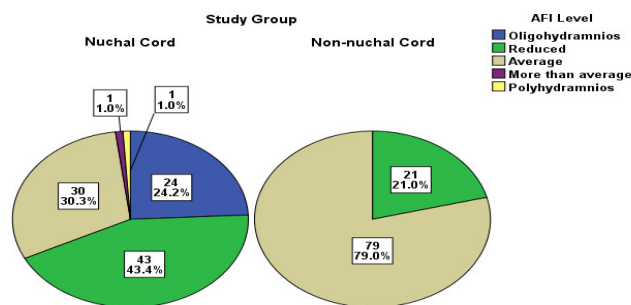
Figure 2: Distribution of sampled women according to ultrasound finding of nuchal cord and to AFI level.

This study found a higher probability to have low birth weight (≤2500 g) in pregnancies with nuchal cord (82.8% in nuchal cord while no such observation in sampled women with no nuchal cord) (P<0.05, Figure 3).

Figure 3: Distribution of sampled women according to ultrasound finding of nuchal cord and to estimated fetal weight.

Regarding decreased levels of AFI (<10 cam) in nuchal group:

Number of cord loops around the neck: out of 67 cases of AFI < 10 cm, 48 cases (71.6%) were having a single loop and 19 (28.4%) cases were having multiple loops around the neck. The association between number of loops and AFI level was not significant (P>0.05).

Tightness of the nuchal cord: out of 67 cases of AFI < 10 cm, the cord found tight in 10 cases (14. 9%).This higher probability to find tight cord in nuchal cord cases of low AFI was found significant in this study (P<0.05, Figure 4).
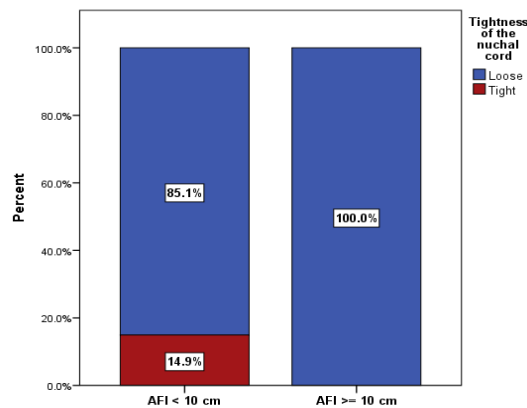
Figure 4: Distribution of women with nuchal cord on ultrasonography according to AFI level and to tightness of the nuchal cord.

Estimated fetal weight: out of 67 cases of low AFI, 52 (77.6%) were having estimated fetal weight > 2500g & 15 (22.4%) of them having estimated weight ≤2500 g.
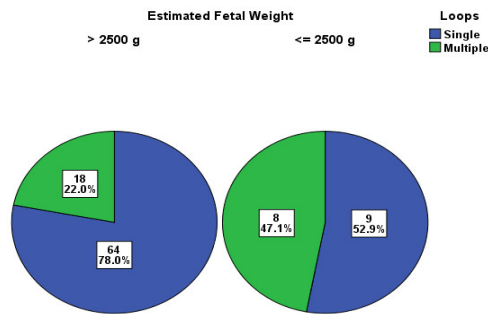
This study found a significant association between low AFI in nuchal cord and low estimated fetal weight (P < 0.05, Figure 5).
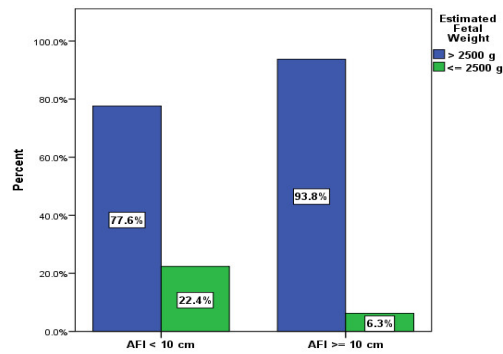
Figure 5: Distribution of women with nuchal cord on ultrasonography according to AFI level and to estimated fetal weight.

Estimated fetal weight: out of 73 cases of a single loop, 64 (87.7%) were having estimated fetal weight > 2500g & 9 (12.3%) of them having estimated weight ≤2500 g, while in 26 cases with multiple loops, 69.2% having estimated fetal weight > 2500g. A significant association between estimated fetal weight and number of nuchal cord loops that the more the estimated fetal weight the less the probability to have multiple loops (P < 0.05, Figure 6).

Figure 6: Distribution of women with nuchal cord on ultrasonography according to number of loops and to estimated fetal weight.

Regarding the tightness of nuchal cord which is diagnosed by seeing divot sign at Doppler ultrasound, this study observed the followings:

- There was no significant association between tightness of the nuchal cord and maternal age. Out of the 89 cases of loose nuchal cord, around 97% of them maternal age lied in the age group 15-35 y and all the 10 cases of tight nuchal cord (100%) were in this age groups (P > 0.05, Table 1).

- A small proportion (10%) of cases with loose nuchal cord and a large proportion (80%) of cases with tight nuchal cord were having estimated birth weight ≤ 2500 g. Low Estimated fetal weight was significantly associated with the tight nuchal cord cases (P < 0.05, Table 1).

- Two thirds (64%) of loose nuchal cord cases are accompanied with AFI < 10 cm and all of tight nuchal cord cases were of AFI < 10 cm. A significant association between tight nuchal cord and AFI < 10 cm (P < 0.05, Table 1).

Table 1: Distribution of sampled women with nuchal cord on ultrasound examination according to tightness of the nuchal cord around the Fetal neck and other variables

Variables	Loose Cord		Tight Cord		P value
	N=89	100.0%	N=10	100.0%	
maternal Age Group					0.555
5-35 y	86	96.6%	10	100.0%	
> 35 y	3	3.4%	0	0.0%	
parity					0.242
Primipara	24	27.0%	1	10.0%	
Multipara	65	73.0%	9	90.0%	
loops					<0.001
Single	71	79.8%	2	20.0%	
Multiple	18	20.2%	8	80.0%	
Estimated Fetal Weight					<0.001
> 2500 g	80	89.9%	2	20.0%	
≤ 2500 g	9	10.1%	8	80.0%	
AFI < 10 cm					0.021
Yes	57	64.0%	10	100.0%	
No	32	36.0%	0	0.0%	

DISCUSSION:

The availability of ultrasound has made the prenatal diagnosis of Nuchal cord (NC) displacement possible. Doppler imaging improved detection of the umbilical cord and its role has been validated and increased the accuracy of diagnosis. Nuchal cord (NC) is quite frequent finding at prenatal period of great clinical significance for obstetricians in addition to pregnant women and their families [11,12].

However, the results of previous studies regarding the association between the NC and amniotic fluid index and estimated fetal weight were conflicting and the impact of NC on the maternal and fetal outcome still under debate [13].

Loose NC was found to be the dominant type, seen in (90.7%) of nuchal cord study group, this goes with previous studies and literatures mentioned that majority of the NCs were loose; Rauf and Akhtar who reported that (89.3%) of the cases had loose NCs [14], while Gupta et al reported that loose NC found in 86.7% of the cases [7].

Regarding number of loops of the NC, the current study found that (71.6%) of the cases had single loop NC while multiple loop in the remaining (28.4%) of the cases, this finding in line with that found by Önderoğlu et al who mentioned that multiple loop NCs are less frequently seen in only (10.6%) of all neonates analyzed in their study [15].

Nonetheless, previous studies demonstrated that the incidence of multiple loops NC is less frequent than one loop NC with an incidence rate of (2%- 8.3%) [11,16].

Presence of NC had decreased mean AFI (8.1±4.9 cm) which was significantly lower than mean AFI in non-nuchal group (11.0 ± 2.0 cm).

In this study found that nuchal cord group women (24.2%) were having oligohydramnios, (43.4%) were having reduced AFI, (30.3%) were having average level of AFI, only one woman were having AFI more than average and only one women were having polyhydramios.

On the other hand, non-nuchal cord group women: none of them were having oligohydramnios, (21%) were having reduced AFI, (79%) were having average of AFI, and none of them were having increased AFI.

Around two thirds (67.7%) of nuchal cord group women having AFI less than 10 cm compared to (21%) in non-nuchal group.

This result may contribute to increased intrapartum complication like FHR irregularities and, oligohydramnios were increased in nuchal cord group, however, results of some previous studies found a significant association while other studies did not, Kashyap and Meena found in their study that nuchal cord is a potent factor for abnormal parameters [17].

Gupta et al. reported that the presence of tight cord around the neck may result in oligohydramnios and increased incidence of fetal distress and low estimated fetal weight [7].

The differences between studies might be attributed to the differences in study designs, management procedures or sample size.

Zahoor et al documented that the presence of a nuchal cord is a major cause of fetal distress, and oligohydramnios low AFI, fetal bradycardia or tachycardia [13], also Karunanidhi et al stated that nuchal cord loops are associated with increased fetal heart irregularities [18].

Furthermore, Sheiner et al reported the significantly higher rates of non-reassuring fetal heart rate in the nuchal cord group than in the control group ($P < 0.001$) [19].

On the other hand, Mastrobattista et al stated that nuchal cord loops are not associated with increased fetal heart rate irregularities [20].

In the present study low AFI, oligohydramnios was found to be more frequent in NC group compared to controls.

These findings go with Shrestha et al who found that higher incidence of oligohyramnios in study group in comparison to control group (p = 0.05) but statistically not significant [11].

Estimated fetal weight in nuchal cord group varied from 1600 to 4020 g and in non –nuchal group from 2700 to 4000 g. mean estimated fetal weight was significantly lower in nuchal cord group (3068.9-489.6 g) compared to non-nuchal cord group (3208.5 -331.5 g)

Regarding the fetal weight, it is observed that the mean fetal weight of babies in nuchal cord group was significantly lower than that of controls;

It is often assumed that nuchal cord causes cord compression and this may lead to low birth weight and intrapartum complications [11].

Similar findings were also reported in previous studies where an association between NC and fetal weight decrease has been described [11,16], these studies referred that the markedly decreased fetal weights may be indicative of a prolonged nuchal cord persistence, leading to chronic mild fetal hypoxia.

CONCLUSION:

Cord around the fetal neck is found to be associated with higher incidence of low fetal weight, low AFI and oligohydramnios which increased risk of adverse perinatal outcome such as fetal distress.

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