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OUTCOMES OF LABOUR OF NUCHAL CORD

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ABSTRACT

Background: The nuchal cord is described as the umbilical cord around the fetal neck. It is classified as simple or multiple, loose or tight with the compression of the fetal neck. The term nuchal cord represents an umbilical cord that passes 360 degrees around the fetal neck. **Objective:** To find out perinatal outcomes in cases of labour of babies with nuchal cord and compared with other cases without nuchal cord. **Patient and Methods:** The prospective case-control study was conducted in maternity teaching hospital centre in Sulaimani / Kurdistan Region of Iraq, from June 2018 to April 2019. Cases of study divided into two groups. First group comprised of women in whom nuchal cord was present at the time of delivery they were labelled as cases. Second group was a control group composed of women in whom nuchal cord was absent at the time of delivery. **Results:** This study included (200) patients, (100) women with nuchal cord in labour. (59%) of the cases of nuchal cord in age group (20-29) years, (40%) of them were primigravida, delivery modes for women with nuchal cord were mainly normal vaginal delivery (76%) and cesarean section (24%). Causes of caesarean section were meconium stain liquor (33.3%), fetal distress (29.2%). (50%) of nuchal cord more than (60) centimetre in length, (74%) of neonate with low apgar score at first minute but (3%) of neonate have low apgar score after five minutes, (19%) of neonate were admitted to neonatal intensive care unit and fetal stillbirth was observed for only one neonate with nuchal cord, but no observed any early neonatal death. The results were compared with a normal umbilical cord cases during labour. **Conclusion:** Nuchal cord occurs mainly in primigravida between (20-29) years age group. A length of cord is highly significant relation with nuchal cord. Nuchal cord lead to increase meconium stain liquor and associated with increase probability of operative delivery and associated with low apgar score of neonate at first minute and increased admition to neonatal intensive care unit. This suggests increase neonatal morbidity but not associated with neonatal mortality.

KEYWORDS: Umbilical cord, Nuchal cord loop, Perinatal outcome.

INTRODUCTION

The umbilical cord (UC) has a very important role in connecting the developing fetus to the placenta.[1,2] The UC carries nutrition and oxygen from the placenta to the fetus.[3] In 1962, Selwyn Crawford defined nuchal cord (NC) as 360 degrees around fetal neck.[4,5] The loops of the cord may be single or multiple, tight or loose.[6] The NC is subdivided in to "Type A" NC that is coiled around the neck by 360 degrees and "Type B" pattern is a true knot which cannot be undone.[7]

Umbilical cord knots in general can be classified as true or loose. True knot of the UC in contrast to other conditions like nuchal coils and cords around the body, may have significant clinical sequel, true UC knot occurs in about 0.3 – 2.1% of pregnancies and tightening of UC knot is a very rare and highly unprecedented complication of pregnancy that can lead to fetal demise or neonatal death. It has been associated with 6% perinatal mortality.[8]

Nuchal cords have prevalence rates of 6% to 37% and thus very common. Approximately half of the NCs resolve before delivery.[7,9] Intra-partum finding of UC around the baby's neck is a common finding, seen in about a third of normal deliveries. This NC has often been the scapegoat for complicated deliveries with adverse outcome like asphyxia or stillbirth.[10] A huge number of women uncomfortable about the UC around the neck of the baby and almost 80% of pregnant women think that NC can cause intrauterine death.[11] Despite the good prognosis in most of the cases, NC is associated with variable fetal heart rate deceleration, decreased fetal movements, fetal distress, and intrauterine fetal demise in few cases.[12,13,14] most of the studies reported birth asphyxia and perinatal death related to NC.[15,16]

Incidence

Reports that the overall incidence of NCs was 6% at 20 weeks gestational age and 29% at 42 weeks of gestation. Presence of two or more loops of NCs is estimated to affect between 2.4% to 8.3% of all pregnancies.[5,17]

Development and Architecture of the Umbilical Cord

In its embryonic stage the UC develops in the region of the body stalk to become the embryo's connection to the fetal portion of the placenta (fetal placenta). The amniotic cavity expands from dorsal to ventral while the chorionic cavity shrinks in volume. During cephalo-caudal and lateral folding the early UC arises as it is "enveloped" by the expanding amnion.[18, 19] In this early stage at around 7–8 weeks postmenstrual age the UC contains the body stalk with umbilical vessels as well as other structures that will later regress and disappear entirely: the allantoic diverticulum (an out pouching from the endoderm connected to the (future) urinary bladder, later the urachus), as well as the extra-embryonic coelom that at this early stage still forms a connection to the chorionic cavity and contains the omphaloenteric duct (connected to the yolk sac), there are initially four umbilical vessels: two arteries (UA) and two veins (UV) typically the right UV subsequently atrophies, thus forming the usual three-vessel UC with one vein carrying oxygenated blood to the fetus and two arteries carrying fetal blood in the opposite direction to the placenta (the vessels are designated as arteries or veins according to their relationship to the fetal heart, not the oxygen content of the blood they carry).[18]

Despite being extremely flexible the UC possesses a mechanical stability that protects its vessels from compression, kinking and rupture. Important contributors to this stability are the cord's outer layer formed by the amnion (amniotic epithelium) and so called Wharton's jelly, the connective tissue of the UC with extracellular matrix. The amnion protects the umbilical vessels from tensile forces. Protection from compression is, however, even more important. The extracellular matrix of Wharton's jelly (e.g. proteoglycans, hyaluronic acid) is hydrophilic and has a highly viscous, jelly-like consistency. In addition collagen fibers are arranged concentrically around the cord vessels. Local pressure is thus cushioned, and the danger of umbilical vessel occlusion, for example caused by normal fetal movement, is significantly reduced.[5,19]

The umbilical coiling index, described by Strong et al. in 1994, denotes the number of complete turns (coils) the UAs make per centimeter of UC length. Normal values are between 0.3–0.5 coils/cm, though values decline with increasing gestational age. Adverse outcomes have been described for both "hyper coiling" (Intra Uterine Growth Restriction (IUGR), pathological fetal heart rate during contractions, low birth weight, thrombosis and stenosis of vessels) and "hypocoiling" (oligohydramnios, pathological fetal heart rate during delivery, low birth weight, operative vaginal delivery and intrauterine death).[5,18]

Umbilical cord length

UC length varies, with a range of 35–70 centimeter diameter of 1–2 cm and 11 helices at birth being regarded as normal. Both shorter and longer cords are associated with increased rates of intrapartum complications. A short UC is thus associated with reduced fetal movement and all its respective causes (e.g. malformation, myopathies, neuropathies, oligohydramnios), longer than average UC are associated with increased risk of UC loops, knots and cord prolapse, these complications are of greater clinical importance in the third trimester.[20,21,22]

Fetal circulation

The fetal venous system develops from three embryological paired veins; the vitelline veins from the yolk sac, the umbilical veins from the chorion and the cardinal veins from the embryo. Venous system development results in the obliteration of the right umbilical vein and the development of the ductus venosus between the left umbilical vein and the inferior vena cava (IVC). The blood from the ductus venosus enters the IVC along with blood returning from the hepatic veins, lower extremities and abdominal wall, and flows into the right atrium.[23,24,25]

Pathophysiology

NC can be single or multiple loops, and loose or tightly wrapped around the neck. Giacomello, et al. recognized two types of nuchals: Type A- a freely sliding pattern which can undo itself and Type B - nuchal loop that encircles the neck in a locked pattern and cannot undo itself. Very rarely a locked loop can be unlocked spontaneously by fetus that seems to be one of the mechanisms of true knot formation. Knots can be single or multiple. If there is a NC at the onset of labor, it is very unlikely to correct itself.[26]

If there is no NC during prelabor, it is unlikely to occur during labor. NC, especially when tightly wrapped, seem to have some similar physical features as those seen in strangulations, they include duskiness of face, facial petechiae, and conjunctival hemorrhage. A review article by Stapczynski et al. on strangulations, describes presence of facial petechiae as a hallmark of jugular vein occlusion (lateral neck compression).When the jugular vein is occluded for ~15–30 seconds, facial petechiae seem to appear. Vagal collapse results from pressure to the carotid sinuses and increased parasympathetic tone. Other described findings of strangulation include retinal hemorrhages, hemotympanum and hyoid bone fractures (considered as pathognomonic of strangulation).[5,26]

The term compression asphyxia is used in adult Forensic Medicine, when strangulated victim torso is compressed by the perpetrator, suffers mechanically limiting expansion of the lungs interfering with breathing. As in

normal delivery of newborns, NC babies' chest is subjected to undue pressure during passage of vaginal canal and may suffer similar thoracic compression mechanically limiting expansion of the lungs. Long term effects of strangulations in adults include stroke and visual deficits. NC may be considered worse than strangulation, since in NC, UC itself acts as a noose while carrying blood supply and the oxygen and umbilical vein being more vulnerable to collapse. Many of infants with NC pass meconium, which is probably an indication of vagal collapse. Based on pathophysiological findings mentioned above, author recommends developing grading system of tight NC as Grade 1: Conjunctival hemorrhage and petechiae. Grade 2: Duskiness of face, facial suffusion and pallor. Grade 3: Respiratory distress, stupor and hypotonia requiring resuscitation.[24,26]

Pathology

Pathology specimens speak volumes about the rare lethal effects of tight NC leading to stillbirth, 20% of stillbirths at autopsy are due to fatal compromise of umbilical circulation. By correlating clinical and autopsy information with placental gross and histologic findings from a series of index cases with a strong presumptive evidence of cord accident, minimal histologic criteria for cord accident were established. "Minimal histologic criteria" suggestive of cord accident were defined as vascular ectasia and thrombosis within the UC, chorionic plate, and/or stem villi.[27]

Clinical features

Infants with a tight NC may develop signs and symptoms such as hypovolemia, hypotension, decreased perfusion and mild respiratory distress, other findings occasionally noted may include facial duskiness, facial petechiae, subconjuntival hemorrhage, facial suffusion, or skin abrasion around the neck, due to tight NCs. Rarely, infants become neurologically depressed or hypotonic with depressed neonatal reflexes. Based on cardio-respiratory and neurological signs and symptoms associated with a tight NC, one can group the common findings together into a possible syndrome called tight Cord around the Neck syndrome, or tCAN syndrome. [5, 27] These propose the term as "a cluster of cardio-respiratory and neurological signs and symptoms associated with unique physical features that occur secondary to tight cord round the neck.[17,28] Rarely, there can be significant blood loss, acidosis, and anemia.[29,30]

Diagnosis

NC can be diagnosed antenatally by ultrasonography, it is gold standard when combined with colour Doppler imaging.[31,32] UC evaluation with sonography includes the appearance, composition, location and size of the cord, a normal cord has a single vein and 2 arteries that have a twisted, rope-like appearance. Absence of twisting often is associated with a decrease in fetal movement and a poor pregnancy prognosis.[33,34,35] In recent years, the three-dimensional ultrasound has become an important diagnosis of placenta and UC pathologies.[36]

Fetal hypoxia

NCs can cause cord compression, leading to obstruction of blood flow in the thin walled umbilical vein, while blood continues to be pumped out through the thicker walled umbilical arteries causing hypovolemia, hypotension and fetal hypoxia. Investigated the value of middle cerebral artery (MCA) and umbilical artery (UA) resistance index in predicting fetal hypoxia in fetuses with UC around the neck in late pregnancy.[30]

Prolonged partial asphyxia evidence

Severe prolonged partial asphyxia could be one of the rare complications of tight NCs. Causes of prolonged partial asphyxia (PPA) include NC, placental failure and tetanic uterine contractions. In prolonged partial asphyxia there is gradual reduction in blood flow and oxygen over several hours to the brain, probably due to occlusion of intramyometrial segment of uterine and or umbilical artery, while cardiac pumping is generally preserved. Brain injury in PPA primarily affects the cerebral cortex and is associated with severe brain swelling in the watershed areas (especially in the parasagittal region). The vascular watershed zones (anterior–middle cerebral artery and posterior–middle cerebral artery) are involved, thereby affecting white matter. PPA could be one of the rare complications of tight NCs.[5]

Obstetrical management

The obstetrical challenge of the clinical management of NCs depends upon number of involved nuchal loops, the amniotic fluid index, the gestational age, and the fetal growth, among other factors. Induction of labor considered as independent risk factor for NCs. A prolonged persistent NC with poor fetal growth deserves close monitoring and delivery as appropriate, some obstetrician option to deliver early when multiple NC loops are noted on fetal scans. Presence of variable decelerations during fetal heart rate monitoring is indicative of possible presence of NC.[5,37]

AIM OF STUDY

To determined labour of pregnant lady with nuchal cord and compare with other pregnant lady without nuchal cords and to find out perinatal outcomes (still births and early neonatal death) of neonates with nuchal cords and compare with other neonates without nuchal cords.

PATIENT AND METHOD

This is a prospective comparative study of (200) pregnant lady which was conducted in the maternity teaching hospital center in Sulaimani / Kurdistan Region of Iraq from June 2018 to April 2019, all patients having term pregnancy admitted to the labour room with

complain of labour pain with following inclusion and exclusion criteria were included in the study.

Inclusion criteria

- Primigravida, multigravida.
- Singleton term gestation with cephalic presentation.
- No hypertension.
- No diabetes mellitus.
- No intrauterine growth restriction.
- No congenital anomalies.

Exclusion criteria

- Twin or higher multiple pregnancies.
- Previous classical caesarian section.
- Pregnancy less than 37 weeks.
- Fetal malpresentation.

All the pregnant women were undergone a normal vaginal delivery. At the time of delivery all neonate born with nuchal cord loop were taken as a study group (n=100). Similarly parity and gestational age matched neonate who fulfilled inclusion criteria but without nuchal cord loop were included in control group (n=100).

Parameters assessed following spontaneously onset of labour, mode of delivery, Normal fetal monitoring was done during labour and delivery in all women and all the babies were given routine nursery care, number of nuchal cord loop, Apgar score was assigned to each baby at 1 minute and 5 minutes of birth, admission to neonatal intensive care unit (NICU). Charts of women in the study were reviewed to obtain demographic data and insure that they met entry criteria. Statistical analyses done by collecting data were tabulated with percentages. The difference between the groups was analyzed using Chi-square test, Fisher-exact test to detect P value for various variables was done. Statistical significance was determined at the 5% level of significant ($P < 0.05$).

RESULTS

This study included 100 women with NC at labour (cases) and 100 women with normal cord at labour (controls). The mean age of women with NC was 27.1±6.5 years; 9% of them were less than 20 years age, 59% of them were in age group 20-29 years, 27% of them were in age group 30-39 years and 5% of them were 40 years age and more. Mean gravidity of women with NC was 2.6±1.6; 55% of them had 1-2 gravida, 38% of them had gravida of 3-5 and 7% of them had gravida of more than 5. Mean Parity of women with NC was 1.3±1.4; 40% of them were nulliparous, 39% of them had 1-2 children and 21% of them had 3-6 children. Mean gestational age of women with NC was 38.9±1.1 weeks; 95% of them were term and 5% of them were postdated.

The delivery modes for women with NC were mainly normal vaginal delivery (76%) and cesarean section (24%). Causes of cesarean section were meconium stain liquor (33.3%), fetal distress (29.2%), failure to progress (25%), failure to induction (8.3%) and bradycardia and failure to progress (4.2%).

Mean cord length was 52.3±7.3 cm; 4% less than 50 cm, 46% 50-60 cm and 50% more than 60 cm. Number of loops were distributed to one loop (54%), two loops (36%), three loops (8%) and four loops (2%). Cord looseness was observed in 49% of women with NC, while cord tightness was observed in 50% of women with NC and cord knot was shown in one woman with NC. (***Figure 1***)

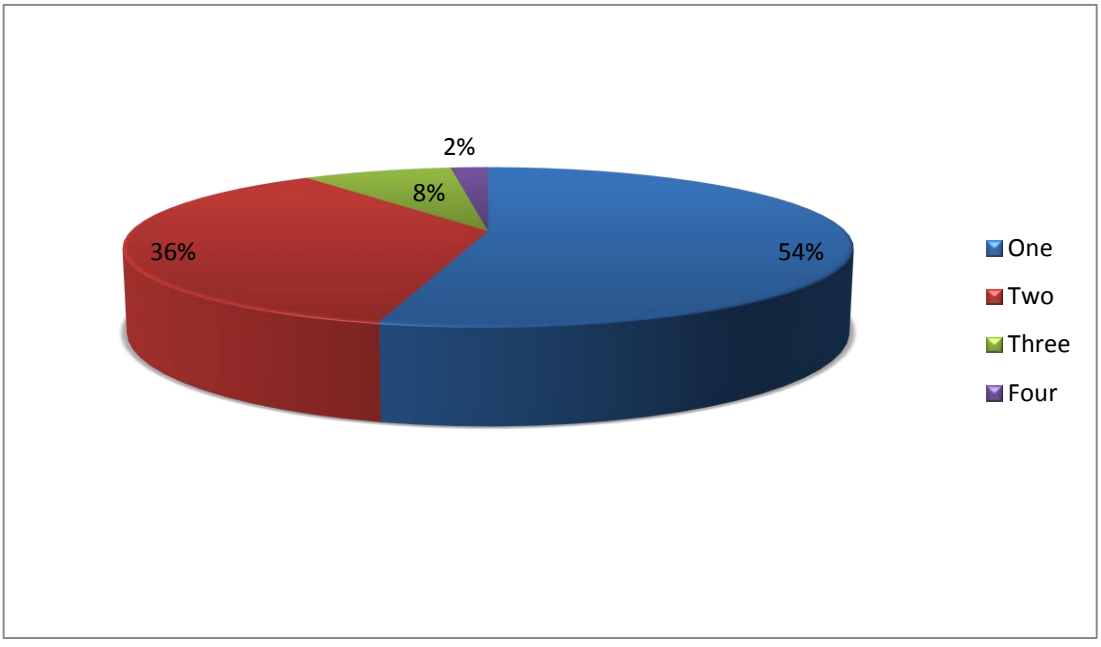

Figure 1: Cord loops number.

Male neonates of women with NC were more than females (51% vs. 49%). Mean apgar score of neonates at 1 minute was 7.1±1.8; 26% of neonates for women with NC had low apgar score at 1 minute. Mean apgar score of neonates at 5 minutes was 9.2±1.4; 3% of neonates for women with NC had low apgar score at 5 minutes. Mean birth weight of neonates was 3.4±0.4 Kg; 95% of them had normal birth weight and 5% of them had increased birth weight. No observed congenital anomalies or early neonatal death for women with NC. Neonatal intensive care unit (NICU) admition was detected for 19% of neonates and fetal stillbirth was observed for only one neonate of women with NC.

A significant association was observed between younger age of women and NC (p=0.009). No significant differences were observed between women with NC and controls regarding gravidity (p=0.8), and gestational age (p=0.9). There was a significant association between nulliparity and NC (p<0.001). (***Table 1***)

A women with NC were significantly delivered by cesarean section (p=0.002). No significant differences were observed between women with NC and controls regarding causes of cesarean section (p=0.5). There was a highly significant association between increase cord length and NC (p<0.001). (***Table 2***)

No significant differences were observed between women with NC and controls regarding fetal gender (p=0.8), apgar score at 5th minutes (p=0.08) birth weight (p=0.3) and fetal stillbirth (p=0.3). A highly significant association was observed between neonates with low apgar score at 1st minute and women with NC (p<0.001). There was a significant association between increased NICU admission and women with NC (p=0.005). (***Table 3 and Figure 2***)

Table 1: Distribution of woman's general characteristics according to study groups.

Variable	Nuchal cord		Controls		P-value
	No.	%	No.	%	
Age mean±SD (27.1±6.5 years)					0.009* S
<20 years	9	9.0	1	1.0	
20-29 years	59	59.0	49	49.0	
30-39 years	27	27.0	40	40.0	
≥40 years	5	5.0	10	10.0	
Gravidity mean±SD (2.6±1.6)					0.8** NS
1-2	55	55.0	51	51.0	
3-5	38	38.0	42	42.0	
>5	7	7.0	7	7.0	
Parity mean±SD (1.3±1.4)					0.03** S
Nulliparous	40	40.0	24	24.0	
1-2	39	39.0	55	55.0	
3-6	21	21.0	21	21.0	
Gestational age mean±SD (38.9±1.1 weeks)					0.9* NS
Term	96	96.0	97	97.0	
Postdate	4	4.0	3	3.0	

** Fishers exact test, **Chi-square test, **NS**=Not significant, **S**=Significant.*

Table 2: Distribution of delivery characteristics according to study groups.

Variable	Nuchal cord		Controls		P-value
	No.	%	No.	%	
Mode of delivery					0.002** S
Normal vaginal delivery	76	76.0	92	92.0	
Cesarean section	24	24.0	8	8.0	
Causes of Cesarean section					0.5* NS
Meconium stain liquor	8	33.3	3	42.9	
Fetal bradycardia	7	29.2	0	0.0	
Failure to progress	6	25.0	3	42.9	
Failure of induction	2	8.3	1	14.2	
Bradycardia and Failure to progress	1	4.2	0	0.0	
Cord length mean±SD (52.3±7.3 cm)					<0.001** S
<50 cm	4	4.0	37	37.0	
50-60 cm	46	46.0	54	54.0	
>60 cm	50	50.0	9	9.0	

** Fishers exact test, **Chi-square test, **NS**=Not significant, **S**=Significant.*

Table 3: Distribution of woman's neonatal outcomes according to study groups.

Variable	Nuchal cord		Controls		P-value
	No.	%	No.	%	
Fetal gender					
Male	51	51.0	50	50.0	0.8*NS
Female	49	49.0	50	50.0	
Apgar score at 1 minute mean±SD (7.1±1.8)					
Normal	74	74.0	99	99.0	<0.001*S
Low	26	26.0	1	1.0	
Apgar score at 5 minutes mean±SD (9.2±1.4)					
Normal	97	97.0	100	100.0	0.08*NS
Low	3	3.0	0	0.0	
Birth weight mean±SD (3.4±0.4 Kg)					
Normal	95	95.0	92	92.0	0.3*NS
Increased	5	5.0	8	8.0	
NICU admission					
Yes	19	19.0	6	6.0	0.005*S
No	81	81.0	94	94.0	
Fetal stillbirth					
Yes	1	1.0	0	0.0	0.3**NS
No	99	99.0	100	100.0	

Chi-square test, **Fishers exact test,* ***NS**=Not significant,* ***S****=Significant.*

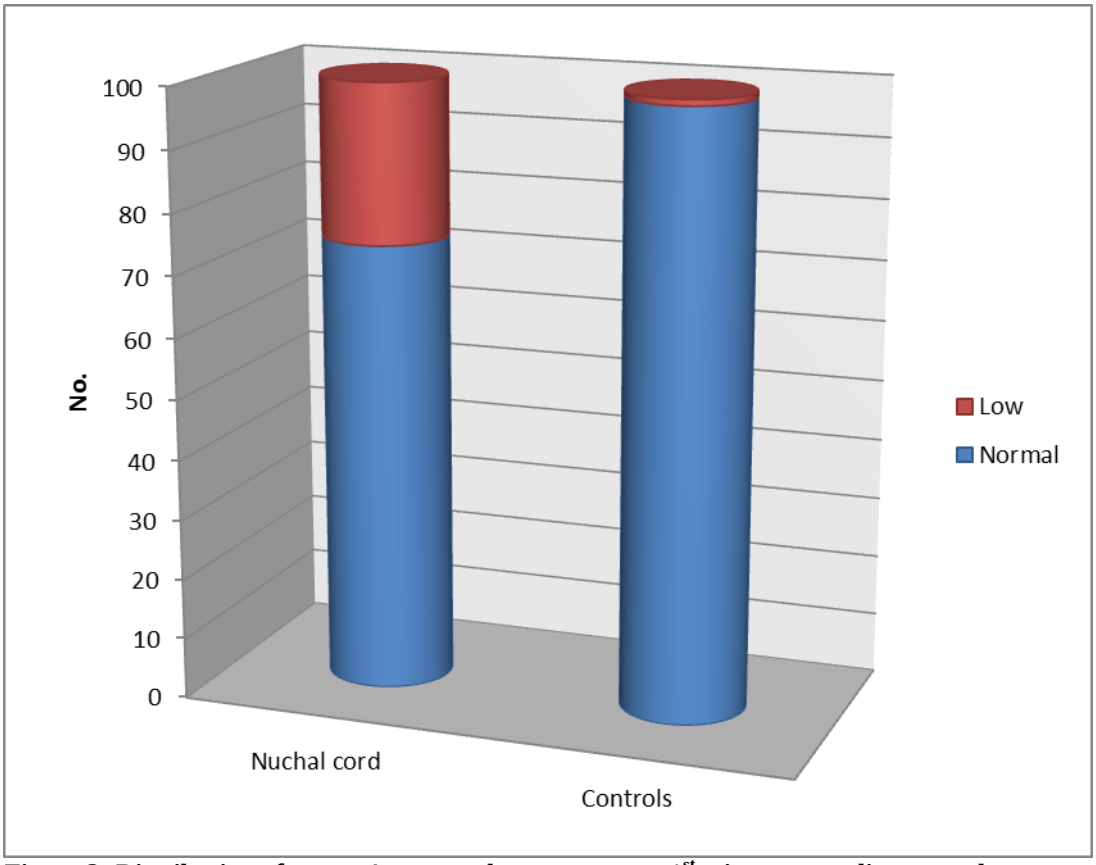

Figure 2: Distribution of women's neonatal apgar score at 1st minute according to study groups.

DISCUSSION

In 1962 Crawford first defined NC as the condition in which the UC was round at least once around the neck of the fetus. NCs that form early can resolve at any time or persist until term and coils may form shortly before delivery.[6] In this study the age of the patients ranged between 20-29 years, and significant association were observed between younger age of women and NC p-value 0.009, agreed with other studies Begum AA etal, Madiha I etal, Ashutosh B etal.[6, 7, 38] as expected as this age group consists of most fertile women. In our study no significant difference were observed between women

with NC and without NC regarding the gestational age. But show primigravida was significantly associated with NC p-value 0.03, was agreed with studies Sangeetha K etal, Tamrakar SR.[39,40] but disagree with these studies Rehana AH etal, Farnaz Z etal.[4,41] because of a good tone of anterior abdominal muscles. In our study, women with NC were significant delivered caesarian section p-value 0.002, this similar to other studies Sangeetha K etal, Shazia T.[39,42] however not agreed with the studies Farnaz Z etal, Khushboo J etal, Gupta Y etal.[41,43,44] this may be explained by increase fetal heart irregularity and meconium stain liquor in newborn delivered with NC loop, which is considered to be a first sign of fetal distress.

In this study although the incidence of meconium staining of liquor was more in women with NC than without NC, the difference was not significant, similar result have been report with other studies Sangeetha K etal, Farnaz Z etal, Aderu D, Nuriye BD etal.[39,41,45,46] the presence of meconium at birth was more common in newborns with one and multiple NC loops, suggested NC loops associated with increase meconium stained liquor.

Length of UC was one of the most important determinants for the occurrence of NC and number of loops, it was found highly significant association between increase cord length and NC p-value < 0.001 this agreed with other studies Farnaz Z etal, Khushboo J etal, Nilesh UB etal.[41,43,47] also observed that increase in the length of UC was also associated with increased number of loops.

In this study no significant difference were observed between women with nuchal cord and without NC group regarding fetal gender and birth weight, as same as other studies Sherer DM etal, Farnaz Z etal.[34,41] but different to other study Tamrakar SR.[40] this may be some of cases as a loss type of NC not affected the blood circulation and nutrition to newborns. In this study demonstrate a significant relation between neonates of NC with low apgar score after one minute p-value <0.001 but this difference absent at five minutes after birth when the second apgar score was given, this agreement to other studies Ashutosh B etal, Farnaz Z etal, Gupta Y etal, Vikram AP etal.[38,41,44,48] suggesting that any possible effect is only transients and NC not a major cause of fetal hypoxemia or apnea. In our study show no relation between fetal of NC with still birth and early neonatal death as exactly as to the other studies Begum AA etal, Poonam M etal.[6] In our study one case of still birth delivered with four tight loops of NC and true single knot.

In this study we found a relation between neonates with cord around neck and needs admission to NICU similar to other studies Tamrakar SR, Farnaz Z etal, Vikram AP etal, Abida N etal.[40,41,48] which shows higher neonatal morbidity in our cases, may be due to very late presentation of cases to specialized center or tertiary care hospitals.

CONCLUSIONS

- NC occurs commonly in primigravida with (20-29 years) age group.
- A length of cord is highly significant relation with NC.
- NC increase meconium stain liquor and associated with increase probability of operative delivery.
- NC associated with low apgar score of neonate at one minute but not in five minutes.
- NC associated with increased admition to NICU this suggested increase neonatal morbidity but not associated with neonatal mortality.

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