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Dr. Jyotsana Gupta
Assistant Professor, Department of Obstetrics and Gynecology, Saraswati Medical College, Unnao, Uttar Pradesh, India

Rupali Sharma
Professor, Department of Obstetrics and Gynecology, G S Medical College & Hospital, Pilkhuwa, Hapur, Uttar Pradesh, India

Aakansha Gupta
Assistant Professor, Department of Radiology, Career institute of medical sciences & Hospital, Ghailla, Lucknow, Uttar Pradesh, India

Corresponding Author:
Dr. Jyotsana Gupta
Assistant Professor, Department of Obstetrics and Gynecology, Saraswati Medical College, Unnao, Uttar Pradesh, India

To study the effect of nuchal cord on perinatal outcome and mode of delivery in uncomplicated pregnancies

Dr. Jyotsana Gupta, Rupali Sharma and Aakansha Gupta

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Abstract
The nuchal cord is blamed as a major cause of fetal distress and perinatal mortality. A prospective & cross-sectional study was conducted in Department of Obstetrics and Gyaenecology in G S Medical college & Hospital, Pilkhuwa, Hapur, U. P. from January 2018 to June 2019 on women attending antenatal clinic. These cases were followed till one week after delivary. Women with Multiple pregnancies, Obstetric complication indicative of elective LSCS, with chronic medical illness, Previous LSCS, chromosomal/structural anomalies of fetuses, with suspected brim cephalopelvic disproportion, were excluded from study. Fetuses were examined for nuchal cord by 2-D ultrasonography and color Doppler at 36 weeks till term. Cases and controls were compared with respect to maternal and fetal outcome, various variables were compared by applying chi-square test as a test of significance. My study suggests that nuchal cord is not associated with adverse perinatal outcome except for variable fetal heart pattern.

Keywords: Nuchal cord, Fetal distress, 2 D ultrasonography, color doppler, Fetal outcome

Introduction
Nuchal cord is defined as umbilical cord being wrapped 360º around fetal neck. [1] It is one of the most common complications of umbilical cord [13]. 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.

Antenatal nuchal cords usually occur randomly with increased frequency in late gestation and appear to be a normal part of intra uterine life [21]

Nuchal cord at delivery had been classified into two types by Collins *et al.* (1997) [14] Type A and Type B. Type A cord encircles the neck in a locked pattern. Type B nuchal cord patterns forms knots if it passes down and over the fetal body. It is uncommon but is directly related with fetal morbidity and mortality.

The role of sonography in the prenatal diagnosis of a nuchal cord has been validated in many previous publications.

Peregrine E *et al.* (2005) [27] found sensitivity of ultrasound in diagnosing a nuchal cord to be 37.5%, with specificity, positive and negative predictive values of 80%, 29% and 85%, respectively. The use of color Doppler flow has increased the accuracy of this prenatal diagnosis.

Nowadays, sonologists, obstericians, and more importantly, parents face this diagnosis more frequently since sonographic examination has become routine practice during prenatal care.

Aims & objectives:
1. To study the incidence of nuchal cord in term uncomplicated pregnancies.
2. To evaluate the effect of nuchal cord on perinatal outcome.
3. To evaluate the effect of nuchal cord on mode of delivery.
4. To study the efficacy of ultrasonography in detecting nuchal cord.

Materials & Methods
A prospective and cross sectional study was conducted in Department of Obstetrics and Gyaenecology in G S Medical college & Hospital, Pilkhuwa, Hapur, U. P. from January 2018 to June 2019. Women with Multiple pregnancies, Obstetric complication indicative of elective LSCS, with chronic medical illness, Previous LSCS, Women having chromosomal/structural

anomalies of fetuses, Women with suspected brim cephalopelvic disproportion, were excluded from study.

Total 900 pregnant women were followed for nuchal cord. Nuchal cord at birth was seen in 289 deliveries. A total of 400 women, 196 in study group with nuchal cord and 204 in control group without nuchal cord with normal singleton pregnancy with cephalic presentation attending antenatal clinic in obstetric department of G S Medical College & Hospital were included in the study. Fetuses were examined for nuchal cord by 2-D ultrasonography and color Doppler at 36 weeks till term. Study group was further sub grouped in to two groups, one group with prenatally ultrasonographically diagnosed nuchal cord and other group with nuchal cord diagnosed at birth without prior detection of nuchal cord to study the efficacy of USG in detecting nuchal cord. Then these cases were followed up till one week after delivery.

At the time of admission cardiotographic recording of fetal heart rate was done of all women. Intrapartum electronic fetal heart rate monitoring was done using cardiotocography machine. Intermittent manual auscultation was also done to monitor fetal heart rate. Fetal heart rate was considered non-reassuring in presence of recurrent early, late or variable deceleration or bradycardia, or tachycardia or unexplained loss of beat to beat variability. All cases were delivered in Department of Obstetrics and Gynecology, G S Medical college & Hospital, Pilkhuwa, Hapur, U. P.

Findings were compared with direct visualization of umbilical cord at time of delivery or cesarean section. Record of presence or absence of nuchal cord, was carefully noted in the proforma. Perinatal outcome and mode of delivery was compared between the study and control groups. Cases and controls were compared with respect to maternal and fetal outcome various variables were compared by applying chi-square test as a test of significance.

Results

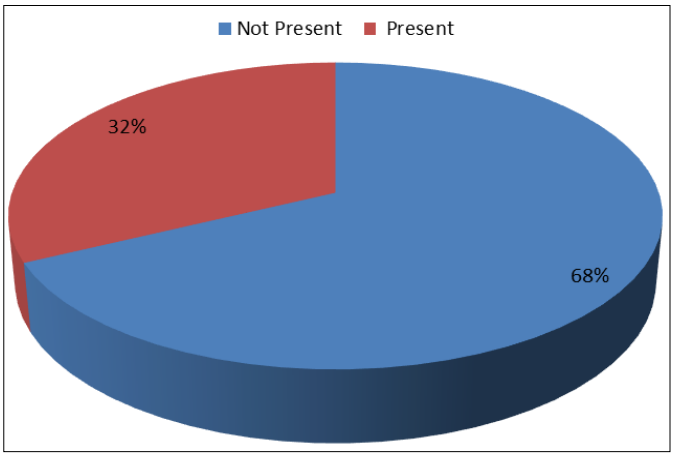

Fig 1: Incidence of nuchal cord

Efficacy of ultrasonography in diagnosing nuchal cord

Out of 120 women with prenatally diagnosed nuchal cord, 117 (97.5%) cases had nuchal cord present at birth, while out of 280 women without prenatally diagnosed nuchal cord on ultrasonography, 79 (28.2%) women had nuchal cord present at birth.

Table 1: NC On USG: NC at Birth Crosstabulation

			NC at Birth		Total
			Not Present	Present	
NC On USG	Not Present	Count	201	79	280
		%	71.8%	28.2%	100.0%
	Present	Count	3	117	120
		%	2.5%	97.5%	100.0%
Total		Count	204	196	400
		%	51.0%	49.0%	100.0%

Sensitivity of ultrasound for detection of nuchal cord:
(True positive /True positive + False negative) x 100 = (117/117+79) x 100=60%
Specificity:
(True negative/True negative + False positive) x 100 = (201/204) x 100 =99%
Positive predictive value:
(True positive/True positive+ False positive) x 100 = (117/117+3) x 100 = 97.5%
Negative predictive value = (True negative/True negative + False negative) x 100 = (201/201+79) x 100 = 71.78%

NC at Birth: Mortality

Table 2 shows the comparison of mortality patterns in the two groups of patients. Nuchal cord was present in 196 women at the time of birth. 1 (0.5%) woman gave birth to an IUD baby. There was no statistically significant difference between the study groups with respect to mortality patterns (P>0.05).

Table 2: NC at Birth: Mortality Cross tabulation

			Mortality		Total	Pearson Chi-Square
			I U D	No		
NC at Birth	Not Present	Count	0	204	204	P=.307
		%	.0%	100.0%	100.0%	
	Present	Count	1	195	196	
		%	.5%	99.5%	100.0%	
Total		Count	1	399	400	
		%	.2%	99.8%	100.0%	

NC at Birth: MSL

Table 3 shows the incidence of meconium staining during labour in the cases & controls. We find that meconium staining during labour was present in 23 (11.7%) cases and 19 (9.3%) controls and was absent in 173 (88.3%) cases and 185 (90.7%) control patients. The statistical analysis of this data shows that there was no statistically significant difference between the two groups (P>0.05).

Table 3: NC at Birth: MSL Cross tabulation

			MSL		Total	Pearson Chi-Square
			No	Yes		
NC at Birth	Not Present	Count	185	19	204	P=.430
		%	90.7%	9.3%	100.0%	
	Present	Count	173	23	196	
		%	88.3%	11.7%	100.0%	
Total		Count	358	42	400	
		%	89.5%	10.5%	100.0%	

N C at Birth: FHS Abn.

Interpretation of the non-stress test (NST) results is shown in table 4. Non stress test was done on patients, who were followed in their antenatal period. Thus it was performed on 196 cases and 204 control patients. We observed reactive NST's in 164 (83.7%) cases and 190 (93.1%) controls. Early deceleration, late deceleration, variable pattern were seen in 2 (1.0%), 5 (2.5%), 7 (3.4%) controls respectively. Similarly Early deceleration, late deceleration, variable pattern were seen in 1 (0.5%), 6 (3.1%), 24 (12.2%) cases respectively. There is significant difference in intrapartum fetal heart deceleration between non nuchal cord versus nuchal cord group ($p< 0.05$).

Table 4: NC at Birth: FHS Abn. Cross tabulation

			Intrapartum FHS Abn					Total	Pearson Chi-Square
			Early decel	Late decel	NA	Reactive	Variable		
NC at Birth	Not Present	Count	2	5	0	190	7	204	P=.014
		%	1.0%	2.5%	.0%	93.1%	3.4%	100.0%	
	Present	Count	1	6	1	164	24	196	
		%	.5%	3.1%	.5%	83.7%	12.2%	100.0%	
Total		Count	3	11	1	354	31	400	
		%	.8%	2.8%	.2%	88.5%	7.8%	100.0%	

NC at Birth: 2nd Stage Labor Duration

Table 5 presents the relationship between presence of nuchal cord and the mean duration of second stage of labour in the patients belonging to study groups. We find that out of 196 cases having nuchal cord, second stage of labour was prolonged in 6 (3.1%) cases. On the other hand in the control group prolonged second stages of labour were encountered in 3 (1.5%) women. The statistical analysis of these data did not show any significant differences between the two groups (p>0.05).

Table 5: NC at Birth: 2nd Stage Labor Duration Cross tabulation

			2nd Stage Labor Duration(min)			Total	Pearson Chi-Square
			NA	Not prol (<30)	Prol (>30)		
NC at Birth	Not Present	Count	16	185	3	204	P=.529
		%	7.8%	90.7%	1.5%	100.0%	
	Present	Count	17	173	6	196	
		%	8.7%	88.3%	3.1%	100.0%	
Total		Count	33	358	9	400	
		%	8.2%	89.5%	2.2%	100.0%	

NC at Birth: Mode of delivery

Table 6 shows the various modes of delivery in the study population. Out of 196 cases, 168 (85.2%) delivered vaginally, 11 (5.6%) cases required operative vaginal (Forceps application) and 17 (8.7%) cases needed caesarean section. Amongst the 204 controls 177 (86.8%) delivered vaginally, 11 (5.4%) required operative vaginal (Forceps application) and 16 (7.8%) cases needed caesarean section. On statistical analysis the rate of caesarean section and operative vaginal delivery was not found to be significantly related to the presence of nuchal cord (p>0.05).

Table 6: NC at Birth: Mode of dilevery Crosstabulation

			Mode of dilevery			Total	Pearson Chi-Square
			VD	LSCS	OFVD		
NC at Birth	Not Present	Count	177	16	11	204	P=.949
		%	86.8%	7.8%	5.4%	100.0%	
	Present	Count	168	17	11	196	
		%	85.7%	8.7%	5.6%	100.0%	
Total		Count	345	33	22	400	
		%	86.2%	8.2%	5.5%	100.0%	

NC at Birth: Apgar Score at 1 Min

Table 7 shows the correlation between presence of nuchal cord and Apgar score of fetus at 1 minute. We find out of 196 cases, 17 (8.7%) new borns had an Apgar score <7 at 1 minute. In the control group only 14 (6.9%) newborns had an Apgar score <7 at 1 minute. The statistical analysis of these data did not show any significant differences between the two groups (p>0.05).

Table 7: NC at Birth: Apgar Score at 1 Min Cross tabulation

			Apgar Score at1 Min		Total	Pearson Chi-Square
			<7	>7		
NC at Birth	Not Present	Count	14	190	204	P=.498
		%	6.9%	93.1%	100.0%	
	Present	Count	17	179	196	
		%	8.7%	91.3%	100.0%	
Total		Count	31	369	400	
		%	7.8%	92.2%	100.0%	

NC at Birth: Apgar score at 5 min

Out of 204 controls none of the newborns had an Apgar score <7 at 5 minutes. Only 2 (1.0%) newborns out of 196 cases had an Apgar score <7 at 5 minutes. Thus an Apgar score <7 at 5 minutes is more in cases. On statistical analysis an Apgar score <7 at 5 minutes was not found to be significantly related to the presence of nuchal cord (p>0.05).

Table 8: NC at Birth: Apgar Score at 5 min Cross tabulation

			Apgar Score at 5 min		Total	Pearson Chi-Square
			<7	>7		
NC at Birth	Not Present	Count	0	204	204	P=.307
		%	.0%	100.0%	100.0%	
	Present	Count	2	194	196	
		%	1.0%	99.0%	100.0%	
Total		Count	2	398	400	
		%	.5%	99.5%	100.0%	

NC at Birth: Bag & Mask Ventilation

Out of 204 controls and 196 cases 10 (4.9%) and 5 (2.6%) newborns required Bag & Mask Ventilation respectively for <30 min, while 5 (2.5%) and 9 (4.6%) newborns required Bag & Mask Ventilation respectively for >30 min. Newborns of 189 (92.6%) women out of 204 controls and 182 (92.9%) out of 196 cases did not required any intervention. Though more number of cases required Bag & Mask Ventilation for >30 min, on statistical analysis Bag & Mask Ventilation was not found to be significantly related to the presence of nuchal cord (p>0.05).

Table 9: NC at Birth: Bag & Mask Ventilation Cross tabulation

			Bag & Mask Ventilation (min)			Total	Pearson Chi-Square
			<30	>30	No		
NC at Birth	Not Present	Count	10	5	189	204	P=.249
		%	4.9%	2.5%	92.6%	100.0%	
	Present	Count	5	9	182	196	
		%	2.6%	4.6%	92.9%	100.0%	
Total		Count	15	14	371	400	
		%	3.8%	3.5%	92.8%	100.0%	

NC at Birth: NICU Adm

From the cases group, 9 (4.6%) newborns required NICU admission whereas from the control groups only 10 (4.9%) required NICU admission. Thus on analysis, the difference was not found to be statistically significant (p>0.05).

Table 10: NC at Birth: NICU Adm Cross tabulation

			NICU Adm		Total	Pearson Chi-Square
			No	Yes		
NC at Birth	Not Present	Count	194	10	204	P=.884
		%	95.1%	4.9%	100.0%	
	Present	Count	187	9	196	
		%	95.4%	4.6%	100.0%	
Total		Count	381	19	400	
		%	95.2%	4.8%	100.0%	

NC at Birth: Ventilator

Out of 196 cases one was IUD and only 1 (0.5%) newborn required ventilator, while none of the control required ventilator. On analysis, the difference was not found to be statistically significant (p>0.05).

Table 11: NC at Birth: Ventilator Cross tabulation

			Ventilator			Total	Pearson Chi-Square
			NA	No	Yes		
NC at Birth	Not Present	Count	0	204	0	204	P=.351
		%	.0%	100.0%	.0%	100.0%	

	Present	Count	1	194	1	196	
		%	.5%	99.0%	.5%	100.0%	
Total		Count	1	398	1	400	
		%	.2%	99.5%	.2%	100.0%	

NC at Birth: Duration of Stay

197 (96.6%) out of 204 controls and 189 (96.4%) out of 196 cases were discharged with their mothers. Their duration of stay was <3 days. Only 7 (3.4%) of controls and 6 (3.1%) of cases required hospitalization for >3 days. On analysis, the difference was not found to be statistically significant (p>0.05).

Table 12: NC at Birth: Duration of Stay Crosstabulation

			Duration of Stay			Total	Pearson Chi-Square
			>3days	<3 days	NA		
NC at Birth	Not Present	Count	7	197	0	204	P=.582
		%	3.4%	96.6%	.0%	100.0%	
	Present	Count	6	189	1	196	
		%	3.1%	96.4%	.5%	100.0%	
Total		Count	13	386	1	400	
		%	3.2%	96.5%	.2%	100.0%	

NC at Birth: Outcome

All the 204 controls had live births; they were discharged in satisfactory condition. One (0.5%) woman from case group had IUD. On analysis, the difference was not found to be statistically significant (p>0.05).

Table 13: NC at Birth: Outcome Cross tabulation

			Outcome		Total	Pearson Chi-Square
			Discharged	NA		
NC at Birth	Not Present	Count	204	0	204	P=.307
		%	100.0%	.0%	100.0%	
	Present	Count	195	1	196	
		%	99.5%	.5%	100.0%	
Total		Count	399	1	400	
		%	99.8%	.2%	100.0%	

Discussion

Perinatal outcome of nuchal cord is a controversial topic. Several studies have reported that nuchal cord is associated with adverse perinatal outcome, increased risk of variable deceleration in both the first and second stage of labor, acidemia, meconium stained liquor, emergency caesarean section, need for neonatal resuscitation, admission to the neonatal intensive care unit, anaemia and perinatal death, Tejani *et al.* (1972) [4], Shepherd *et al.* (1985) [5], Jauniaux *et al.* (1995) [12], Collins *et al.* (1995) [11], Rhoades *et al.* (1999) [16].

On the contrary, Rhoades *et al.* (1999) [16], Clapp III *et al.* (2003) [21], Sheiner E *et al.* (2005) [28], in their studies found nuchal cord to be a normal part of intrapartum life that is seldom associated with any perinatal morbidity.

We found that meconium staining during labour was present in 23 (11.7%) cases and 19 (9.3%) controls. There was no statistically significant difference found between the two groups (P>0.05). A study by Gutierrez *et al.* (2000) [18] and Ouintero *et al.* (2004) [26] favours our findings. In the contrary Singh et at (2008) [38] found nuchal cord to be statistically significantly associated with meconium stained liquor($P< 0.05$) & subgroups having tight cord around the neck had significantly higher proportion of meconium stained liquor.

In our study the presence of nuchal cord was not found to be significantly (p>0.05) associated with any adverse effects on the base line fetal heart rate, beat to beat variability or the presence of late decelerations. This finding is in accordance with the finding of Mastrobattista JM *et al.* (2005) [31], Peregrine E *et al.* (2005) [27] Assimakopoulos *et al.* (2005) [30], Onderoğlu *et al.* (2008) [37] and Kemfang *et al.* (2011) [39]. Shrestha *et al.* (2007) [33], found that intrapartum complications like FHR irregularities were increased in nuchal cord group but statistically not significant.

We found statistically significant ($p< 0.05$) increase in the frequency of variable fetal heart rate deceleration in patients having nuchal cord, 24 (12.2%) in cases Vs 7 (3.4%) in controls. This finding is in accordance with the finding of Hankins G D *et al.* (1987) [6], Miser WF (1992) [7]. Clapp *et al.* (2003) [21] E Shiener *et al.* (2005) [28] and Ogueh *et al.* (2006)[32] also found that occurrence of intrapartum abnormalities were significantly associated with nuchal cord.

Spellacy *et al.* (1966) [3], Clapp *et al.* (1999) [17], Larson *et al.* (1997) [13], Gutierrez G *et al.* (2000) [18] and Deborah *et al.* (2003) [24] Zahoor F *et al.* (2013) [40] found that the risk of antepartum stillbirth was not increased in the presence of a nuchal cord entanglement. In the present study 1(0.8%) out of 120 women with ultrasonologically diagnosed nuchal cord delivered an IUD baby vaginally. Rest 119 (99.2%) women with ultrasonologically diagnosed nuchal cord gave birth to live babies. There was no statistically significant difference between the study groups with respect to mortality patterns (P>0.05).

We find that out of 196 cases having nuchal cord, second stage of labour was prolonged in 6 (3.1%) cases only, which is not statistically significant (P>0.05). Adinma J J B *et al.* (1993) [9], S Nazam *et al.* (2020) [42] also did not find any significant difference in the duration of labor in patients having tight, loose or no nuchal cord. Ogueh *et al.* (2006) [32] found that women with nuchal cord had a longer second stage of labor (p=0.0013)

In our study we did not find any correlation between presence of nuchal cord and the mode of delivery of the fetus (P>0.05). Similar results have been published by Clapp *et al.* (2003) [21], Ouintero *et al.* (2004) [26] and Schaffer *et al.* (2005) [29].

Peregrine E *et al.* (2005) [27], Assimakopoulos *et al.* (2005) [30], Markov *et al.* (2007) [34], Ghosh *et al.* (2008) [36], Kemfang *et al.* (2011) [39], Zahoor F *et al.* (2013) [40] and R Vasa *et al.* (2018) [41] also have not found any significant association between nuchal cord and increased risk of caesarean or vaginal instrumental deliveries (P>0.05).

Louis Dippel (1964) [2], Jauniaux *et al.* (1995) [12] and Rhoades *et al.* (1999) [16] found nuchal cord to be associated with need for neonatal resuscitation. In our study more number of cases as compared to controls required Bag & Mask ventilation for >30 min, but it was not found to be significantly related to the presence of nuchal cord (p>0.05). This is supported by study done by R Vasa *et al.* (2018) [41].

In our study we found, 17 (8.7%) newborns out of 196 cases as compared to14 (6.9%) newborns among 204 controls had an Apgar score <7 at 1 minute (p>0.05). Only 2 (1.0%) newborn out of 196 cases as compared to none newborn among controls had an Apgar score <7 at 5 minutes (P>0.05). Similar results were found by Gutiérrez G *et al.* (2000) [18], Clapp *et al.* (2003) [21], Peregrine E *et al.* (2005) [27], Ghosh *et al.* (2008) [36], Onderoğlu *et al.* (2008) [37], Kemfang *et al.* (2011) [39], Zahoor F *et al.* (2013) [40] and R Vasa *et al.* (2018) [41].

In our study 9 (4.6%) newborns among cases required NICU admission whereas from the control groups only 10 (4.9%) required NICU admission, the difference was not found to be statistically significant (p>0.05). The findings of our study are in concordance with Gutierrez G *et al.* (2000) [18], Clapp *et al.* (2003) [21], Deborah *et al.* (2003) [24], Ouintero *et al.* (2004) [26], Peregrine E *et al.* (2005) [27], Schaffer *et al.* (2005) [29], Shrestha *et al.* (2007) [33], Kemfang *et al.* (2011) [39], Ghosh *et al.* (2008) [36] and R Vasa *et al.* (2018) [41].

The incidence of nuchal cord of 32.1% in our study, this is in concordance with the studies done by Hashimoto *et al.* (2003) [22], Schauffer *et al.* (2005) [29], and Neena Lal *et al.* (2007) [35].

Out of 120 women with prenatally diagnosed nuchal cord, 117 (97.5%) cases had nuchal cord present at birth. While out of 280 women without prenataly diagnosed nuchal cord on ultrasonography, 79 (28.2%) women had nuchal cord present at birth.

Sensitivity of USG for detection of Nuchal Cord: = 60%
Specificity of USG for detection of Nuchal Cord: = 99%
Positive predictive value: = 97.5%
Negative predictive value: = 71.78%

Table 14: Comparison of Ultrasonographic Studies

Author	Ultrasound modality	Sensitivity (%)	Specificity (%)
Jauniaux *et al.* (1992) [8]	Gray scale imaging	33	
	Colour Doppler	79	
Ertan *et al.* (1994) [10]	Colour Doppler	97	93
Morgan *et al.* (1997) [15]	Gray scale imaging	80	96
Gutierrez *et al.* (2000) [18]	Colour Doppler	92	87
Zhao *et al.* (1994) [19]	Colour Doppler, NST, Gray scale imaging		97.8
Hanaoka *et al.* (2002) [20]	2-Dimensional	69	
	Colour Doppler	83	
	3-Dimensional	71	
Aksoy *et al.* (2003) [23]	Colour Doppler	95	92
Peregrine *et al.* (2005) [27]	Colour Doppler	37.5	80
Assimakopoulos *et al.* (2005) [30]	Two dimensional	85	89
Our study	Gray scale imaging, Color dopplar	60	99

Various studies including our study shows that ultrasound with Colour Doppler can improve detection rate of nuchal cord during pregnancy and make it an important decision making tool prior to induction of labor in high risk pregnancies.

Conclusion

My study suggests that if on ultrasonographic examination nuchal cord is detected, parents should be reassured. Non stress test and intrapartum electronic fetal heart rate monitoring is desirable, but intense intrapartum electronic fetal heart rate monitoring in prenatally diagnosed nuchal cord is not mandatory. Nuchal cord is not associated with adverse perinatal outcome except for variable fetal heart pattern so it does not alter standard management. Caserean section in absence of any other obstetric indication is not recommended on the basis of nuchal cord alone. Further larger studies need to be done for more firm conclusion.

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