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Dr. Neha Bhadrashetty
Post Graduate Student, Department of Obstetrics and Gynaecology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India

Dr. E Gomathy
Professor, Department of Obstetrics and Gynaecology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India

Corresponding Author:
Dr. E Gomathy
Professor, Department of Obstetrics and Gynaecology, Sri Devaraj Urs Medical College, Tamaka, Kolar, Karnataka, India

Association of umbilical cord abnormalities and nonreassuring fetal heart rate and its perinatal outcome

Dr. Neha Bhadrashetty and Dr. E Gomathy

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Abstract
Introduction: Constant observation of fetal heart rate during labour has been used over recent 50 years for antenatal assessment of fetus in view of hypoxemia and acidemia [1] Abnormality found in fetal heart rate during labour is one of the major indications for immediate delivery or emergent caesarean section worldwide. Such umbilical cord abnormalities include cord entanglements, hypercoiling, true knots, strictures and short cords. Umbilical cord which acts as a lifeline between mother and fetus is an easily accessible and assessable structure and there is some evidence that adverse antenatal and perinatal events could be predicted by examination of umbilical cord abnormalities intraoperatively or postnatally and thus the perinatal outcome can be detected.

Objectives of the study

- To study the correlation between umbilical cord abnormalities and none reassuring fetal heart rate.
- Neonatal outcome in patients with umbilical cord abnormalities.

Methodology: All those women whose Cardiotocography showing non reassuring fetal heart rate according to NICE guidelines, with no maternal or fetal clinical risk factor will be considered for the study. Patients will be followed up till the surgery and intraoperative findings will be noted or will be followed up till vaginal delivery. APGAR scores at 1 minute and 5 minutes seen and cord blood pH (7.36-7.45 as normal) is taken into account to study perinatal outcome. The purpose of the study will be detecting the prevalence and types of umbilical cord variabilities and their correlation with non reassuring heart rate of the fetus and its perinatal outcome. Short cord of less than 30 cms and long cord of more than 70 cms is considered for the study. In our tertiary care hospital in Kolar district of Karnataka, we decided to conduct study with a sample size of 150 patients.

Results: A total of 150 women were taken into the study who belonged within the inclusion criteria. Correlation between CTG and cord abnormalities showed that 73.3% were associated with non reassuring CTG and 26.7% were associated with abnormal CTG. Among the umbilical cord abnormalities noted, 44% were cord entanglements, 25% were long cord and 15% were short cord. In present study, correlation between cord abnormalities and CTG has been established which showed that 30% of long cord showed non reassuring CTG and 80% of cord entanglement showed abnormal CTG. P value being <0.001 was found to be statistically significant on Chi square test. Mean values of pH with long cord is 7.21, short cord is 7.25, knot of the cord is 7.21 and cord entanglement is 7.29 which indicates acidic cord blood pH. P value on anova test is <0.05 which appears to be statistically significant. Hence cord abnormality has been associated with acidic cord blood pH which indicates adverse perinatal outcome.

Conclusion: Umbilical cord abnormalities is being commonly noted during the deliveries but the significance had been ignored. This study shows that there is correlation between incidence of umbilical cord abnormalities and fetal distress identified prior to delivery which is proved statistically significant. Further study establishes correlation between umbilical cord abnormalities and adverse perinatal outcome depicted as cord blood pH acidosis and increased NICU admission.

Keywords: umbilical cord, FHR, NICU, APGAR score

Introduction

Constant observation of fetal heart rate during labour has been used over recent 50 years for antenatal assessment of fetus in view of hypoxemia and acidemia [4]. Abnormality found in fetal heart rate during labour is one of the important indications for immediate delivery or emergent cesarean section worldwide. The mechanisms leading to non-reassuring fetal heart rate tracings are complex and broad, involving pregnancy complications, maternal and fetal diseases, and clinical events which may compromise oxygen supply to the fetus [4]. Umbilical cord abnormalities (UCA) usually describe situations where fetal blood flow is decreased or interrupted because of altered structure or function. UCA is correlated with adverse pregnancy

outcomes including birth asphyxia and emergency Caesarean birth [1]. Of the reported UCA, the nuchal cord, where there is coiling of umbilical cord at least once around the fetal neck, has increased incidence peaking at birth [2, 3]. Among the various complications, several umbilical cord abnormalities have been correlated with the abnormality of fetal heart rate and adverse perinatal outcome. Such umbilical cord abnormalities include cord entanglements, hypercoiling, true knots, strictures, and short cords. Intraoperative findings such as tight cord entanglements, uterine rupture, or placental abruption may also cause fetal hypoxia leading to non-reassuring heart rate of the fetus [6]. The cord around the umbilicus which acts as a major connection between mother and fetus is an easily accessible and assessable structure and there is some affirmation that adverse antenatal and perinatal events could be predicted by examination of umbilical cord abnormalities intraoperatively or postnatally and thus the perinatal outcome can be detected.

The relation of cord around the neonatal neck and pregnancy outcome has been studied extensively suggesting an expanded risk for induction of labour, slow progress of labour, foetal distress, shoulder dystocia, meconium, low APGAR scores, and a higher rate of instrumental and caesarean deliveries. Non availability of source about cord entanglement, sites of entanglement, and other cord abnormalities induces the need for this study [5].

Gross cord abnormalities make the fetus liable to stasis induced vascular ectasia and thrombosis thus leading to vascular obstruction and adverse neonatal outcomes, including IUGR and stillbirth [7]. Careful interpretation of FHR patterns help to detect fetal asphyxia. Further supplementary examination of the umbilical cord for abnormalities will assess their correlation with non-reassuring fetal heart rate and thus perinatal outcome could be detected.

Objectives of the study

- To study the correlation between umbilical cord abnormalities and non-reassuring fetal heart rate.
- Neonatal outcome in patients with umbilical cord abnormalities.

Materials and Methods

- A total of 146 pregnant women having live singleton fetus in the cephalic presentation with term gestation (37 to 42 weeks) getting admitted to labour ward of RLJH hospital during the period of study.
- Study design: A prospective observational study.
- Study period: October 2018-June 2020.

Inclusion criteria

- Age between 18 and 35 years
- Period of gestation 37-42weeks
- Single live fetus in cephalic presentation

Exclusion Criteria

- Malpresentation
- Previous 2 caesarean section
- Abnormal progress in labour
- Multiple pregnancies
- Preterm labour (<37 weeks of gestation)
- Fetal or neonatal malformations
- IUGR

Study population and sample size

The sample size is calculated based on the difference between 2 groups with umbilical cord abnormalities that is between emergency caesarean section group and vaginal delivery group – Association between umbilical cord abnormalities and development of fetal distress leading to emergency caesarean deliveries done in the year 2015. Observed variance estimate is of 40% difference, 80%power, 5% alpha and with 95% confidence interval, This being prospective observational study, total of 146 women are taken in to the study after taking consent form, irrespective of mode of delivery. Sample size 146.

Methodology

All pregnant women whose Cardiotocography is showing non-reassuring fetal heart rate (According to NICE guidelines 2019 – FHR 100-109 or 160-180 bpm with baseline variability less than 5bpm for 30-50 minutes or more than 25bpm for 15 to 25 minutes with variable decelerations with no concerning characteristics for 90 minutes or with any concerning characteristics in upto 50% of contractions for 30 minutes or more or less or late decelerations in over 50% of contractions for less than 30 min, with no maternal or fetal clinical risk factor are considered for the study.

Patients are followed up till the surgery and intraoperative findings are noted or are followed up till vaginal delivery and umbilical cord length, morphology and abnormalities are noted.

Short cord is considered below 30 cms and long cord is considered more than 70 cms in our study. Apgar score at 1 minute and 5 minutes is documented and cord blood pH is taken into account and perinatal and neonatal outcome assessed.

Cord blood collection: Double clamping of an umbilical cord is done as early as possible after delivery. Blood is drawn into a pre-heparinized syringe from this isolated segment. Blood is collected from umbilical artery and vein (from placental side of the clamped umbilical cord) for blood gas analysis and is processed in an arterial blood gas analyser for cord blood ph. Cord blood pH is documented.

Results

Correlation between umbilical cord abnormalities and CTG

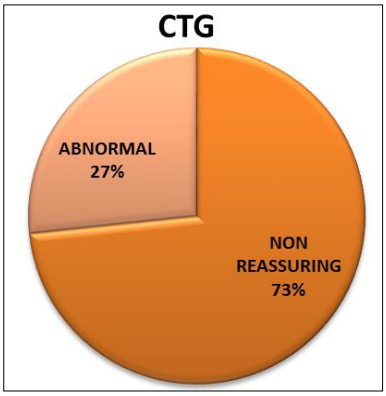

Fig 1: Graphical distribution of CTG among cord abnormalities

Incidence of cord abnormalities was associated with non reassuring fetal heart rate where 73% presented with non reassuring fetal heart rate CTG and 27% presented with abnormal fetal heart rate CTG.

Incidence of cord abnormalities was associated with increased incidence of caesarean section constituting 72% of total study group and only 28% of the study population underwent vaginal delivery.

Incidence of cord abnormalities has no much significance on APGAR score as 98% of the study group depicted normal

APGAR score at 5th minute.

Incidence of loop of cord around the neck was the most common abnormality found in the study constituting 44%of the study group, cord knot occupying 15%, short cord occupying 16% and long cord constituting 25%.

Distribution of umbilical cord abnormalities and perinatal outcome

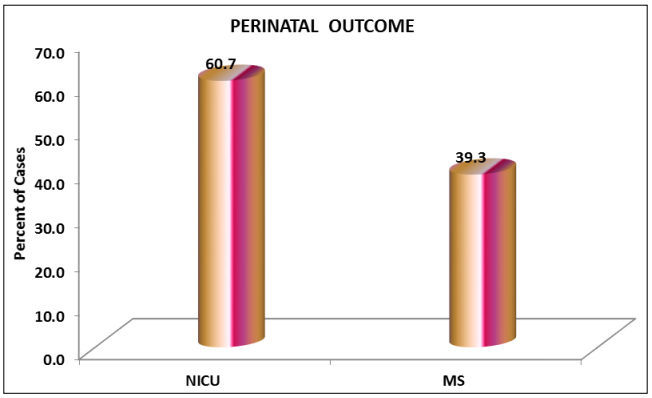

Fig 2: Graphical distribution of perinatal outcome among cord abnormalities

Incidence of cord abnormalities was associated with increased NICU admission of the baby as 60% of the study group showed NICU admission.

Table 1: Correlation between umbilical cord abnormalities and CTG

Umbilical cord abnormality	CTG				Chi square test	
	Non reassuring CTG (n=110)		Abnormal CTG (n=40)		P value	Sig
	N	%	N	%		
Long cord	34	30.9	4	10.0	*P*<0.001	Highly sig
Short cord	20	18.2	3	7.5		
Cord knot	22	20.0	1	2.5		
Loops of cord	34	30.9	32	80.0		

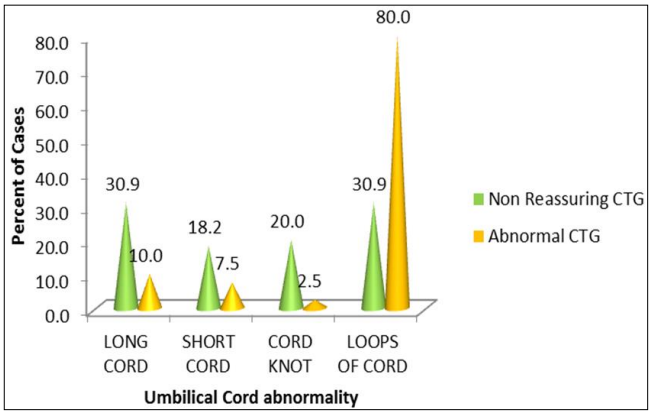

Fig 3: Graphical distribution of correlation between umbilical cord abnormalities and CTG

Incidence of cord abnormalities was associated with non reassuring and abnormal CTG where 80% of cord entanglement showed non reassuring fetal heart rate which was found to be statistically significant with P value of less than 0.001.

Table 2: Correlation between CTG and perinatal outcome

Perinatal Outcome	CTG				Chi Square test	
	Non Reassuring CTG (n=110)		Abnormal CTG (n=40)		P Value	Sig
	N	%	N	%		
NICU	59	53.6	32	80	*P*<0.005	Highly Sig
MS	51	46.4	8	20		

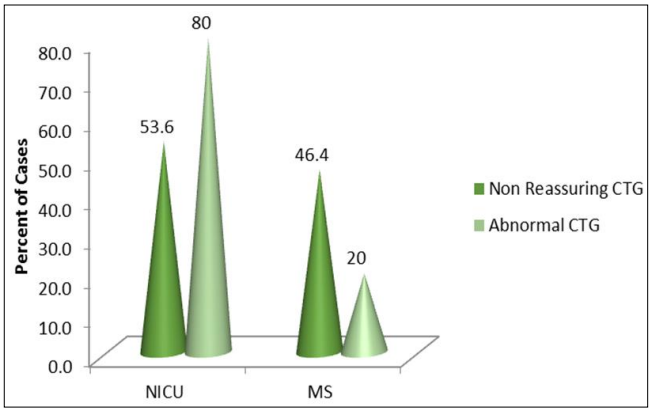

Fig 4: Graphical distribution of correlation between CTG and perinatal outcome

Non reassuring CTG and abnormal CTG was associated with adverse perinatal outcome depicting 80% cases having NICU admission which was found to be statistically significant with P value of less than 0.005.

Table 3: Correlation between umbilical cord abnormalities and cord blood PH

Umbilical Cord Abnormality	PH		ANOVA	
	Mean	Std. Deviation	P Value	Sig
Long Cord	7.21	0.12	*P*<0.05	Sig
Short Cord	7.25	0.17		
Cord Knot	7.21	0.16		
Loops of Cord	7.29	0.12		

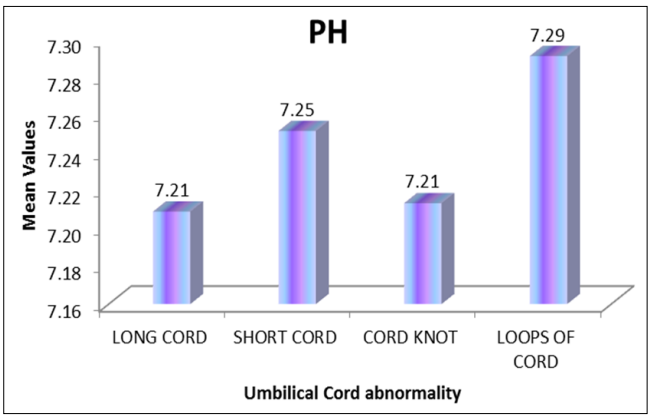

Fig 5: Graphical distribution of correlation between umbilical cord abnormalities and cord blood pH

Incidence of cord abnormalities has correlation with ph of cord blood and adverse perinatal outcome as cord blood ph among all the abnormalities is depicting acidosis and has been proved to be statistically significant with P value of less than 0.05.

Discussion

This study is a correlation between fetal heart rate which is non reassuring or abnormal with umbilical cord abnormalities and associated perinatal outcome. Study is prospective observational and is conducted in the Department of Obstetrics and Gynaecology from October 2018 to June 2020 at Sri Devraj Urs Medical College, Tamaka, Kolar.

A total of 150 pregnant ladies were involved. Non-reassuring and abnormal CTG were followed up till delivery and umbilical cord abnormality was noted. All types of cord abnormalities were documented. Further perinatal outcome was assessed with the help of Apgar scores, cord blood pH and NICU admission.

Distribution of gravidity shows majority of women were multiparous constituting 61.3% among which 52.2% were gravida 2, 37% were gravida 3 and 10% were gravida 4. There was no statistical significance between incidence of cord abnormalities and gravidity. Distribution of gestational age showed no much variability where 38.7% were between 37 to 40 weeks gestation and 32% were between 41 to 42 weeks of gestation with no statistical significance.

Correlation between CTG and cord abnormalities showed that 73.3% were associated with non reassuring CTG and 26.7% were associated with abnormal CTG which was similar to the study conducted by Weiner *et al.*, which showed 93.2% of them had non reassuring CTG and 36% of them had abnormal CTG.

In the present study 72% underwent emergency LSCS whereas 28% had vaginal delivery. In Joshi *et al.*, similar study percentage of caesarean delivery was noted although difference was not statistically significant [20]. Weiner *et al.*, reported that the rate of LSCS was greater with short cords [4]. Balkawade *et al.*, showed that short-cord was associated with higher incidence of LSCS rates which was statistically significant [13].

In present study 71% had APGAR of 7 at first minute and 98% had APGAR of 9 at fifth minute. Algriesi *et al.*, showed that there was increased incidence of APGAR less than 7 at first minute with short cords when compared to long cords [25]. Linde *et al.*, showed there was risk of low APGAR at 5 minutes with cord entanglements and short cords [67]. Vasa *et al.*, study showed correlation between cord abnormality and APGAR at 5th minute which showed P value of 0.01 which was statistically significant [19].

Among the umbilical cord abnormalities noted, 44% were cord entanglement, 25% were long cord and 15% were short cord. Linde *et al.*, also showed similar incidence with 20% of cord entanglements and 9% of short cords.

In the present study 67% were males and 32% were female babies, 72% had birth weight more than 2.5 kg which showed no significance.

Perinatal outcome was also assessed with NICU admission of the baby and in the present study 60% of babies had NICU admission. Balkawade *et al.*, proved the increased incidence of NICU admission in babies associated with long and short cords and low APGAR scores [24].

Table 4: Correlation of parameters with various studies

Parameters	Linde *et al.*, study (2018)	Vasa *et al.*, study (2018)	Weiner *et al.*, study (2019)	Present study
Maternal Age	<24 years of age (22%)	20-34 years of age (69%)	-	21-25years of age (78%)
Parity	Gravida 2 (22%)	Multiparity (73%)	Multiparity (64%)	Gravida 3(84%)
Gestational Age	37-41 weeks (23%)	>37weeks (89%)	-	38-40weeks (93%)
Mode of Delivery	Caesarean (21%)	Vaginal (71%)	Caesarean (40%)	Caesarean (72%)
CTG Abnormality	-	NRFHR (50%)	NRFHR (93%)	NRFHR (73%)
Apgar Scores	Low 5 min APGAR (23%)	Normal (95%)	Low at 5 minutes (40%)	NORMAL (71%)
Cord PH	-	Acidosis (76%)	Acidosis (68%)	Acidosis (68%)
Nicu Admission	More (22%)	-	More (40%)	More (65%)

In present study, correlation between cord abnormalities and CTG has been established which showed that 30% of long cord showed non reassuring CTG and 80% of cord entanglement showed abnormal CTG. P value being <0.001 was found to statistically significant on Chi square test. Thus cord abnormalities were associated with abnormal CTG. Vasa *et al.*, study showed significance between cord abnormality and non-reassuring fetal heart rate with significant p value of <0.001.Weiner *et al.*, showed similar significance where cord entanglements, especially multiple loops were associated with non reassuring fetal heart rate and adverse perinatal outcome [4].

In present study, strong correlation was found between CTG and NICU admission. 53% of non-reassuring CTG was associated with NICU admission and 80% of abnormal CTG were admitted to NICU. P value was found to be <0.005 which was statistically highly significant. Cord abnormalities associated with abnormal CTG had increased admission to NICU which depicted adverse perinatal results.

Ramaprabha *et al.*, conducted a study which showed similar results where abnormal CTG was associated with adverse perinatal outcomes [22]. Vasa *et al.*, also showed correlation between NICU admission and CTG abnormality with p value of 0.03 which was statistically significant [19].

The present study shows correlation between cord abnormality and umbilical cord ph. Long cord is associated with mean pH of 7.21, short cord with pH of 7.25, knot of the cord with pH of 7.21 and cord entanglement with pH of 7.29 which indicates acidic cord blood pH. P value on anova test is <0.05 which appears to be statistically significant. Hence cord abnormality has been associated with acidic cord blood pH which indicates adverse perinatal outcome. Vasa *et al.*, showed similar significance in their study where cord abnormalities were associated with cord blood pH acidosis indicating adverse perinatal outcome [19].

Conclusion

Umbilical cord abnormalities is being commonly noted during the deliveries but the significance had been ignored. This study shows that there is correlation between incidence of umbilical cord abnormalities and non-reassuring fetal heart rate identified before child birth which is proved statistically significant.

Correlation between umbilical cord abnormalities and abnormal perinatal outcome can be assessed through cord blood pH acidosis and increased incidence of NICU admission in this study.

Prediction of adverse perinatal outcome associated with cord abnormalities can be detected early with the help of non-reassuring CTG and this acts as prognostic tool in preventing the same.

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